Final version published in Journal of Public Economic Theory 6, 593–606.

Severance Payments and Unemployment Insurance: A Commitment Issue

RICHARD MARTIN
Victoria University of Wellington

STEEVE MONGRAIN
Simon Fraser University

SEAN PARKINSON
University College of the Fraser Valley

Abstract

In the event of a job termination, many workers receive severance payments from their employer, in addition to publicly provided unemployment insurance (UI). In the absence of a third party enforcer, contracts featuring severance payments must be supported by an implicit self-enforcing contract. Workers believe employers will make severance payments only if it is in their best interest ex post. If firms discount the future deeply, they will reduce the severance payment they offer, in order to relax their incentive constraint. Workers are forced to bear risk, and too many workers are laid off. We show that a well-designed public UI system can correct these distortions.

1. Introduction

Being fired is a very costly incident for many workers. Accordingly, unemployment insurance(UI) can improve welfare by partially smoothing the income streams of risk adverse workers. In the event of a job termination, most workers are eligible for publicly provided UI. However, a sizable proportion

---

Richard Martin, Victoria University of Wellington, P.O. Box 600, Wellington, New Zealand (Richard.Martin@vuw.ac.nz). Steeve Mongrain, Department of Economics, RIIM and CIRPÉE, Simon Fraser University, 8888 University Drive, Burnaby, BC, Canada, V5A 1S6 (mongrain@sfu.ca). Sean Parkinson, University College of the Fraser Valley, Abbotsford, BC, Canada, V2S 7M8 (parkinss@ucfv.bc.ca).

We would like to thank Robin Boadway, Patrick Francois, Nicolas Marceau, Joanne Roberts and Jonathan Rosborough for useful comments. Steeve Mongrain would also like to thank Simon Fraser University, SSHRC for financial support. All errors are the responsibility of the authors.

of workers also receive insurance from their employer.[1] When workers and firms sign contracts that include a severance payment, they have a means to further smooth workers' income between periods of employment and unemployment. Unfortunately, these contracts are typically difficult to enforce. McLeod and Malcomson (1989) and Carmichael (1983) have illustrated that, because it is difficult for a third party to observe who initiated a job separation, severance payments must be supported by a self-enforcing contract. Consider a firm that wishes to reduce its work force. If the firm was to honor its contracts, it would have to make severance payments to the terminated workers. A cheaper alternative for the firm would be to put pressure on the employees to quit, in which case no severance payments must be made. This implies that workers will only accept a contract that is self-enforcing for the firm. Firms will find it in their best interest to make severance payments if they extract sizable rents from their workers. If this is the case, then not honoring their contracts jeopardizes this stream of future profits.[2]

In the absence of publicly provided UI, we demonstrate that the equilibrium level of severance payment can be inefficiently low. If a firm discounts the future sufficiently deeply, it will not be able to commit to providing their workers with full insurance. Thus, firms will reduce the amount of insurance they offer in order to be able to commit to making the payment. However, partial insurance implies that risk averse workers are forced to bear risk. Further, firms will not face the social cost associated with laying off workers, and consequentially lay off too many workers. Much of our analysis of publicly provided UI will be done in this second-best world, where firms cannot commit to providing their workers with full insurance.

It is well recognized in the literature that publicly provided UI programs can have a negative impact on employment. In this paper, we show that a well-designed public provision of UI can improve the efficiency of the economy. The existence of publicly provided UI reduces the need for firms to provide insurance to their workers. As the size of the severance payment shrinks, the firm's commitment problem associated with making the payment diminishes. Thus, public provision of UI can reduce both layoffs and the volatility of the

[1]In the US, 36% of all full-time employees of the large and medium private establishments receive severance payments, while 15% of all full-time employees of the small private establishments receive severance payments. The same numbers for professional technical-related employees are 48% and 23%, respectively.

[2]There are some similarities between this paper and Greif, Milgrom, and Weingast (1994). Medieval kings faced a commitment problem, when it came to protecting the property rights of visiting merchants. A king could reap an immediate benefit by confiscating the goods of a visiting merchant. Kings overcame this commitment problem by encouraging the formation of trade guilds, which lessened the degree of competition between merchants. This distortion in trade allowed kings to commit to protecting the rights of visiting merchants. Similarly, in this paper firms lessen their commitment problem by reducing the size of their severance payments, creating a distortion in the economy that leads to partial insurance.

workers' income. Of course, UI programs can introduce distortions of their own. Unemployment benefits subsidize layoffs, making layoffs more attractive to the firm. A conventional way to correct this problem is to introduce an experience rating in the way the system is financed.[3] Experience rating forces firms to internalize part of the subsidy provided by unemployment benefits, and consequently reduces the distortion in layoff decisions. We demonstrate that publicly provided UI, featuring a high experience rating can improve the efficiency of an economy. The remainder of the paper is organized as follows. In Section 2, we present an overview of the model. In Section 3, we analyze the equilibrium, both when contracts are enforceable, and when they are not. Publicly provided UI is discussed in Section 4. We conclude in Section 5. All proofs are given in the Appendix.

2. The Model

The economy is composed of an infinite number of successive generations. Each generation lives for two periods. M workers are born at the beginning of each generation and live for two periods. We call the workers young in their first period of life, and old in their second period. Workers are risk averse, do not have access to financial markets, and do not discount the future. The per period, twice continuously differentiable utility function is given by $U = U(W + R)$ where W is outside income and R is home production. This home production takes a value of zero if the worker is working, and a value of r if the worker is unemployed. It is also assumed that $U' \geq 0$ and $U'' \leq 0$.

The first sector of the two-sector economy, denoted sector 1, is composed of a large number of infinitely lived identical firms that are not exposed to productivity shocks. It is assumed that firms in this sector have constant returns to scale and act competitively. Worker productivity per period is given by x where $x > r$. It is assumed that workers who accept jobs in the other sector cannot move back to sector 1 if they are laid off.[4]

The other sector denoted sector 2 is composed of K identical firms that are infinitely lived. Firms discount each generation at a rate of δ, but do not discount within a generation. Firms take prices as given and are risk neutral. The output price is normalized to one. In the first period of each generation, the production function is $F[N]$ where N is the number of workers working for the firm. It is assumed that $F' > 0$ and $F'' < 0$. However, in the second period, all firms in sector 2 experience a negative productivity shock, resulting in the production function $pF[n]$ where $p < 1$.[5]

[3]Topel and Welch (1980) have a good survey on the topic.

[4]It is not essential that laid-off workers stay unemployed: as long as there is enough friction that workers cannot instantaneously find a new job, we would be able to derive similar results.

[5]We assume that the probability of the shock is one, introducing the possibility of no shock will not change the nature of the results.

We assume that it is impossible for the courts to observe which party initiates a job separation. Either party can take hidden actions to induce the other party to initiate the separation. This implies that contracts involving separation payments are not enforceable by a third party.[6] However, we assume that young workers know if, in the past, a firm agreed to pay a severance payment, and did not fulfill its obligation.[7] The equilibrium contract obviously depends on the young workers' beliefs about whether the firm will make severance payments, given the firm's history. The equilibrium concept used is Perfect Baysian Equilibrium. We assume that young workers believe that firms that did not pay a severance payment in the past will not pay them in the future. In this scenario, the strongest possible punishment is used, meaning that workers never accept a contract featuring a severance payment if the firm has defaulted in the past.[8]

2.1. Sequence of Events

Each one of the infinite number of generations is composed of two periods. At the beginning of the first period each firm in sector 2 offers long-term contracts to N young workers. The contracts stipulate a wage for the first period w_y, a wage for the second period w_o and a severance payment s for the laid-off workers. Workers have to choose whether to accept the offer or to work in sector 1 at a wage x per period. Production takes place, and then wages and taxes are paid. At the beginning of the second period, firms in sector 2 experience a negative productivity shock, resulting in the production function $pF(n)$ where $p < 1$. We denote n as the number of workers retained by a sector 2 firm after the productivity shock occurs. Next, the firms decide whether to pay the severance payments or not. Laid-off workers receive the value of their home production. Finally, production takes place and UI benefits, wages, and taxes are paid. The sequence is then repeated for all generations.

3. Equilibrium with Full Commitment

To serve as a benchmark, we begin by assuming that contracts featuring severance payments are enforceable by the courts. For each generation, firms

---

[6]Macloed and Malcomson (1989) and Carmichael (1983) used the same type of argument.

[7]Workers within a firm are assumed to be able to observe the reason for a separation; they are able to see the difference between a worker who quits and one who quits because the firm pressured the worker to leave.

[8]This is one of many possible beliefs the workers could have and it is important to acknowledge that this equilibrium is not unique; different beliefs will lead to different equilibria. However, this assumption is standard in the literature on optimal labor contracts, such as Thomas and Worrall (1988). Moreover, it generates the same qualitative results as a wide variety of more complicated beliefs. For example, if we were to assume that the punishment only lasted for x periods, firms would find it even more difficult to commit to making severance payments.

in sector 2 decide the terms of their labor contracts, how many workers to hire, and how many workers to layoff. In order to solve the firm's problem we first determine the optimal lay-off rule, taking as given the number of employees and the wage contracts. Because of the productivity shock (p), firms will only keep n workers, and lay off $N - n$ workers. The firm maximizes $pF[n] - w_o n - s(N - n)$ by choosing n. The number of workers retained $n(w_o, s)$ solves $pF'[n(w_o, s)] = w_o - s$.

Given the layoff rule and the long-term contract, firms in sector 2 have to choose how many workers to hire. The firm maximizes $F[N] - w_y N + pF[n(w_o, s)] - w_o n(w_o, s) - s[N - n(w_o, s)]$ by choosing N. Firms will hire $N(w_y, s)$ workers, which solves $F'[N(w_y, s)] = w_y + s$. It is important to notice that $N_s(w_y, s) - n_s(w_o, s) < 0$ where N_s is the derivative of $N(w_y, s)$ with respect to s, so when severance payments increase, the number of workers laid off by a firm decreases. Using the solutions to the two previous problems, we can define the profit function $\pi(w_y, w_o, s)$ as

$$\begin{aligned}\pi(w_y, w_o, s) = {} & F[N(w_y, s)] - w_y N(w_y, s) \\ & + pF[n(w_o, s)] - w_o n(w_o, s) - s[N(w_y, s) - n(w_o, s)].\end{aligned}$$

The total cost of the severance payments paid by firm i is given by $[N(w_y, s) - n(w_o, s)]s$. The impact of a change in s on the total severance payment made by a firm is given by $[N_s(w_y, s) - n_s(w_o, s)]s + [N(w_y, s) - n(w_o, s)]$. When s increases by one unit, the direct impact leads to an increase in the total cost equal to the number of workers that are laid off. However, $N_s(w_y, s) - n_s(w_o, s) < 0$, thus the sign of the expression is uncertain.

ASSUMPTION 1: *We will assume that* $\frac{\partial[N(w_y,s) - n(w_o,s)]}{\partial s} \frac{s}{[N(w_y,s) - n(w_o,s)]} > -1$ *for every value of s between zero and full insurance.*

Assumption 1 says that the elasticity of the number of layoffs with respect with changes in s has to be less that one in absolute value. If this was not the case, the firm could lower the total cost of the severance payment by increasing the size of the severance payments.

We now solve for the contract $\{w_y, w_o, s\}$ that will be offered by firms to workers. Every worker can choose to work in sector 1 for a wage of x for two periods, giving them a lifetime utility of $2U(x)$. On the other hand, if a worker accepts a long-term contract in sector 2, the worker receives w_y for the first period and w_o for the second period, if the worker is not laid off. However, because of the productivity shock in the second period, firms will lay off some workers. Because all workers have the same productivity, the probability of a worker being laid-off is simply $\frac{N(w_y,s) - n(w_o,s)}{N(w_y,s)}$. The participation constraint is

$$U(w_y) + \frac{n(w_o, s)}{N(w_y, s)} U(w_o) + \frac{N(w_y, s) - n(w_o, s)}{N(w_y, s)} U(r + s) \geq 2U(x).$$

Firms offer workers a contract that maximizes the firm's expected profit, subject to the worker's participation constraint.[9] For future reference we will call this contract type I.

LEMMA 1: *When severance payments are enforceable, firms fully insure workers by offering a long term contract where* $w_y^\star = w_o^\star = x$ *and* $s^\star = x - r$.

The intuition behind Lemma 1 is straightforward. Since workers are risk averse, it is optimal for firms in sector 2 to fully insure workers. Given this contract, the number of workers retained $n^\star$ is given by $pF'[n^\star] = r$. The number of workers hired $N^\star$ is given by $F'[N] = 2x - r$. The per-period profits under this contract are

$$\pi^\star = F[N^\star] - xN^\star + pF[n^\star] - xn^\star - (x - r)[N^\star - n^\star].$$

Under this contract, there is no need for an unemployment insurance system since workers are fully insured, and hiring and layoff decisions are socially efficient. All traditional results about unemployment insurance and experience rating follow.

4. Equilibrium without Full Commitment

Consider the full insurance wage contract labeled I. If contracts featuring severance payments are not enforceable by the courts, then firms in sector 2 would face a tradeoff when deciding whether or not to make the severance payments. At any generation t, a firm could default on the payment, and gain $[N^\star - n^\star](x - r)$. However, there is a cost associated with defaulting. In subsequent generations, workers will doubt the credibility of a wage contract featuring a severance payment. In order to simplify matters, we assume that workers hold the belief that if the firm chose to default on a severance payment in the past, it will always default in the future. Thus, workers will not be willing to accept a wage contract featuring a positive severance payment from the firm. However, even if workers do not trust a firm to make severance payments, they will be willing to work for the firm if it offers a pure wage contract that satisfies the worker's participation constraint. Pure wage contracts are assumed to be enforceable by the courts. A firm offering a pure wage contract would maximize

$$\pi_{pw} = F[N(w_y)] - w_y N(w_y) + pF[n(w_o)] - w_o n(w_o),$$

[9] By doing so we implicitly assume that there is a very large number of workers and a relatively smaller number of jobs in sector 2, so the bargaining power is all in the hands of the firm in sector 2. Obviously this is not the only possible labor market structure; in particular we could introduce bargaining over wages with different bargaining power. In such an environment, the participation constraint will be more difficult to satisfy and workers would achieve a higher level of utility. However, the incentive side of the problem, and the need to provide insurance, will remain present generating similar results.

subject to the participation constraint

$$U(w_y) + \frac{n(w_o)}{N(w_y)}U(w_o) + \frac{N(w_y) - n(w_o)}{N(w_y)}U(r) \geq 2U(x).$$

Note that this maximization problem is identical to the maximization problem when severance payments were enforceable, but with an additional "lack of credibility" constraint, $s = 0$. Maximization and substitution yields

$$\pi^\star_{pw} = F\big[N^\star_{pw}\big] - xN^\star_{pw} + pF\big[n^\star_{pw}\big] - xn^\star_{pw}.$$

The "lack of credibility" constraint is binding because workers are risk averse, implying that $\pi^\star > \pi^\star_{pw}$. Thus, if the firm defaults on the severance payment, it sacrifices $\pi^\star - \pi^\star_{pw}$ in each of the subsequent generations. For a given discount factor δ, the cost of not making a severance payment is given by $\frac{\delta}{1-\delta}(\pi^\star - \pi^\star_{pw})$. Firms will pay severance payment only if $\delta \geq \bar{\delta}$ where

$$\bar{\delta} = \frac{[N^\star - n^\star](x - r)}{[N^\star - n^\star](x - r) + \pi^\star - \pi^\star_{pw}}$$

and where $\bar{\delta} \in [0, 1]$. When the firm's discount factor in sector 2 is sufficiently large ($\delta \geq \bar{\delta}$), publicly provided UI is not needed because firms offer a full insurance contract and they can commit to making the payments. Conversely, when the discount factor is too low, a full insurance contract is not self-enforcing for the firms. In such a case, firms will be constrained in how much insurance they can offer their workers and still be able to commit to making the payments. We denote $\{w^{\text{II}}_y, w^{\text{II}}_o, s^{\text{II}}\}$ to be the self-enforcing equilibrium contract. This equilibrium contract can be solved the same way as contract with full commitment (called type I), but with the addition of one further constraint $\frac{\delta}{1-\delta}(\pi(w_y, w_o, s) - \pi^\star_{pw}) \geq [N(w_y, s) - n(w_o, s)]s$. Firms offer a contract that maximizes their profits, subject to the participation constraint of the workers and the incentive constraint of the firm. The firm's problem is the following:

$$\max_{\{w_y, w_o, s\}} \{F[N(w_y, s)] - w_y N(w_y, s) + pF[n(w_o, s)] - w_o n(w_o, s)$$
$$- s[N(w_y, s) - n(w_o, s)]\},$$

subject to: $\frac{\delta}{1-\delta}(\pi(w^{\text{II}}_y, w^{\text{II}}_o, s^{\text{II}}) - \pi^\star_{pw}) \geq [N(w_y, s) - n(w_o, s)]s$, and

$$U(w_y) + \frac{n(w_o, s)}{N(w_y, s)} U(w_o) + \frac{N(w_y, s) - n(w_o, s)}{N(w_y, s)} U(r + s) \geq 2U(x).$$

Under this type of contract, which we will call type II, the number of workers hired is given by $N^{\text{II}} = N(w_y^{\text{II}}, s^{\text{II}})$ and the number of workers retained is given by $n^{\text{II}} = n(w_o^{\text{II}}, s^{\text{II}})$.

LEMMA 2: *If a firm's discount factor is lower than $\bar{\delta}$ and Assumption 1 is satisfied, then the firm will not fully insure workers* $(w_o^{\text{II}} > r + s^{\text{II}})$.

Firms do not offer full insurance because it would be too tempting for them to default on their severance payments. Firms provide the maximum amount of insurance that they can credibly commit to paying.[10]

When contracts fully insure workers, then $w_o^{\star} = s^{\star} + r$. In such a case, the number of workers retained by the firm is given by $pF'(n) = w_o - s = r$. Under the type II contract $w_o^{\text{II}} > s^{\text{II}} + r$, and the number of workers retained n^{II} is determined by $pF'(n^{\text{II}}) = w_o^{\text{II}} - s^{\text{II}} > r$. Therefore, by concavity of the production function we know that $n^{\text{II}} < n^{\star}$. Smaller severance payments reduce the cost of terminating workers, and consequently firms lay-off more workers. Moreover, because firms need to compensate workers for the diminution in severance payments, the wages paid to workers are higher. These two factors combine to induce the firms to retain fewer workers.

On the other hand, the difference in hiring under contracts I and II is ambiguous. In the "laissez-faire" economy, the full insurance contract of type I leads to $w_y^{\star} = s^{\star} + r = x$. The number of workers hired by a firm in sector 2 is given by $N^{\star}$ where $F'(N^{\star}) = 2x - r$. Under the type II contract without full insurance, $w_y^{\text{II}} > x$ and $s^{\text{II}} < x - r$, and the number of workers hired N^{II} is given by $F'(N^{\text{II}}) = w_y^{\text{II}} + s^{\text{II}}$. Because the production function is concave, we know that if $w_y^{\text{II}} + s^{\text{II}} < 2x - r$, then $N^{\text{II}} > N^{\star}$. Similarly, if $w_y^{\text{II}} + s^{\text{II}} > 2x - r$, then $N^{\text{II}} < N^{\star}$. The difference depends on the sum of the first period wages and the severance payment. If the sum is higher than under the full insurance contract, the firm will hire fewer workers. On the other hand, if the sum is smaller, the firm will hire more workers.

If the firm's discount factor is too low to support a full insurance contract, there are two reasons why the introduction of publicly provided UI can increase efficiency. First, risk averse workers are forced to bear risk. Second, both the hiring and layoff decisions are distorted, possibly leaving the economy with too much unemployment.

[10]One peculiarity of this self-enforcing contract is that the wage contracts will feature a decreasing wage profile. Since workers are risk averse, they will want to be compensated with higher wages. Because a change in first period wages does not increase the probability of being laid off, workers will prefer to be compensated with a higher wage in the first period. Data analysis indicates an increasing wage profile. However, the introduction of general human capital could generate such a wage profile.

5. Optimal Unemployment Insurance Program

The government in this model has access to three tools. The first tool is the UI benefit (b). In order to finance the benefit, the government can use two forms of taxation: payroll taxes (τ),[11] which are uniform taxes per worker, and experience rated taxes, with an experience rating of e. The advantage of using experience rated taxes is that it reduces the layoff distortion associated with the publicly provided UI benefit. Note that in this model, a UI system featuring full insurance and an experience rating of 1 will always lead to a first best outcome. For the remainder of the paper, we concentrate on government intervention when firms cannot commit to fully insuring their workers themselves: $\delta < \bar{\delta}$.

The government will be required to keep a balanced budget for each generation.[12] Since the government expenditure is $[N - n]bK$, the per-generation government budget constraint is given by $[N - n]bK = 2\tau(M - kN) + \tau KN + \tau nK + e[N - n]bK$. The right-hand side of the equality is the tax revenue. The first term is the payroll tax in sector one. The second and third terms are the payroll taxes for workers in sector two on young workers and old retained workers, respectively. The final term is the experience rated component. Note that under a full experience rating system ($e = 1$), the payroll taxes will be equal to zero.

Before looking at government intervention we need to understand the sources of inefficiency in the "laissez-faire" economy when $\delta < \bar{\delta}$. In the absence of government intervention, firms will offer their workers type II contracts. Risk averse workers are forced to bear risk, but are still ex ante equally well off because they get their reservation expected utility.[13] Further, low severance payments cause a distortion in the layoff decision; firms lay off too many workers. Hiring is also distorted compared to the first best allocation, but the sign of the distortion is ambiguous. As we will see, publicly provided UI programs will improve efficiency when firms cannot commit to fully insuring their workers.

THEOREM 1: *If firms offer workers type II contracts, then introducing publicly provided UI will attain the first best if the UI scheme features a full experience rating* $(e, \tau) = (1, 0)$, *and full insurance* $b = x - r$. *Severance payments are completely crowded out,* $s = 0$.

---

[11]We will restrict the payroll tax to not discriminate on the basis of the age of a worker nor on the basis of the sector. Adding the ability to discriminate could increase the ability of a government to improve welfare. For example, in a second best world, reducing taxation on old workers would induce firms to fire less workers, which might improve welfare. Not allowing for discrimination strengthens our results.

[12]Because the population is not growing, various forms of the budget constraint will generate similar results.

[13]If workers were to earn some surplus in equilibrium, then contracts of type II would result in a welfare loss on their part.

Recall that firms are not able to commit to fully insuring their workers if $\delta < \bar{\delta}$. If the government provides full insurance $b = x - r$, firms would find it in their best interest to offer pure wage contracts where $s = 0$, regardless of whether they had a commitment problem or not. In general, the government has an advantage over firms in terms of credibility. As long as people believe in the government's power to tax and redistribute, publicly provided UI can improve efficiency. If UI offers full insurance, workers no longer bear risk. If UI features a full experience rating, then the firm's hiring and layoff decisions are not distorted.

In fact, publicly provided UI does not have to completely crowd out severance payments to eliminate distortions in the economy. As the publicly provided benefit b increases, the size of the severance payment $s = x - r - b$ necessary to provide a worker with full insurance decreases. If b is sufficiently large, a firm with any non-zero discount rate will be able to commit to making the payment. Let b^f be the publicly provided benefit that *just* allows a firm[14] with discount rate δ to commit to "topping off" the publicly provided benefit, thus providing the employee with full insurance. Further, if we denote the equilibrium profits for a given level of b by $\pi^\star(b)$, we can implicitly define b^f with the following equation:

$$\delta = \frac{[N^\star(b^f) - n^\star(b^f)](x - r - b^f)}{[N^\star(b^f) - n^\star(b^f)](x - r - b^f) + \pi^\star(b^f) - \pi^\star_{pw}(b^f)}.$$

COROLLARY 1: *If firms offer workers type II contracts, then introducing publicly provided UI will attain the first best if the UI scheme features a full experience rating* $(e, \tau) = (1, 0)$*, and a benefit* $b \in [b^f, x - r]$*. Severance payments are partially crowded out when* $b \in (b^f, x - r)$*.*

So far we have assumed that the government has total freedom over the UI system, especially concerning the level of experience rating. Outside of the United States, experience ratings are rare, and even in the United States the experience rating is far from one. It is not the intention in this paper to provide justification for experience rating lower than one.[15] All UI systems with $e < 1$ will not be first best. Nevertheless, if firms are offering type II contracts, publicly provided UI can be efficiency enhancing, even with an experience rating $e < 1$.

COROLLARY 2: *If firms offer workers type II contracts, then introducing publicly provided UI will increase efficiency if the UI scheme features an experience rating close to one* $(e, \tau) \approx (1, 0)$*, and a benefit* $b \in [b^{f\tau}, x - r]$*.*

---

[14]If firms have different discount factors, b^f needs to be set so contracts of type I are self-enforcing for the smallest discount factor.

[15]In fact, an increase in the experience rating level for $e < 1$ will always be efficiency improving.

Suppose that the government offers a benefit $b^{f\tau}$ generous enough that firms can commit to "topping off" the publicly provided UI, providing workers with full insurance. In the absence of this intervention, workers would be exposed to risk, only partially insured by their employer. Public provision of benefit $b^{f\tau}$ would eliminate the inefficiency of risk averse workers bearing risk. However, if $b^{f\tau}$ is financed in part by payroll taxes, the UI scheme will not achieve the first best outcome. The reason why is that the employer's hiring and layoff decisions will be distorted because the employer does not face the true social costs associated with his behavior. Thus, a UI scheme financed in part by payroll taxes may or may not increase efficiency in this model: it eliminates the efficiency loss associated with partial insurance, but it creates distortions in the hiring and layoff behavior of the firms. However, we know that as $e \to 1$, the distortions in hiring and layoffs will disappear, whereas the benefit of full insurance remains. Thus, for values of e sufficiently close to one, a UI scheme that would allow firms to commit to "topping off" the publicly provided UI will increase efficiency.

The model developed above could be generalized to cover other types of state contingent contracts, where the state is not observable by a third party. Anytime the state is not verifiable by a third party, two choices are available if a claim is made: honor the contract, or default. By defaulting, the insurance provider reaps an immediate benefit. However, the insurance provider would suffer in the future, due to a reputation effect. A contract would be self-enforcing if the eventual losses exceed the immediate benefit of breaking the contract. If insurance providers compete to attract clients, they will face the incentive to reduce the size of the state contingent payment. By doing so, the firm relaxes its incentive constraint, and is better able to compete for clients.

Appendix

Proof of Lemma 1: The first-order conditions are

$$U'(w_y) - \frac{n(w_o, s)}{N(w_y, s)^2} N_{w_y}(w_y, s)[U(w_o) - U(r+s)] = \frac{N(w_y, s)}{\phi}, \quad \text{(A1)}$$

$$U'(w_o) + \frac{n_{w_o}(w_o, s)}{n(w_o, s)}[U(w_o) - U(r+s)] = \frac{N(w_y, s)}{\phi}, \quad \text{(A2)}$$

$$U'(s+r) + \frac{N(\cdot)n_s(\cdot) - n(\cdot)N_s(\cdot)}{[N(\cdot) - n(\cdot)]N(\cdot)}[U(w_o) - U(r+s)] = \frac{N(\cdot)}{\phi}, \quad \text{(A3)}$$

$$U(w_y) + \left[\frac{n(\cdot)}{N(\cdot)}U(w_o) + \frac{N(\cdot) - n(\cdot)}{N(\cdot)}U(r+s)\right] = 2U(x), \quad \text{(A4)}$$

where ϕ is the Lagrange multiplier on the participation constraint. We can see that if $w_y = w_o = x$ and $s = x - r$ all equations are satisfied. ■

Proof of Lemma 2: The first-order conditions when severance payments are not enforceable and firm's discount factor is too low are

$$U'\left(w_y^{\text{II}}\right) - \frac{n^{\text{II}}}{N^{\text{II}2}} N_{w_y}^{\text{II}} \left[U\left(w_o^{\text{II}}\right) - U(r + s^{\text{II}})\right] = \frac{N^{\text{II}}}{\phi} + \frac{\psi}{\phi} N_{w_y}^{\text{II}} s^{\text{II}}, \quad \text{(A5)}$$

$$U'\left(w_o^{\text{II}}\right) + \frac{n_{w_o}^{\text{II}}}{n^{\text{II}}} \left[U\left(w_o^{\text{II}}\right) - U(r + s^{\text{II}})\right] = \frac{N^{\text{II}}}{\phi} - \frac{\psi}{\phi} \frac{n_{w_o}^{\text{II}} N^{\text{II}}}{n^{\text{II}}} s^{\text{II}}, \quad \text{(A6)}$$

$$U'(s^{\text{II}} + r) + \frac{N n_s - n N_s}{[N - n] N} \left[U\left(w_o^{\text{II}}\right) - U(r + s^{\text{II}})\right]$$

$$= \frac{N}{\phi} + \frac{\psi}{\phi} \left[\frac{N_s - n_s}{N - n} s + 1\right] N, \quad \text{(A7)}$$

$$U\left(w_y^{\text{II}}\right) + \left[\frac{n^{\text{II}}}{N^{\text{II}}} U\left(w_o^{\text{II}}\right) + \frac{N^{\text{II}} - n^{\text{II}}}{N^{\text{II}}} U(r + s^{\text{II}})\right] = 2U(x), \quad \text{(A8)}$$

$$\frac{\delta}{1 - \delta} \left[F\left(N^{\text{II}}\right) - (w_y^{\text{II}}) N^{\text{II}} + pF(n^{\text{II}}) - \left(w_o^{\text{II}}\right) n^{\text{II}}\right.$$

$$\left. - s^{\text{II}} [N^{\text{II}} - n^{\text{II}}] - \pi_{pw}^{\star}\right] = [N^{\text{II}} - n^{\text{II}}] s^{\text{II}}, \quad \text{(A9)}$$

where ϕ is the Lagrange multiplier on the participation constraint and ψ is the Lagrange multiplier on the self-enforcing constraint. We also define $\{w_y^{\text{II}}, w_o^{\text{II}}, s^{\text{II}}\}$ as the contract that solves the system of equations, $N^{\text{II}} = N(w_y^{\text{II}}, s^{\text{II}})$ is the number of workers hired under this contract, and $n^{\text{II}} = n(w_o^{\text{II}}, s^{\text{II}})$ be the number of workers retained by firms. Using Equations (A6) and (A7) we get:

$$\left[U'(s^{\text{II}} + r) - U'\left(w_o^{\text{II}}\right)\right] + \left[\frac{N^{\text{II}} n_s^{\text{II}} - n^{\text{II}} N_s^{\text{II}}}{(N^{\text{II}} - n^{\text{II}}) N^{\text{II}}} - \frac{n_{w_o}^{\text{II}}}{n^{\text{II}}}\right] \left[U\left(w_o^{\text{II}}\right) - U(r + s^{\text{II}})\right]$$

$$= \frac{\psi}{\phi} \left[1 + \frac{N_s^{\text{II}} - n_s^{\text{II}}}{N^{\text{II}} - n^{\text{II}}} s^{\text{II}} + \frac{n_{w_o}^{\text{II}}}{n^{\text{II}}} s^{\text{II}}\right] N^{\text{II}}. \quad \text{(A10)}$$

We can see that the right-hand side of equation above is positive if $1 + \frac{(N_s^{\text{II}} - n_s^{\text{II}})}{N^{\text{II}} - n^{\text{II}}} s + \frac{n_{w_o}^{\text{II}}}{n^{\text{II}}} s > 0$. Because $n_s^{\text{II}} = -n_{w_o}^{\text{II}}$, and because of Assumption 1, we know that the above inequality will be satisfied. If the right-hand side of (A10) is positive, by concavity we know that $w_o^{\text{II}} > r + s^{\text{II}}$. ■

Proof of Theorem 1: Under full experience rating $\tau = 0$ and $e = 1$. If $b = x - r$, we know that for any given δ, the contract is of type I since $\bar{\delta} = 0$. Consequently, substituting the values of b, e and τ, we get that $s = 0$ and $w_o = w_y = x$. Under these conditions $n^\star$ is given by $pF'(n^\star) = x - b = r$, which is efficient. Similarly, $N^\star$ is given by $F'(N^\star) = x + b = 2x - r$, which is also efficient. The contract is first best. ■

Proof of Corollary 1: The proof goes in the same line that Theorem 1, under full experience rating $\tau = 0$ and $e = 1$. For a given δ, the contract is of type I is self-enforcing if

$$\delta = \bar{\delta} = \frac{[N^\star(b^f) - n^\star(b^f)](x - r - b^f)}{[N^\star - n^\star](x - r - b^f) + \pi^\star(b^f) - \pi^\star_{pw}(b^f)}.$$

Consequently, substituting the values of b, e and τ, we get that $s = x - r - b^f$ and $w_o = w_y = x$. Under these conditions $n^\star$ is given by $pF'(n^\star) = r$, which is efficient. Similarly, $N^\star$ is given by $F'(N^\star) = 2x - r$, which is also efficient. The contract is first best. ■

Proof of Corollary 2: Suppose the public UI system has parameters $(b^{f\tau}, e, \tau)$. A firm retains n workers: $\max_{\{n\}} \pi = pF[n] - [w_o + \tau]n - [s + eb^{f\tau}] \times (N - n)$, where $n(w_o, s)$ solves $pF'[n(w_o, s)] = w_o + \tau - s - eb^{f\tau}$. A firm hires N workers: $\max_{\{N\}} \pi = F[N] - (w_y + \tau)N + pF[n(w_o, s)] - (w_o - \tau)n(w_o, s) - (s + eb^{f\tau})[N - n(w_o, s)]$, where $N(w_y, s)$ solves $F'[N(w_y, s)] = w_y + \tau + s + eb^{f\tau}$. The firm's profit function is $\pi(w_y, w_o, s) = F[N(w_y, s)] - (w_y + \tau)N(w_y, s) + pF[n(w_o, s)] - (w_o + \tau)$ $n(w_o, s) - (s + eb^{f\tau})[N(w_y, s) - n(w_o, s)]$. Suppose $(b^{f\tau}, e, \tau)$ satisfies both

$$\delta = \frac{[N^\star(b^{f\tau}) - n^\star(b^{f\tau})](x - \tau - r - b^{f\tau})}{[N^\star(b^{f\tau}) - n^\star(b^{f\tau})](x - \tau - r - b^{f\tau}) + \pi^\star(b^{f\tau}) - \pi^\star_{pw}(b^{f\tau})}$$

and

$$K[N - n]b^{f\tau} = 2\tau(M - kN) + \tau KN + \tau nK + eK[N - n]b^{f\tau}.$$

The first equation ensures the benefit $b^{f\tau}$ is generous enough that firms can commit to "topping off" the publicly provided UI, fully insuring their workers. The second equation ensures that the government breaks even on the UI system. If e is arbitrarily close to 1, $n^\star$ is determined by $pF'(n^\star) \approx r$, which is arbitrarily close to first best. Similarly, $N^\star$ is determined by $F'(N^\star) \approx 2x - r$, which is also arbitrarily close to first best. ■

References

BOADWAY, R., and A. J. OSWALD (1983) Unemployment insurance and redistributive taxation, *Journal of Economics* **20**, 193–210.

BOADWAY, R., and N. MARCEAU (1994) Time inconsistency as a rationale for public unemployment insurance, *International Tax and Public Finance* **1**, 107–126.

BURDETT, K., and R. WRIGHT (1989) Optimal firm size, taxes, and unemployment, *Journal of Public Economics* **39**, 275–287.

CARMICHAEL, L. (1983) Firm specific human capital and promotion ladders, *Bell Journal of Economics* **14**, 251–358.

GREIF, A., P. MILGROM, and B. R. WEINGAST (1994) Coordination, commitment, and enforcement: The case of the merchant guild, *Journal of Political Economy* **102**, 745–776.

MACLEOD, W. B., and J. MALCOMSON (1989) Implicit contracts, incentive compatibility, and involuntary unemployment, *Econometrica* **57**, 447–480.

MARCEAU, N. (1993) Unemployment insurance and market structure, *Journal of Public Economics* **52**, 237–249.

OSWALD, A. J. (1986) Unemployment insurance and labor contracts under asymmetric information: Theory and facts, *The American Economic Review* **76**, 365–377.

SHAPIRO, C., and J. E. STIGLITZ (1984) Equilibrium unemployment as a worker discipline device, *The American Economic Review* **74**, 433–444.

THOMAS, J., and T. WORRALL (1988) Self-enforcing wage contracts, *Review of Economics Studies* **55**, 341–353.

TOPEL, R., and F. WELCH (1980) Unemployment insurance: Survey and extension, *Economica* **47**, 351–379.