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Publicly Provided Unemployment Insurance and Commitment

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Abstract

A model is constructed in which, given the inability of implicit contracts to be self-enforcing, a minimum wage policy combined with unemployment insurance can be welfare-improving. Unemployment insurance can be decentralized to the private sector if the government can commit to a minimum wage. However, if it cannot, a government which acts in the interest of the workers will have an incentive to increase the minimum wage to exploit private insurers. The full-commitment optimum can be achieved by publicly provided unemployment insurance.

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PUBLICLY PROVIDED UNEMPLOYMENT INSURANCE AND COMMITMENT

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I. Introduction

The public provision of unemployment insurance (UI) is virtually a universal phenomenon in developed capitalist economies. Yet, the literature on why the public sector should be involved in this activity is relatively scant. The conventional arguments for public sector intervention tend to be based either on the inefficiencies associated with market failures of various types, or on redistributive equity. Although market failure is widely recognized to exist in markets for insurance due to asymmetric information (moral hazard and adverse selection), it has not been convincingly shown that public provision could avert this source of inefficiency. The public sector is not likely to have better information than the private sector.[1] As analyzed in the literature, UI could as easily be provided by the private sector as by the public sector. The fact that it was provided by the public sector has simply been taken as given.[2]

There has been some literature on the use of public UI as a redistributive instrument, alongside other instruments such as redistributive taxation. Wright (1986) has argued that, even if the workers are risk-neutral, a majority voting equilibrium could be characterized by a public UI scheme because of its redistributive aspects. This would be true, he argued, even if there were complete markets in the economy that could be used to smooth consumption. Boadway and Oswald (1983) showed that UI could be useful for redistributive purposes if the government were limited to a linear income tax. They showed that the optimal UI scheme for redistributive purposes does not necessarily exhibit full experience-rating, which is presumably what a private scheme would do. Marceau and Boadway (1991) showed that the simultaneous use of UI alongside a minimum wage can be a component of an optimal redistributive policy even when the government has access to a non-linear optimal income tax in the sense of Mirrlees (1971). This policy allows the government to relax a self-selection constraint which limits the amount of redistribution that can

[1] It has been shown that government use of taxes and subsidies could improve market efficiency in the face of moral hazard even without full information, but this does not require public provision. See Arnott and Stiglitz (1986).

[2] See Baily (1977, 1978), Burdett (1979), Burdett and Hool (1983), Burdett and Wright (1989a, 1989b), Feldstein (1976), or Mortensen (1983,1986).

be achieved by the non-linear income tax.[3]

Another unexplained phenomenon is the absence of a private market for UI alongside public provision. One might expect that, given the observed deficiencies of public UI schemes, there might be efficiency advantages from supplementary private provision. Some firms provide severance pay to their permanently laid-off workers, and that might be viewed as a sort of UI. However, firms typically do not provide payments to their workers who are on temporary layoff, and there is certainly no organized UI market to which workers can go for insurance against layoff.[4] Topel and Welch (1980) have argued that the timing of the unemployment spells of the workers in the U.S. was highly correlated so that the unemployment risk was, in part, uninsurable. Consequently, no private scheme could be established that would be significantly different from the saving and the borrowing of the firms or the workers. This argument does not, however, explain why no private UI scheme exists for that part of the risk that is insurable.

The purpose of this paper is to provide an analysis of one reason why the public sector provides UI. The reason has to do with the time inconsistency of government policy.[5] The basic argument revolves around the fact that the probability of the event being insured against, unemployment, is partly under the control of the public sector. In the presence of private UI, we argue that a government which is primarily interested in the welfare of the workers will have an short-sighted incentive to exploit the UI system, and will not be able to commit to avoid that incentive. Without such commitment, the privately-provided UI scheme will be sub-optimal. One way to overcome this commitment problem is for the public sector itself to provide UI. The policy instrument which gives rise to this time-consistency problem is a minimum wage. We construct a model in which a minimum wage is itself a sensible policy instrument, but it is one whose magnitude the government may not be able to commit to.

The model we use is of an economy with a large number of industries with iden-

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[3] This self-selection constraint implicit in the optimal income tax problem was first analyzed by Stern (1982) and Stiglitz (1982), and discussed in the context of expenditure policy by Nichols and Zeckhauser (1982).

[4] See Oswald (1986) for a discussion on these issues.

[5] The issue of commitment has been the subject of a growing program of research, mainly in the macro-economics literature. The papers by Fischer (1980) and Kydland and Prescott (1977) on fiscal policy and Barro and Gordon (1983) on monetary policy are classics. A comprehensive survey of the literature in this area can be found in Blackburn and Christensen (1989). Recently, there has been an extension of the analysis into tax theory. See, for example, Rogers (1987), Bruce (1990), and Brito, Hamilton, Slutsky, and Stiglitz (1991).

tical competitive firms. Industries face the possibility of an uncertain production shock. The output of each firm depends upon the number of workers employed and on whether or not the firm is in an industry with an adverse shock. The shock is fully diversifiable and the owners of the firm are risk-neutral. Thus, if the firm could enter into implicit contracts with its workers, it would insure the workers fully by a contract consisting of fixed wages and the possibility of layoff in the bad state, as in Azariadis (1975), Baily (1974), or Gordon (1974). However, some requirements are necessary for such implicit contracts to be self-enforcing. In those contracts, the workers receive less than their marginal product in the good state and more in the bad state. Workers would be bid away from firms in the good state by higher wage elsewhere, and the firms would have an incentive to renege on the wage promised in the bad state. In the jargon of Carmichael (1989), a non-trivial[6] contract is self-enforcing if upholding the agreement will generate a "surplus" for the two parties.[7] In the type of model we are here considering, the surplus could be a reputation as in Carmichael (1984) or Holmström (1981). But in our model, since there are no repeated relationships, no reputations can be built, and thus, no non-trivial implicit contracts are self-enforcing. The implicit contract solution would not be sustained. In such a circumstance, a minimum wage can be welfare-improving, especially when combined with UI.

We first analyze the optimal minimum-wage-UI policy. For the model we are using, we will typically have to introduce incentive compatibility conditions to ensure that laid-off workers are not better off than those who continue working. We then consider whether UI can be decentralized to the private sector in this model. We find that, since the optimal minimum wage is not time-consistent, decentralization will be optimal only if the government can commit to its minimum wage policy. Without commitment, the time-consistent policy is characterized by private insurance contracts written so that the government has no incentive to renege on its stated minimum wage. It is argued that the time-consistent allocation under private UI with no commitment is sub-optimal; less than full insurance will be offered. The full-commitment allocation will be attainable only with public provision of UI.

Throughout the analysis, we assume that the government takes decisions which maximize the expected welfare of the workers, each of whom is identical *ex ante*. It does not take account of the welfare of the capitalists. This is clearly an extreme caricature of how governments actually behave, but it captures in a straightforward way the main feature we are trying to analyze. That is the fact that minimum wages can be thought of as implementing in an imperfect way the ideal of an implicit contract, which is unenforceable. If the private sector provides UI competitively,

[6] A contract is non-trivial if it contains promises that, in some future period, one of the party would prefer not to keep.

[7] This argument has been proved in MacLeod and Malcomson (1987, 1989).

the government would have an incentive to improve the lot of the workers at the expense of the insurers, once the latter have written insurance policies. For the story to apply, there needs only to be a redistributive motive in favour of the workers. It would be possible to add capital owners to the model, but the analysis would become more complicated.

II. The Model

The economy consists of a fixed, but large, number of competitive industries, each consisting of a given number of *ex ante* identical competitive firms.[8] We assume the output price of each industry is fixed and normalized to unity, and that all firms have the same production technology.[9] Thus, all industries are *ex ante* identical. This allows us to concentrate on the insurance aspects of the problem. We will focus on the representative firm in each industry in what follows. Each such firm faces an idiosyncratic risk as to the state of nature. The firm will either be in a good state with probability λ or a bad state with probability $1-\lambda$. Since there is no aggregate risk, λ also represents the proportion of firms which will be in the bad state *ex post*. Each firm has a production technology given by $\theta F(N-L)$ with:

$$F' > 0; \quad F'' < 0; \quad \text{and} \quad \lim_{L \to N} F' = \infty$$

and where N is the number of workers hired by the firm before the state of nature is revealed, L is the number laid off after the state is revealed, and θ is unity for the good state and less than unity for the bad state. We denote the good state as state 1 and the bad state as state 2. In the model that follows, N is the same for all firms, while L is zero for firms in the good state. In the event of layoff, workers are selected randomly from the firm's work force. Thus, the probability of being laid off given that a firm is in the bad state is simply L/N. The *ex ante* probability of being laid off is $(1-\lambda)L/N$. For simplicity, we assume that the hours worked h are indivisible so that h_0 hours are supplied by an employed worker and none by an unemployed one.

We assume that workers are risk-averse and obtain utility from income and leisure. For simplicity, we assume that leisure and income are perfect substitutes. This implies that the monetary value of leisure is fixed. Specifically, utility is defined

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8 We could let the number of firms in each industry be endogenous and determined by a zero profit condition, but this would complicate the analysis unnecessarily.

9 Alternatively, the production shock introduced below could have represented a price shock determined on world markets. The same analysis would apply.

by the function $u = g(w - \gamma h)$ where w is income and h is hours worked. The utility function satisfies the following properties:

$$g' > 0; \; g'' < 0; \; \text{ and } \; \lim_{w \to \infty} g'(w - \gamma h) = 0.$$

Following Sargent (1987), since h_0 is a parameter, we can write for an employed worker: $u = g(w - \gamma h_0) = u(w)$ where $u(w)$ satisfies::

$$u' > 0; \quad u'' < 0; \quad \text{and} \quad \lim_{w \to \infty} u' = 0.$$

Denoting by r the pecuniary value that a worker attaches to working 0 hours rather than h_0 hours, we can write $g(w + r - \gamma h_0) = u(w + r)$. In what follows, we will now only use the utility functions $u(w)$ for the employed and $u(w + r)$ for the unemployed.

Consider first the competitive equilibrium in the absence of government intervention. It is assumed that there is no inter-industry mobility once the state of the world is revealed. However, workers may move among firms in the same industry. This intra-firm mobility causes the possibility of an implicit contract between firms and their workers to break down. At the same time, the absence of inter-industry mobility allows the spot price of labour to vary among industries once the state of nature is revealed. If the labour market is competitive, the wages will adjust so that every workers is paid according to his marginal productivity in each firm. The spot labour market will adjust so that there will be no unemployment ($L = 0$). Then, with probability λ, a worker will obtain the wage $w_1 = F'(N)$, and with probability $(1 - \lambda)$, he will get $w_2 = \theta F'(N)$. Obviously, $w_1 > w_2$ since $\theta < 1$. We also assume that $w_2 > r$ which means that a worker would prefer to be employed. We can then write the *ex ante* expected utility of the workers in the competitive equilibrium as:

$$EU^{ce} = \lambda u(w_1) + (1 - \lambda) u(w_2). \tag{1}$$

We wish to consider the possible beneficial effects of minimum wages and UI in such an economy. Before proceeding further, we now posulate two assumptions. First, it is assumed that the states of nature are observed by both the workers and the firms but not by a third party like a court or an insurance company. This assumption implies that no state-contingent contracts are legally enforceable. Second, we assume that the employment status of a worker (employed or unemployed) can be costlessly observed by any third party. In this economy, a first-best social-welfare maximizing optimum would involve a state-contingent implicit contract with full insurance for the workers such that their incomes were identical no matter what the state of nature and with some layoffs assuming leisure has enough value. But because of our assumptions, these contracts cannot be written since they are not self-enforcing. This opens up the possibility for a minimum wage for two reasons.

First, the minimum wage resembles a state-contingent contract to the extent that it involves a type of sticky wage and it induces some layoffs. Second, some insurance (UI) can now be provided to the laid-off workers since contracts can be written that are contingent on employment status. We thus proceed and assume that the government (e.g., the vote-maximizing government) only cares about the welfare of the workers and totally disregards the capitalists (either the firms described above or the insurance companies described below) and that it does not take into account the impact of its actions on the future.[10] Thus, the social welfare function that is maximized by the government is simply the sum of worker expected utilities. Since all workers are identical *ex ante*, this is equivalent to maximizing per worker expected utility. It is then quite possible that a minimum wage will be welfare-improving for the workers, even in the absence of UI.[11]

To see this, denote the potential minimum wage by $\bar{w}$. We wish to consider minimum wages that satisfy[12] $w_1 \geq \bar{w} > w_2$. This implies that the employment by a firm in the bad state will be determined implicitly by:

$$\bar{w} = \theta F'(N - L). \tag{2}$$

Differentiation of (2) yields the effect of minimum wage changes on unemployment:

$$\frac{dL}{d\bar{w}} = -\frac{1}{\theta F''} > 0 \tag{3}$$

where

$$\frac{d^2L}{d\bar{w}^2} = -\frac{F'''}{\theta F''^2}\frac{dL}{d\bar{w}} >, =, < 0.$$

Per worker expected utility will now be given by:

$$EU^{mw} = \lambda u(w_1) + (1-\lambda)\left[\left(1 - \frac{L}{N}\right)u(\bar{w}) + \frac{L}{N}u(r)\right].$$

The effect of an increase in the minimum wage is given by:

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[10] Barro and Gordon (1983) make assumptions such that the planner's objective function is similar to the one used here.

[11] The use of minimum wages as policy instruments have been found in a variety of places in the literature. On this, see Drazen (1986), Guesnerie and Roberts (1984,1987), Lang (1987, 1988), and Marceau and Boadway (1991). A good survey of the classic analysis is found in Brown, Gilroy, and Cohen (1982).

[12] We also requires w_1 to be finite.

$$\frac{dEU^{mw}}{d\bar{w}} = (1-\lambda)\left[\left(1-\frac{L}{N}\right)u'(\bar{w}) + \frac{u(\bar{w})-u(r)}{\theta N F''}\right]. \tag{4}$$

The first term is positive and the second negative (since $\bar{w} > r$), making the overall sign ambiguous. In what follows, we assume that the positive effect outweighs the negative and that a minimum wage will improve the expected utility of the workers, albeit at the expense of the capital owners.[13] The government would then choose $\bar{w}$ such that the righthand side of (4) is zero. In principle is is possible in this economy that the minimum wage could actually exceed w_1 so that there is unemployment in both states. This would occur if the size of the transfer from profits were large enough. We assume that at the optimum, this will not be the case. It could have been ruled out by introducing capital income into the social welfare function explicitly.

If the minimum wage is implemented, the possibility of UI is created. We turn to that next.

III. The Planning Optimum with Minimum Wages and Unemployment Insurance

It is instructive first to characterize the optimal combination of minimum wage and UI when there are no further restrictions on the ability of a planner to implement the policy. We shall see that there will be incentive compatibility problems which prevent this optimum from being achieved, and an incentive compatibility constraint will have to be added. Since we are ruling out other tax instruments, the UI scheme will have to be self-financing.

Let q be the payment of UI benefits to those laid-off. It is provided to all workers at an *ex ante* price of π per unit. For the UI to be self-financing in the aggregate, it must be actuarially-fair. This implies that the price per unit of insurance must equal the probability of being laid off, or:

$$\pi = (1-\lambda)\frac{L}{N}. \tag{5}$$

[13] The sign of the second derivative of EU^{mw} with respect to $\bar{w}$ is also ambiguous. However, we assume it to be negative so that the second-order condition for the choice of an optimal minimum wage is satisfied. It should be noted that, even if the sign of (4) is negative in the absence of UI, it might be positive when combined with UI. Our subsequent analysis focuses on this case.

The planner chooses a minimum wage and UI scheme to maximize per worker expected utility. The Lagrangian expression for this problem is:

$$\begin{aligned}\mathcal{L}(q,\pi,\bar{w},\delta) =& \lambda u(w_1-\pi q)+(1-\lambda)\left[\left(1-\frac{L}{N}\right)u(\bar{w}-\pi q)+\frac{L}{N}u(r+q-\pi q)\right] \\ &+\delta\left(\pi-(1-\lambda)\frac{L}{N}\right). \end{aligned} \tag{6}$$

The first-order conditions are:

$$-\lambda\pi u'(1)-(1-\lambda)\left[\left(1-\frac{L}{N}\right)\pi u'(2)-\frac{L}{N}(1-\pi)u'(L)\right]=0 \tag{7}$$

$$-\lambda q u'(1)-(1-\lambda)\left[\left(1-\frac{L}{N}\right)qu'(2)+\frac{L}{N}qu'(L)\right]+\delta=0 \tag{8}$$

$$(1-\lambda)\left[\left(1-\frac{L}{N}\right)u'(2)-\frac{u(2)-u(L)}{N}\frac{dL}{d\bar{w}}\right]-\delta\frac{(1-\lambda)}{N}\frac{dL}{d\bar{w}}=0 \tag{9}$$

where $u(1)$, $u(2)$ and $u(L)$ are the utilities obtained in the good state, employed in the bad state and unemployed respectively (i.e., $u(1)=u(w_1-\pi q)$, etc.).

These conditions can be given a straightforward interpretation. From (7), we obtain:

$$u'(L)=\frac{\lambda u'(1)+(1-\lambda)(1-L/N)u'(2)}{\lambda+(1-\lambda)(1-L/N)}. \tag{10}$$

That is, $u'(L)$ is a weighted average of $u'(1)$ and $u'(2)$, where the weights are the probabilities of being in the good state and in the bad state, if employed. Notice that if $\bar{w}<w_1$, it must be that $q+r>\bar{w}$; that is, the worker is better off if unemployed than if employed in the bad state. This is not incentive-compatible, and we will rule out this possibility below. The optimality of $q+r>\bar{w}$ occurs in this case because of the fact that $\bar{w}<w_1$ so that full insurance is not possible. Setting the quantity of insurance such that $q+r$ lies between $\bar{w}$ and w_1 compensates for the inability to have full insurance.[14]

[14] Full insurance in the implicit contract model is obtained by both increasing the wage above the market clearing level in the bad state and reducing it below in the good state. Only the former is done here so the outcome is inferior to the implicit contract model.

Next, consider the condition on π. Substituting (7) into (8) we obtain:

$$u'(L) = \frac{\delta}{q}. \tag{11}$$

This condition, along with (10), determine q and π, given $\bar{w}$. Notice that (10) and (11) are compatible with there being full insurance. This would require setting $\bar{w} = w_1$. To see whether that is desirable, we turn to condition (9), the first-order condition on the minimum wage. With full insurance and using (3), (9) becomes:

$$\bar{w} = -(N-L)\theta F''(N-L). \tag{12}$$

At the same time, full insurance implies that $\bar{w} = w_1 = q + r$. Thus, from the marginal productivity conditions and (12), the following must hold simultaneously for there to be full insurance:

$$F'N = \theta F'(N-L) = -(N-L)\theta F''(N-L).$$

Since there is only one variable (L) in these three equations, they will generally not be satisfied, and full insurance will not be optimal. We will assume in what follows that $\bar{w} < w_1$ so that there is no unemployment in the good state. For this case, as we have mentioned, $u'(1) < u'(L) < u'(2)$. From the latter inequality, $q + r > \bar{w}$, so that the optimum is not incentive-compatible.

To make the planner's optimizing problem incentive-compatible, we need simply to amend the Lagrangian expression (6) by adding the constraint $q + r \leq \bar{w}$. Expression (6) is changed by the addition of $+\gamma(\bar{w} - r - q)$, where $\gamma > 0$ is a Lagrangian multiplier. The first-order condition on q, (7), has the additional term $-\gamma$ added to its left-hand side, while the condition on $\bar{w}$, (9), has the term γ added to its left-hand side. The effect of the incentive compatibility constraint, assuming it is binding, is to reduce the marginal benefit of increases in q and increase the marginal benefit of increases in $\bar{w}$. At the incentive-compatible optimum, q will be somewhat lower and $\bar{w}$ somewhat higher than at the previous optimum. Since the constraint will be binding at the incentive-compatible optimum if it was violated at the full optimum, the following condition will be satisfied at the incentive-compatible optimum[15]: $\bar{w} = q + r < w_1$.

Thus, there will be less than full insurance for the economy as a whole, although for firms in the bad state, workers receive the same utility whether they are employed or unemployed.

[15] To see this, simply note that the expected utility of workers is increasing in q as long as $(q + r) \in [0, \bar{w}]$.

IV. Implementing the Planning Optimum

In the above optimum, the planner both sets the minimum wage and operates the UI system. This section considers whether the latter can be decentralized to a competitive insurance industry with the government setting the minimum wage. That depends upon whether the government is able to commit to a given minimum wage policy regardless of the type of UI offered by the private sector. We first briefly discuss the case in which commitment is possible, indicating the incentive that exists for the government to renege on its commitment. Then, the consequences of the government not being able to commit are analyzed.

1. Decentralizing the Incentive Compatible Optimum with Full Commitment

The ability to decentralize the UI scheme when the government is able to commit to a minimum wage policy can be readily explained. The above planning problem can be restated as a two-stage problem. In the first stage, the planner selects the value of $\bar{w}$ which maximizes expected utility given the value of (q, π). This yields $\bar{w}$ as a function of (q, π). In the second stage, the planner chooses the insurance policy (q, π) which maximizes expected utility, with the minimum wage adjusting as in the first stage problem. The dependency of $\bar{w}$ on (q, π) does not appear explicitly in the first-order conditions because of the Envelope Theorem, so the form of the conditions is exactly the same as the the earlier planning problem, and the solution is also the same. Given this two-stage disaggregation of the planning problem, the ability to decentralize UI becomes apparent.

The government announces as a minimum wage the value of $\bar{w}$ which solves the above optimal problem with the incentive compatibility constraint. Given this value of $\bar{w}$, the competitive insurance industry will, in equilibrium, clearly offer the insurance policy (q, π) which maximizes the expected utility of the worker subject to both the incentive compatibility constraint and the zero profit constraint (i.e., actuarial fairness). This choice of (q, π) is the same as that in the second stage of the above problem. Thus, given that the minimum wage has been chosen optimally, the planning solution with incentive compatibility is replicated. Thus, with full commitment, UI can be decentralized to the private sector.

In this problem, having the government set the minimum wage in the first stage and letting the insurance industry act given the value of $\bar{w}$ reflects the assumption of full commitment. It is easy to show that the government will, in fact, have an incentive to renege on its commitment to $\bar{w}$ at the decentralized optimum. Per worker expected utility at the full-commitment optimum EU^{fc} is:

$$\lambda u(w_1 - \pi q) + (1-\lambda)\left[\left(1 - \frac{L(\bar{w})}{N}\right) u(\bar{w} - \pi q) + \frac{L(\bar{w})}{N} u(r + q - \pi q)\right] \tag{13}$$

where layoffs are a function of the minimum wage. Consider the effect on expected utility of a change in $\bar{w}$. For the purpose of this exercise, the government does not take account of the zero-profit condition; the insurance policy set by the private sector is taken as given. Moreover, account need not be taken of the incentive compatibility constraint either since, as will be seen, the incentive will be for the short-sighted government to increase the minimum wage and thus relax the self-selection constraint. Thus, differentiating (13) with respect to $\bar{w}$ yields:

$$\frac{\partial EU^{fc}}{\partial \bar{w}} = (1-\lambda)\left[\left(1 - \frac{L}{N}\right) u'(2) - \frac{u(2) - u(L)}{N}\frac{dL}{d\bar{w}}\right].$$

Since $u(2) = u(L)$ at the incentive-compatible optimum, the second term on the right-hand side disappears and the expression is clearly positive. This shows that the government operating on behalf of the workers clearly has an incentive to increase the minimum wage at the incentive-compatible optimum. This increases layoffs and forces the insurance companies to suffer a loss. Given that the minimum wage can be changed at will, there is no reason to believe that the government can commit to it, given that it would be time-inconsistent to do so. We next turn to the equilibrium that might emerge when such commitment is not possible.

2. *The No-Commitment Equilibrium*

The no-commitment equilibrium will be taken to be the rational expectations equilibrium that will emerge when the minimum wage policy of the government must be time-consistent. In terms of the above two-stage procedure, the order of choice is reversed. In the first stage, the insurance policy (q, π) is chosen by the private sector under rational expectations (i.e., knowing how to solve the second stage). Actuarial fairness in this case implies $\pi = (1-\lambda)L(\bar{w})/N$. In the second stage, the uncommitted government selects $\bar{w}$, taking as given the insurance policy (q, π) of the first stage. The second stage yields $\bar{w}(q, \pi)$, which can be written simply as $\bar{w}(q)$ given the relation between $\bar{w}$ and π from the actuarial fairness condition above. This functional relationship $\bar{w}(q)$ is taken as given in the first stage. Our procedure will be to solve the two-stage problem backwards, starting with the second stage and using the solution for that to solve the first stage.

i. Stage 2: The Choice of $\bar{w}$.

In this stage, the government takes the insurance policy (q, π) as given and chooses $\bar{w}$ to maximize expected utility. The expression for expected utility is the same as in (13). The first-order condition for Stage 2 is:

$$\left(1-\frac{L}{N}\right)u'(\bar{w}-\pi q)-\frac{u(\bar{w}-\pi q)-u(r+q-\pi q)}{N}\frac{dL}{d\bar{w}}=0. \tag{14}$$

This equation yields $\bar{w}(q,\pi)$. Since π itself depends upon $\bar{w}$ as discussed above, this can be written as $\bar{w}(q,\pi(\bar{w}))=\bar{w}(q)$. Differentiating this, we obtain:

$$\frac{d\bar{w}}{dq}=\frac{\partial\bar{w}}{\partial q}\left[1-\frac{\partial\bar{w}}{\partial\pi}\frac{d\pi}{d\bar{w}}\right]^{-1}. \tag{15}$$

In (15), $\partial\bar{w}/\partial q$ and $\partial\bar{w}/\partial\pi$ are behavioural relations coming from the solution to this second stage problem (14). The expression $d\pi/d\bar{w}$ comes from the zero profit condition $\pi=(1-\lambda)L(\bar{w})/N$.

ii. <u>Stage 1: The Choice of UI</u>.

Stage 1 represents the equilibrium behaviour of the competitive insurance industry. The firms in the industry can compute the solution to Stage 2. In particular, they know the relationship between $\bar{w}$ and q obtained from (15) as discussed above, denoted as $\bar{w}(q)$. As well, they know $\pi(\bar{w})$ from the zero profit condition. The equilibrium in the competitive insurance industry can be characterized as the choice of insurance coverage q which maximizes per worker expected utility given $\bar{w}(q)$ and $\pi(\bar{w})$. Again, incentive compatibility will not be a constraint here as will become obvious from the results of Stage 1.

The problem of Stage 1 may be stated as choosing q to maximize:

$$EU^{nc}=\lambda u(w_1-\pi(\bar{w}(q))q)+(1-\lambda)\left[\left(1-\frac{L(\bar{w}(q))}{N}\right)u(\bar{w}(q)-\pi(\bar{w}(q))q)\right.$$
$$\left.+\frac{L(\bar{w}(q))}{N}u(r+q-\pi(\bar{w}(q))q)\right]. \tag{16}$$

Using the first-order condition from Stage 2, the first-order condition for this problem yields:

$$-\lambda\pi u'(1)-(1-\lambda)\left[\left(1-\frac{L}{N}\right)\pi u'(2)-\frac{L}{N}(1-\pi)u'(L)\right]$$
$$-\left[\lambda q u'(1)+(1-\lambda)\left(1-\frac{L}{N}\right)qu'(2)+(1-\lambda)\frac{L}{N}qu'(L)\right]\frac{d\pi}{d\bar{w}}\frac{d\bar{w}}{dq}=0. \tag{17}$$

Using the zero profit condition and rearranging, we obtain:

$$q\frac{d\pi}{d\bar{w}}\frac{d\bar{w}}{dq} = -\pi\left[1 - \frac{u'(L)}{\lambda u'(1) + (1-\lambda)\left(\left(1-\frac{L}{N}\right)u'(2) + \frac{L}{N}u'(L)\right)}\right]. \tag{18}$$

We are now in a position to characterize the no-commitment equilibrium. The following proposition establishes the relationship between q and the minimum wage.

> **Proposition:** The no-commitment equilibrium is characterized by positive unemployment insurance but less than that of the incentive-compatible planning optimum: $0 < q < \bar{w} - r < w_1 - r$.

Proof: First, to show that $q > 0$, consider (18). Since $q + r \leq \bar{w} < w_1$, we have $u'(L) \geq u'(2) > u'(1)$. Then, the right-hand side of (18) is necessarily positive. Thus, $q = 0$ would be a contradiction. So, $q > 0$. Now, let q^* denote the solution to (18). Since (18) has been derived subject to the constraint that (14) must hold, q^* has to be consistent with (14). Consider (14) with the government choosing $\bar{w}$ given q^*. Denote by $\bar{w}^*$ the minimum wage chosen by the government so (14) can be written:

$$\left(1 - \frac{L}{N}\right)u'(\bar{w}^* - \pi q^*) = \frac{u(\bar{w}^* - \pi q^*) - u(r + q^* - \pi q^*)}{N}\frac{dL}{d\bar{w}}. \tag{19}$$

To show that $q^* < \bar{w}^* - r$, suppose instead that $q^* = \bar{w}^* - r$. Then, the right-hand side of (19) is 0. Since $L < N$ unless[16] $\bar{w}^* = \infty$ and since we have assumed that $\bar{w} < w_1$ where w_1 is finite, it has to be the case that $(1 - L/N) > 0$. Also, since $\bar{w}^*$ has to be finite, it cannot be the case[17] that $u'(\bar{w}^* - \pi q^*) = 0$. So the left-hand side cannot be 0, a contradiction. Thus, given that $dL/d\bar{w} > 0$, $q^* < \bar{w}^* - r$. ■

Thus, in the no-commitment equilibrium, laid-off workers in the bad state firms receive less than full insurance relative to the employed ones. It is clear that the welfare of the workers is inferior under no commitment than under full commitment since the full-commitment outcome was a replication of the incentive-compatible planning optimum. An immediate corollary follows:

> **Corollary:** If unable to commit, the government should implement its own UI scheme. This scheme should exhibit full insurance to workers in the bad state firms and should be actuarially-fair: $q = \bar{w} - r < w_1 - r$ and $\pi = (1-\lambda)L(\bar{w})/N$.

[16] It has been assumed that $\lim_{L\to N} F' = \infty$.

[17] It has been assumed that $\lim_{w\to\infty} u' = 0$.

This follows directly given the sub-optimal outcome reached under no commitment and decentralization. The UI scheme implemented by the government should obviously replicate the incentive-compatible planning optimum so it should exhibit both actuarial fairness and full insurance in the bad state firms.

Note that, in the above discussion, we have not considered the possibility of the insurance companies imposing a deductible on the insurance policies offered to their insurees. It is straightforward to show that the planning optimum with or without incentive compatibility will not involve a deductible. Thus, the full commitment equilibrium will not offer a deductible. However, it can be shown that in the no-commitment equilibrium, insurance companies may offer unemployment insurance with a positive deductible. This is obviously sub-optimal compared with the planning optimum. Thus, a public UI scheme will again be welfare-improving and will have no deductible.

V. Conclusion

As in the existing literature on commitment, it has been shown that the inability of a government to commit to a fixed policy could be costly. In this case, the private provision of UI leads to an outcome that is inferior to the planning solution if the government is not able to commit to a pre-determined minimum wage policy. A government acting in the interest of the workers will have an incentive to increase the minimum wage above the announced optimal value in order to exploit the UI system on behalf of the workers. Given the inability of the government to commit, a public UI scheme is then the superior outcome. It replicates the planning optimum even in the absence of commitment. This paper thus provides a rationale for the existence of public UI schemes.

Our paper did not incorporate moral hazard either on the workers' or on the firms' side. This is in contrast with the previous literature on UI which has highlighted extensively the harmful effects of UI due to the changes in the incentives of the agents in the economy. It should then be noted that the introduction of workers' or firms' moral hazard in the current analysis would imply that the optimal UI scheme would exhibit only partial coverage. Still, the inability of the government to commit should lead to a sub-optimal outcome in the case of private provision of UI. A public UI scheme could then yield the constrained optimal outcome.

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