Strategic Unemployment*

Julia Angerhausen,† Christian Bayer,‡ Burkhard Hehenkamp §

First version: April 2006

This version: 1st March 2007

Abstract

We propose a dynamic model that explains why individuals may be reluctant to pick up work although the wage is above their reservation wage. Accepting low paid work will put them in an adverse position in future wage bargaining, as employers could infer the individual's low reservation wage from his working history. Employers will exploit their knowledge offering low wages to this individual in the future. Therefore, employees with low reservation wage *strategically* opt into unemployment to signal a high reservation wage.

Keywords: strategic unemployment, asymmetric information, wage bargaining, minimum wage

JEL classification: D82, J30, J64

1 Introduction

High levels of unemployment persist in a number of OECD countries, especially continental Europe. In particular, unemployment rates amongst the unskilled and low-skilled labor force are high. To explain this, the economics literature most commonly refers to the high wage replacement rates that are paid in all these countries. Accordingly, a

*We thank Wolfgang Leininger for helpful comments and discussion.

†Department of Economics, University of Dortmund, Germany. Email: J.Angerhausen@wiso.uni-dortmund.de

‡Department of Economics, University of Dortmund, Germany. Email: Christian.Bayer@wiso.uni-dortmund.de

§Corresponding author: Department of Economics, University of Dortmund, 44221 Dortmund, Germany. Email: burkhard.hehenkamp@udo.edu

worker has to be compensated for both, the loss of unemployment benefits and his disutility from work. He will therefore be reluctant to pick up badly paid jobs. However, the empirical literature on happiness and unemployment at best suggests that this disutility of work does not exist (see Frey and Stutzer, 2002, for an overview). A typical finding is that unemployment spells affect happiness in an adverse way that goes beyond the loss in income. In other words, even when the income level is controlled for, unemployment correlates with substantial unhappiness (Clark and Oswald, 1994; Winkelmann and Winkelmann, 1998).

Taking these results seriously, we would expect individuals to be willing to work for less than the unemployment benefit. This is actually observed rarely if at all. To address this puzzle, we put forward a model that can explain a reluctancy to pick up low paid work in spite of the fact that the employee does not suffer a significant disutility of work. Specifically, we investigate a two-period model with two principals and one agent. Each principal is incompletely informed about the agent's reservation wage. Principal 1 offers a wage contract in period one, and the agent decides whether to accept it or not. Being informed about the agent's decision in period one, Principal 2 offers a wage contract in period two that the agent may again accept or reject. This complicates the decision problem to the agent in period one. He may wish to signal a high disutility of work to future employers by rejecting a low wage offer. Accepting the offer, the agent would reveal his low reservation wage, which entailed a lower offer in the future. This signaling activity can result in unemployment when screening the agents' types is either ineffective or too costly to Principal 1. The corresponding type of unemployment is what we call *strategic unemployment* in the following. Strategic unemployment is voluntary, but (as will turn out) second-best inefficient.

A similar idea has been modeled by Ma and Weiss (1993), who analyze how agent's can signal a higher skill level by choosing unemployment instead of an unskilled job. Doing so raises their chance of being offered a higher wage in the following period. The first main difference to our setup is that in Ma and Weiss agents have different opportunities on the labor market in the first and second period of the game, whereas we use an identical labor market setup throughout the model. Second, the agents in Ma and Weiss can select into two types of jobs, while we have only one type of job. Agents differ only in reservation wages, but not in their aptitude to do the job offered. Therefore, most related to our line of argument is the seminal work by Hart and Tirole (1988). The paper addresses the issue of contract renegotiation in a multi-period buyer-seller model, where the seller is incompletely informed about the buyer's reservation price and where all bargaining power goes with the seller. Consequently, revelation of information in early periods is very costly to the buyer in the later periods of play so that extensive pooling takes place. Vincent (1998) departs from the strongly asymmetric distribution of bargaining power, investigating linear-pricing contracts (as opposed to the non-linear pricing contracts that maximize a monopolistic seller's profit). If the seller's bargaining power is reduced this way, there is comparatively more revelation of information in early periods.

Having the lower segment of the labor market in mind, it is more natural to assume that asymmetric information goes with the buyer, which is the firm in a labor-market setup. Unlike firms' profits, workers' reservation wages primarily represent a psychological construct, which is much harder to be observed. Hart (1983; section 5.C) and Moore (1985) propose models in this spirit.

Both, Hart (1983) and Moore (1985), consider the case of privately observed reservation wages. Hart focuses on the productive inefficiency resulting from asymmetry in information. Moore addresses the issue of involuntary layoffs and retentions. Both authors examine a multi-period model where firms propose long-term contracts to workers in period one. At the time of contracting, the reservation wage is unknown to both parties. Subsequently, workers learn their reservation wage and may report it to the firm thereafter. Now, the firm decides whether to lay-off the worker or to continue the relationship paying a wage conditional on the reported reservation wage. The terms contracted on in the first period apply to both of these options and renegotiation of the contract is assumed to be infeasible.

Our setup differs in two important aspects. First, we concentrate on reservation wages that are private information to the worker already at the instant of contracting. Second, we extend the model to two periods of contracting, which leads to the key element of our paper. A firm may learn an agent's reservation wage from his employment history. Thus, agents with a low reservation wage are reluctant to pick up badly paid jobs as this has an adverse effect on the prospects of future earnings. As a consequence, unemployment results from contracts that are *not* signed, even though employment would be first-best efficient.

The remainder of this paper is organized as follows: In Section 2, we set up the model and solve for strategies and beliefs in weak perfect Bayesian equilibrium. We proceed with computing strategic and non-strategic unemployment. Section 3 discusses the robustness of our results and two possible extensions. First, it examines to what extent the two-period setup can be interpreted in the same way as a model with an infinite time horizon. Second, it analyzes how far vertical integration of the principals, firing costs, or a legal minimum wage can improve welfare by reducing strategic unemployment. Section 4 concludes.

2 The Basic Model

In this section, we set up a model where employers (principals) in the labor market have imperfect information on the reservation wages of potential employees (agents). Subsequently, we solve for weak perfect Bayesian equilibrium.

2.1 Principals

We consider a situation in which employers randomly draw projects that have a fixed value of revenues π. The employer needs an agent to implement the project and generate the revenues. He randomly meets agents and bargains about the amount of the wage payment. For simplicity, we assume that all bargaining power is with the principal. Consequently, bargaining takes the form of take-it-or-leave-it offers. The principal does not know the reservation wage of the agent, but is aware of his employment history including past wages.[1] To keep the model simple, we consider a two-period situation. In each period $t = 1, 2$, the profitability π_t of the project is probabilistic. Profitability is

[1] In the appendix, we discuss what happens if the principal can only observe accepted wage offers.

independently and identically distributed according to a distribution function G with a continuous density on a compact support. Furthermore, the profitability of a project is strictly positive ($\pi_t > 0$), which ensures that it is always profitable to employ a low-type agent at his reservation wage $\underline{\theta} = 0$.

Having learned about the profitability of his project, an employer makes a take-it-or-leave-it wage offer of w_t to the agent. To exclude strategic behavior on behalf of the principals, an agent does not work for the same principal in both periods. In the first period (the present), the employment history is completely uninformative about the reservation wage of the agent. In the second period (the future), the employer draws a new project and meets another agent. Accordingly, from the perspective of the employer, there is no strategic interaction between the two periods.

2.2 Agents

However, for employees there is such interaction. Principals learn about an employee's reservation wage through his working history. For this reason, we formulate the model from the point of view of an agent, who meets a different principal in each period of his working live.

Agents have a type $\theta \in \{\underline{\theta}, \bar{\theta}\}$ which reflects a reservation wage that is either high or low. The difference in reservation wages may for example account for different effort costs. For ease of exposition, the low reservation wage is normalized to zero: $\underline{\theta} = 0$.[2] The probability of an agent to be of the low type is p. The agent is aware that potential employers cannot observe his reservation wage. Hence, he has to take into account that the acceptance or rejection of an employment offer will shape the beliefs of potential future employers with respect to his reservation wage.

2.3 Chronology

This yields the following chronology of events within our model: First, nature draws the profitability of Principal 1's project π_1 and the agent's reservation wage θ, where

[2] Suppose, $\underline{\theta} > 0$. Then we can rewrite the model in terms of gains from employment instead of revenues defining a new distribution function $\tilde{G} = G(\pi - \underline{\theta})$ as well as shifted reservation wages $\tilde{\underline{\theta}} = \underline{\theta} - \underline{\theta} = 0$ and $\tilde{\bar{\theta}} = \bar{\theta} - \underline{\theta}$.

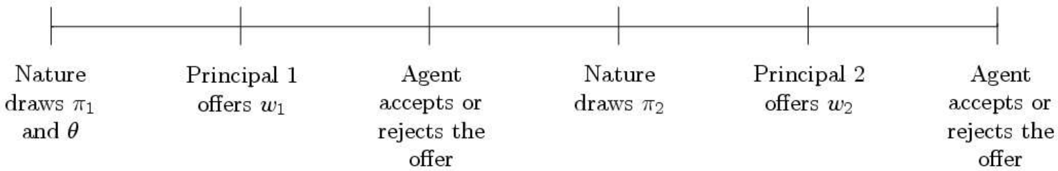


Figure 1: Chronology of the events

$p = Prob(\theta = \underline{\theta}) \in (0,1)$ is the probability of the agent to be of the low type.

Knowing the profitability of his project, Principal 1 then makes a wage offer w_1. In a next step, the agent accepts the offer (a) and receives $w_1 - \theta$, or rejects it $(\neg a)$ and receives $\underline{U} = 0$.

In the second period, nature draws the profitability of Principal 2's project π_2 from the distribution G. Afterwards, Principal 2 makes a wage offer w_2 and again, the agent accepts it (a) and receives $w_2 - \theta$, or rejects it $(\neg a)$ and receives $\underline{U}$. Figure 1 gives an overview of the succession of events.

2.4 Solution

The model is solved via backward-induction. Consequently, we first characterize the agents' behavior facing possible wage offers in the second period. Anticipating this behavior, the principal chooses an optimal wage offer that is based on his belief about the type of the agent. In the first period, the agent thus takes into account how accepting or rejecting the wage offer in period one will shape this belief. Finally, Principal 1 offers a profit-maximizing wage to the agent in period one.

Second Period

In the second period, all types of agents accept any wage offer that is larger than their reservation wage, $w_2 \geq \theta$. This implies that $\underline{\theta}$-types will accept any positive wage offer as their reservation wage equals zero. On the other hand, the high-type agents only accept wage offers that comply with $w_2 \geq \bar{\theta}$.

Principal 2 wants to pay a wage that is as low as possible, but needs to take into account that agents only accept wage offers that exceed their reservation wage. As the highest reservation wage is $\bar{\theta}$, a principal will never make a wage offer larger than this. The wage $w_2 = \bar{\theta}$ is sufficiently high to be accepted by all types of agents.

All the same, the principal may offer a low wage $w_2 = \underline{\theta} = 0$ that only meets with the reservation wage of the low-type agent. This strategy is risky. Agents with a high reservation wage will reject the offer $w_2 < \bar{\theta}$ and the project cannot be implemented. The principal believes the agent to be of the low type $\underline{\theta}$ with probability $\mu(s_1, w_1)$ (and of the high-type agent with probability $1 - \mu(s_1, w_1)$, accordingly). This belief is based on the employment history (s_1, w_1), where $s_1 \in \{a, \neg a\}$ refers to acceptance or rejection of the first-period wage offer w_1.[3]

For Principal 2 to make the low wage offer, the expected profit from choosing $w_2 = \underline{\theta}$ must be larger than the expected profit from a wage offer $w_2 = \bar{\theta}$. In the former case, this amounts to $\mu(s_1, w_1)\pi_2$, in the latter to $\pi_2 - \bar{\theta}$. Hence, he offers $w_2 = 0$ if

$$\mu(s_1, w_1)\pi_2 > \pi_2 - \bar{\theta},$$

and $w_2 = \bar{\theta}$ otherwise. The more likely the principal considers the low type to be, the higher is the probability for a low wage offer. On the other hand, the higher the revenue from the project, the more profitable is a high wage offer (unless $\mu(s_1, w_1) = 1$, where $w_2 = \underline{\theta}$ is always optimal). This trade-off between the two possible wage offers characterizes a threshold for π_2

$$\bar{\pi}_2 = \frac{\bar{\theta}}{1 - \mu(s_1, w_1)}. \tag{1}$$

For all revenue realizations below this threshold, the agent receives a low wage offer. Consequently, the low-type agent's expected payoff in period two is

$$V(s_1, w_1|\underline{\theta}) = \bar{\theta}[1 - G(\bar{\pi}_2)] + \underbrace{\underline{\theta}G(\bar{\pi}_2)}_{=0} = \bar{\theta}\underbrace{[1 - G(\bar{\pi}_2)]}_{\text{Prob}(\pi \geq \bar{\pi}_2)}. \tag{2}$$

[3]For expositional simplicity, we assume that Principal 2 can observe rejected wage offers. In the appendix, we discuss changes that would result from the alternative specification where rejected wage offers remain unobserved.

Since $\bar{\pi}_2$, and hence also $V(s_1, w_1|\underline{\theta})$, depends on the principal's belief μ, there are two critical values of V. The value

$$\overline{V} = \bar{\theta}\left[1 - G\left(\bar{\theta}\right)\right]$$

corresponds to the fully informative belief $\mu(s_1, w_1) = 0$, which assumes that all agents with history (s_1, w_1) are of the high type. Conversely,

$$\underline{V} = \bar{\theta}\left[1 - G\left(\frac{\bar{\theta}}{1-p}\right)\right]$$

corresponds to the belief $\mu(s_1, w_1) = p$, i.e. the first period ex-ante probability of the low type. Put differently, history is completely uninformative about the agent's type.

For a high-type agent, the expected second-period payoff is invariant to the principal's belief, so that $V(s_1, w_1|\bar{\theta})$ is constant. Specifically, we have $V(s_1, w_1|\bar{\theta}) = 0$ as the high type agent is either paid his reservation wage or will be unemployed.

First Period

Since the high type's expected second-period payoff is invariant to the working history (s_1, w_1), he cannot gain from acting strategically in the first period. So the high-type agent accepts a wage offer w_1 if

$$w_1 \geq \bar{\theta} \tag{3}$$

and rejects otherwise.

The decision making of the agent with a low reservation wage is less straightforward. He has to take into account that working in period one may affect the beliefs of future employers. This, in turn, will have consequences for his second-period payoff. As a result, he accepts to work for a wage w_1 only if

$$w_1 - \underline{\theta} + \delta V(a, w_1|\underline{\theta}) \geq \delta V(\neg a, w_1|\underline{\theta}). \tag{4}$$

The inequality compares the discounted expected payoff over both periods for the two alternatives, acceptance and rejection. The discount factor is δ. Inserting $\underline{\theta} = 0$, inequality

(4) reduces to

$$w_1 \geq \delta[V(\neg a, w_1|\underline{\theta}) - V(a, w_1|\underline{\theta})] =: \delta\Delta(w_1). \tag{5}$$

In words, the wage offer in period one must compensate for the discounted differential $\delta\Delta$ in information rents–$V(s_1, w_1|\underline{\theta})$, $s_1 \in \{a, \neg a\}$–which the low-type agent could realize in period two.

Equilibrium

Considering a model with incomplete information, we solve for weak perfect Bayesian equilibrium. Accordingly, we have to determine both, equilibrium strategies and equilibrium beliefs.

In equilibrium, any wage offer in period one larger than the high reservation wage, $w_1 \geq \bar{\theta}$, will be accepted by all agents. We already argued that the high type always accepts this offer. Taking this into account, the low type would reveal his type if he rejected the offer, thus decreasing the value of future income. Therefore, he accepts the offer expecting a future income of $\underline{V}$. Wage offers above $\bar{\theta}$ do not discriminate either type. In other words, acceptance of any wage offer $w_1 \geq \bar{\theta}$ does not create information, so that Principal 2 continues to have the belief $\mu\left(a, w_1 \geq \bar{\theta}\right) = p$.[4]

In contrast to the above, the high-type agent will reject any offer $w_1 < \bar{\theta}$. This generates an incentive for the low type to mimic the behavior of the high type. To influence the principal's belief, he may reject wage offers that are above his reservation wage but below the high type's reservation wage. He *strategically* opts for unemployment.

In equilibrium, the principal's belief $\mu(s_1, w_1)$ to face a low-type agent has to be equal to the true probability of observing this type conditional on employment history (s_1, w_1). Let $q(w_1)$ be the probability of the agent to accept a wage offer w_1. As p is the probability of a low type in the population, since all high types reject an offer $w_1 < \bar{\theta}$

[4]Since rejection is off the equilibrium path, we assume $\mu\left(\neg a, w_1 \geq \bar{\theta}\right) = p$ for simplicity.

and since $1 - q(w_1)$ is the probability of a low type to reject, we obtain

$$\mu(\neg a, w_1) = \frac{\overbrace{p(1-q(w_1))}^{\text{Probability of low type AND rejection}}}{\underbrace{(1-p)+p(1-q(w_1))}_{\text{Probability of rejection}}} = p\frac{1-q(w_1)}{1-pq(w_1)} \tag{6}$$

$$\mu(a, w_1) = 1$$

as an equilibrium condition.

If $q \in (0,1)$, then the agent mixes over the pure strategies "rejection" $(\neg a)$ and "acceptance" (a). However, the agent will only choose a mixed strategy, if the underlying belief of the principal sets him indifferent between accepting and rejecting the offer, i.e. if inequality (5) is binding. Since $\mu(a, w_1) = 1$ implies $V(a, w_1|\underline{\theta}) = 0$, he is indifferent if

$$w_1 = \delta V(\neg a, w_1|\underline{\theta}) = \delta\bar{\theta}\left[1 - G\left(\frac{\bar{\theta}}{1-\mu}\right)\right]. \tag{7}$$

Together with (6) this implicitly defines an acceptance probability $q^+(w_1)$ that is consistent with wage offer w_1

$$w_1 = \delta\bar{\theta}\left[1 - G\left(\bar{\theta}\frac{[1-pq^+(w_1)]}{1-p}\right)\right].$$

In case G^{-1} exists, we obtain

$$q^+(w_1) = \frac{1}{p} - G^{-1}\left(1 - \frac{w_1}{\delta\bar{\theta}}\right)\frac{(1-p)}{\bar{\theta}p}. \tag{8}$$

Yet, this formula may well yield values $q^+ \notin [0,1]$. Recall that $\overline{V}$ and $\underline{V}$ were defined as the expected second period payoffs corresponding to $\mu = 0$ and $\mu = p$, respectively. Since q^+ is defined by (6) and (7), we obtain that $q^+(\delta\underline{V}) = 0$ and $q^+\left(\delta\overline{V}\right) = 1$. Additionally, the following Lemma shows that $q^+(w_1)$ is monotonically increasing . We can thus infer that $q^+(w_1) \in [0,1]$ only for $w_1 \in \left[\delta\underline{V}, \delta\overline{V}\right]$.

Lemma 1 *If $G(\pi)$ is continuously differentiable and has a non-zero density on its whole support, then $q^+(w_1)$ is monotonically increasing on $W = \left[0, \delta\bar{\theta}\right]$.*

Proof. *Differentiating q^+ with respect to w_1 yields* $\frac{\partial q^+}{\partial w_1} = \frac{1}{G'\left(G^{-1}\left(1-\frac{w_1}{\delta\bar{\theta}}\right)\right)}\frac{1-p}{\bar{\theta}p}\frac{1}{\delta\bar{\theta}} > 0.$

The term is defined if $G' > 0$, i.e. the density is non-zero. The inverse of the distribution function, G^{-1}, is defined on the whole interval W. ■

Outside the interval $\left[\delta \underline{V}, \delta \overline{V}\right]$, $q^{+}(w_1)$ is no longer a probability measure, i.e. $q^{+}(w_1) \notin [0,1]$. This means that wage offers outside $\left[\delta \underline{V}, \delta \overline{V}\right]$ induce an equilibrium in pure strategies. Wage offers above $\delta \overline{V}$ are always accepted by the agent, wage offers below $\delta \underline{V}$ are always rejected.

Combining this argument with the argument for wage offers above $\bar{\theta}$, the equilibrium probability that a low type agent accepts an offer w_1 is given by

$$q^{*}(w_1) = \begin{cases} 0 & \text{if } w_1 < \min\left(\delta \underline{V}, \bar{\theta}\right) \\ 1 & \text{if } w_1 \geq \min\left(\delta \overline{V}, \bar{\theta}\right) \\ q^{+}(w_1) & \text{if } \min\left(\delta \underline{V}, \bar{\theta}\right) \leq w_1 < \min\left(\delta \overline{V}, \bar{\theta}\right) \end{cases}. \tag{9}$$

This leads us to the following proposition.

Proposition 2 *There exists a Bayesian Nash equilibrium*

$$\{s_1^{*}(w_1|\,\theta), s_2^{*}(w_2|\,\theta), w_2^{*}(\pi_2, s_1, w_1)\} \times \{\mu^{*}(s_1, w_1)\}$$

in the subgame after Principal 1 has set wage w_1, which is characterized as follows:

1. *the strategy of the high reservation type is*

$$s_1^{*}\left(w_1|\,\bar{\theta}\right) = \begin{cases} a & \text{if } w_1 \geq \bar{\theta} \\ \neg a & \text{if } w_1 < \bar{\theta} \end{cases}.$$

2. *the strategy of the low reservation type is*

$$s_1^{*}\left(w_1|\,\underline{\theta}\right) = \begin{cases} a & \text{with probability } q^{*}(w_1) \\ \neg a & \text{with probability } 1 - q^{*}(w_1) \end{cases},$$

3. *Principal 2 believes the probability of facing an agent with low reservation wage to be*

$$\mu^{*}(s_1, w_1) = \begin{cases} p & \text{if } w_1 \geq \bar{\theta} \\ p\frac{1-q^{*}(w_1)}{1-pq^{*}(w_1)} & \text{if } s_1 = \neg a \text{ and } w_1 < \bar{\theta} \\ 1 & \text{if } s_1 = a \text{ and } w_1 < \bar{\theta} \end{cases}.$$

4. Principal 2 offers a wage $w_2^*(\pi, s_1, w_1)$ to an agent with history (s_1, w_1) that is given by

$$w_2^*(\pi_2, s_1, w_1) = \begin{cases} \bar{\theta} & \text{if } \pi_2 \geq \frac{\bar{\theta}}{1-\mu^*(s_1,w_1)} \\ \underline{\theta} = 0 & \text{if } \pi_2 < \frac{\bar{\theta}}{1-\mu^*(s_1,w_1)} \end{cases}$$

if he has a project of revenues π.

5. Each type of agent θ accepts the wage offer w_2 if $w_2^* \geq \theta$

$$s_2^*(w_2|\,\theta) = \begin{cases} a & \text{if } w_2 \geq \theta \\ \neg a & \text{if } w_2 < \theta \end{cases}.$$

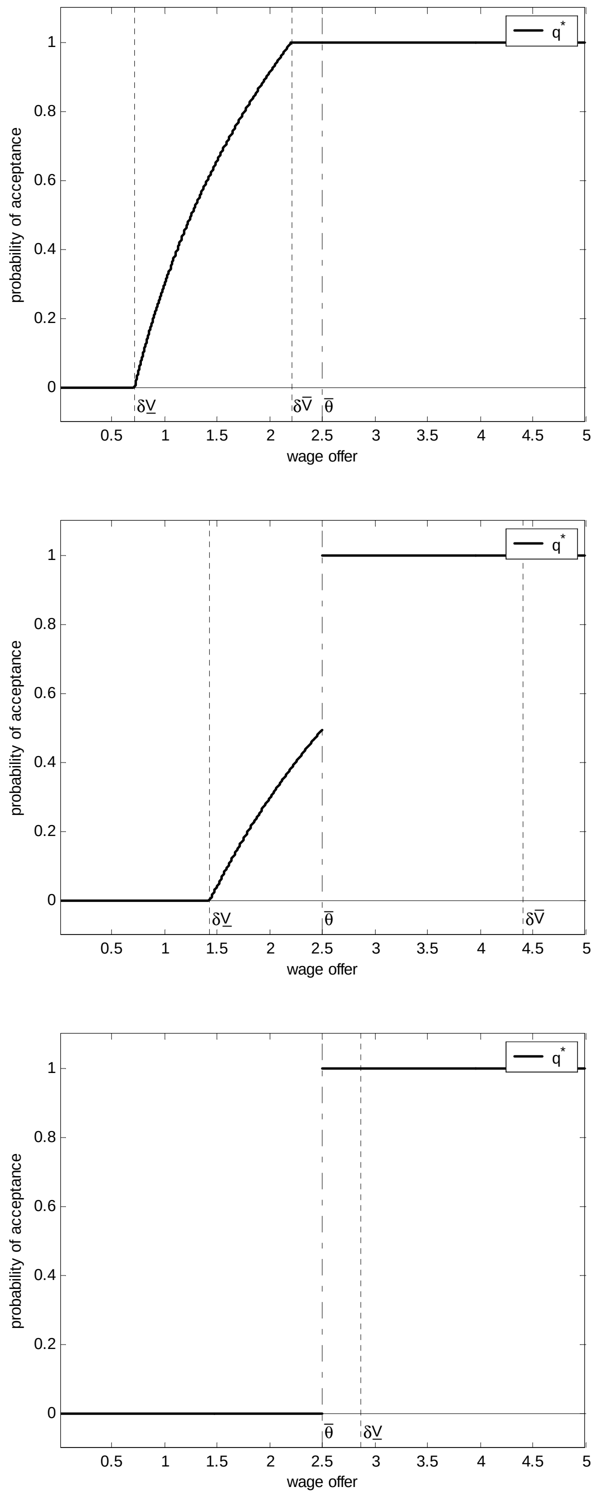
Proof. *As argued in the text.* ■

This characterization of the equilibrium in each w_1-subgame embraces three situations with different implications for the ability of Principal 2 to infer the type of the agent. For one set of model parameters, there exist some wage offers which induce a full revelation of the agent's type. For another set of model parameters, a wage offer can achieve partial revelation at best. Finally, there are model parameters for which no wage offer can achieve a revelation of the type of the agent.

The three panels in Figure 2 display these different situations. The *standard case* is $\delta\underline{V} < \delta\overline{V} < \bar{\theta}$, where all wage offers between $\delta\overline{V}$ and $\bar{\theta}$ achieve complete screening. The top panel in Figure 2 displays q^* for this situation. The next case is that of $\delta\underline{V} < \bar{\theta} < \delta\overline{V}$, illustrated by the second panel. Here, only *partial revelation* of the type can be achieved. Wage offers between $\delta\underline{V}$ and $\bar{\theta}$ reveal the type of the agent only partiallybecause some low-type agents remain unemployed for *strategic* reasons. Finally, if $\bar{\theta} \leq \delta\underline{V}$, *no revelation* of the type can be induced. All agents with a low reservation wage remain *strategically* unemployed if they receive an offer $w_1 < \bar{\theta}$. This is shown in the bottom panel of Figure 2.

The central parameter that discriminates the three cases is the disount factor δ, i.e. the more important the future, the more likely is strategic unemployment. This can be illustrated by reformulating the critical values of the standard, the partial revelation,

Figure 2: Probability of accepting a wage offer by the low type agent



and the no-revelation case:

$$\bar{\theta} > \delta\overline{V} \Leftrightarrow \delta < \left[1 - G\left(\bar{\theta}\right)\right]^{-1}, \tag{Standard Case}$$

$$\delta\overline{V} \leq \bar{\theta} < \delta\underline{V} \Leftrightarrow \left[1 - G\left(\bar{\theta}\right)\right]^{-1} \leq \delta < \left[1 - G\left(\frac{\bar{\theta}}{(1-p)}\right)\right]^{-1}, \tag{Partial Revelation}$$

$$\bar{\theta} < \delta\underline{V} \Leftrightarrow \delta > \left[1 - G\left(\frac{\bar{\theta}}{(1-p)}\right)\right]^{-1}. \tag{No Revelation}$$

Obviously, $\delta > 1$ is necessary for the partial or no revelation outcome. Accordingly, strategic unemployment becomes more significant when the future is relatively more important than the present (e.g. when period two represents a much longer period of time than period one).

Before we come back to this issue in the next section, we close the model by characterizing the wage-setting behavior of Principal 1. Like in the second period, the principal needs to compare the secure gain from offering $\bar{\theta}$ to the lottery from offering a wage $w_1 < \bar{\theta}$. Facing a low-type agent, it would be optimal for Principal 1 who has a project of value π_1 to offer

$$w_1^{+}\left(\pi_1\right) = \arg\max_{w_1 \geq 0} q^{*}\left(w_1\right)\left[\pi_1 - w_1\right].$$

He will meet a low-type with probability p, and therefore offers $w_1^{*}\left(\pi_1\right) = w_1^{+}\left(\pi_1\right)$ if

$$\begin{aligned} pq^{*}\left(w_1^{+}\left(\pi_1\right)\right)\left[\pi_1 - w_1^{+}\left(\pi_1\right)\right] &> \pi_1 - \bar{\theta} \Leftrightarrow \\ \pi_1\left(1 - pq^{*}\left(w_1^{+}\left(\pi_1\right)\right)\right) &> \bar{\theta} - w_1^{+}\left(\pi_1\right) pq^{*} \end{aligned} \tag{10}$$

Otherwise, he will offer the high reservation wage $w_1^{*}\left(\pi_1\right) = \bar{\theta}$.

2.5 Unemployment in Equilibrium

The second period represents a standard monopsony situation. The equilibrium belief determines Principal 2's degree of information about the agent's reservation wage. If he is fully informed, he can achieve perfect price discrimination and the monopsonistic market outcome is efficient. Some workers with a high reservation wage are unemployed

$$U_2 = (1-p)\,G\left(\bar{\theta}\right), \tag{11}$$

but this is voluntary unemployment. If the principal remains uninformed ($\mu = p$), he will offer a wage of $\underline{\theta}$ too often, leading to inefficiently high unemployment of high types

$$U_2 = (1-p)\,G\left(\bar{\pi}_2\right). \tag{12}$$

In the first period, also strategic unemployment of low types adds to the inefficient unemployment for monopsony reasons. Let $\bar{\pi}^*$ be the threshold value of revenues at which the firm the firm opts for $w_1^*(\pi) = \bar{\theta}$, i.e. $\bar{\pi}_1^* := \inf\left\{\pi | w_1^*(\pi) = \bar{\theta}\right\}$. Then we obtain

$$U_1 = p\int_0^{\bar{\pi}_1^*} \left[1 - q^*\left(w_1^*(\pi)\right)\right] dG(\pi) + (1-p)\,G\left(\bar{\pi}_1^*\right). \tag{13}$$

The first part of this sum reflects *strategic unemployment,* the latter monopsony induced unemployment. The monopsonistic firm can hire all agents at wage $\bar{\theta}$, or alternatively hire a low-type employee at $w_1^*(\pi)$. Since the latter option has lower value to the principal in the presence of strategic unemployment, we obtain

$$\bar{\pi}_1^* < \bar{\pi} = \frac{\bar{\theta}}{1-p}$$

for the threshold value. Accordingly, strategic unemployment *reduces* the ability of the principal to exert monopsony power. Consequently, non-strategic unemployment is reduced by the strategic behavior of the agent. However, the additional strategic unemployment may well outweigh this reduction. A particularly interesting case is the one of no revelation. In this case $\bar{\pi}_1^* = \bar{\theta}$ follows and equation (13) reduces to

$$U_1 = p\int_0^{\bar{\theta}} [1-0]\, dG(\pi) + (1-p)\,G\left(\bar{\theta}\right) = G\left(\bar{\theta}\right). \tag{14}$$

We can compare this expression to the expression (12) for monopsony unemployment easily.

Proposition 3 *If* $G(\bar{\theta}) > (1-p)\,G\left(\frac{\bar{\theta}}{1-p}\right)$*, then aggregate unemployment is larger in the no-revelation case than in a standard monopsony situation.*

Lemma 4 *If* G *is (strictly) concave, i.e. its density is (strictly) decreasing, then* $G(\bar{\theta}) \geq (>)\,(1-p)\,G\left(\frac{\bar{\theta}}{1-p}\right)$ *for any* p*. If* G *is (strictly) convex, the reverse inequality applies.*

Proof. *For a (strictly) concave function* G*, we obtain*

$$\begin{aligned}(1-p)G\left(\frac{\bar{\theta}}{1-p}\right) &= (1-p)G\left(\frac{\bar{\theta}}{1-p}\right) + pG(0) \\ &\leq (<)\;\; G\left((1-p)\frac{\bar{\theta}}{1-p} + p\cdot 0\right) = G(\bar{\theta})\,. \end{aligned} \tag{15}$$

■

However, looking just at the increase in unemployment from $(1-p)G\left(\frac{\bar{\theta}}{1-p}\right)$ to $G(\bar{\theta})$ will understate the welfare loss due to strategic unemployment. It is the most efficient matches that are destroyed by the strategic reasoning. Compared to the monopsony case, only fewer *and less efficient* matches are formed between high reservation wage workers and employers with projects of a value between $\bar{\pi}$ and $\bar{\theta}$. Thus, strategic unemployment may be substantially welfare harming and will be most prevalent in the no-revelation case.

3 Extensions and Discussion

3.1 Infinite Time Horizon

But why should the no-revelation case be particularly relevant? We have seen that $\delta > 1$ is necessary to establish this case. So far, we just argued informally that this assumption may reflect the future being a longer period than the present. One way to incorporate this would be a model with more than two periods. However, an exhaustive analysis quickly becomes much less tractable as the number of periods grows. Moreover and more importantly, it does not provide us with many additional general insights. Therefore, we skip presenting the full model extension to an infinite horizon. Instead, we concentrate on showing that the case of strategic unemployment without revelation of types requires a much weaker assumption on the discount factor within the extension to an infinite time horizon.

Let $\beta < 1$ be the discount factor for each period. Suppose unrevealed low-type agents never accept an offer below $\bar{\theta}$. Then principals will offer all agents $w = \bar{\theta}$ as long as revenues are sufficient. We will show that this constitutes an equilibrium. In this situation, a low-type agent that never reveals his type has an expected payoff of $\overline{V} = \bar{\theta}\left(1 - G\left(\bar{\theta}\right)\right)$ in each period. This gives him a discounted expected future payoff of

$$\Phi := \frac{\beta}{1-\beta}\left[\bar{\theta}\left(1 - G\left(\bar{\theta}\right)\right)\right].$$

On the other hand, once he has revealed his type, his future payoff is zero. This implies that not accepting, and hence not revealing the type, is the best response to any wage offer that fulfills $w_1 < \Phi$. Consequently, revelation can only be achieved if there exist wages between Φ and $\bar{\theta}$, i.e. the interval $\left[\Phi, \bar{\theta}\right]$ is non-empty. This, in turn, implies the following proposition.

Proposition 5 *In the infinite horizon case, there is no revelation of types in equilibrium if* $\beta > \frac{1}{2-G(\bar{\theta})}$.

Proof. *As argued, there is no revelation of types if the interval* $\left[\Phi, \bar{\theta}\right]$ *is empty. This means*

$$\frac{\beta}{1-\beta}\left[\bar{\theta}\left(1 - G\left(\bar{\theta}\right)\right)\right] > \bar{\theta} \Leftrightarrow \beta\left(1 - G\left(\bar{\theta}\right)\right) > 1 - \beta \Leftrightarrow \beta > \frac{1}{2 - G\left(\bar{\theta}\right)}.$$

■

If β is close to $1, \beta > \frac{1}{2-G(\bar{\theta})}$ is only a very loose restriction and *strategic unemployment* becomes a significant and constant equilibrium phenomenon in a model with an infinite horizon.

3.2 Vertical Integration, Firing Costs and Minimum Wages

If there is partial revelation at least, integration of both principals is a possibility to soften the strategic unemployment problem. Principal 1 then takes into account the effect his wage offer has on the knowledge of Principal 2 about the type of the agent. Then, the principal can strategically choose a wage that enables him to screen the agents.

However, in the no-revelation case even integration of the principals does not solve the screening problem. If $\delta \underline{V} > \bar{\theta}$, then no wage offer by Principal 1 will screen the agents' types. The low-type agent loses too much if he reveals his type. Revelation forces the principal to pay zero wage in the second period. This is the key to the no-revelation result. The principal cannot credibly commit to pay a wage above the low reservation wage in the second period, although he might wish to do so in the first period.

This lack of commitment can be healed by firing costs or a minimum wage (see Hart and Tirole, 1988). Suppose both principals vertically integrate and offer a two-period contract in period one. In period two, the principal may change the contract with the agent, but in case he does, he will have to pay a firing cost of c. Therefore, any offer for period two $w_2 \leq c$ is credible in period one.

Suppose the principal offers the same wage w for both periods. If $w < \bar{\theta}$, then the agent compares the expected income from working $(1+\delta)\, w$ with the information rent $\delta\Delta$ from not revealing his type. Consequently, the two-period wage offer changes inequality (5) to

$$(1+\delta)\, w > \delta\Delta \Leftrightarrow w > \frac{\delta}{1+\delta}\Delta.$$

As long as $w < c$, this offer is credible. The upper bound to the information rent is $\bar{\theta}$. This means that there are wage offers that fulfill

$$\bar{\theta} > w > \frac{\delta}{1+\delta}\bar{\theta} > \frac{\delta}{1+\delta}\Delta.$$

Consequently, if the firing costs c exceed $\frac{\delta}{1+\delta}\bar{\theta}$, screening is a possible option for the principal.

The extent to which the principal uses screening depends on two factors. One is the efficiency gain from perfect discrimination in period two. The other is the loss of monopsony power in period one by offering rents to the low-type agent. Say the principal finds it optimal to fully screen the agents. This means that no high-type agents are inefficiently unemployed in period two (there is perfect price discrimination). Compared to the situation with one-period contracts, strategic unemployment is reduced in period one. A smaller wage offer is required to induce the agent to reveal his type and accept to work. Hence, firing costs may lower unemployment overall.

Minimum wages have a similar effect, but additionally they reduce the monopsony power in the first period. Therefore, they also reduce the inefficient unemployment of high types due to monopsony power. However, unlike firing costs, the optimal minimum wage needs to be determined by a central authority.

4 Conclusion

We have proposed a model in which workers strategically choose to be unemployed in order to signal a high reservation wage. If they value the future much more than the present (e.g. because it is a longer period of time), this may lead to persistently high strategic unemployment as there is no revelation of reservation wages over time. In each period, agents with a low reservation wage reject to work for a low wage so as to not reveal their type and not be exploited in the future.

This may explain in particular, why the striking finding of the happiness literature that a disutility of work cannot be found is not at odds with the fact that few wage contracts are actually formed at the level of unemployment benefits. Low paid workers strategically opt for unemployment in order not to reveal their willingness to work.

The key element to our result is a lack of commitment power on behalf of the principals. They can neither commit to make once-and-for-all low wage offers, nor can they commit to not exploit the knowledge about the agents reservation wage in the future. Legal institutions, such as multi-period contracts combined with firing costs or a legal minimum wage, may help to mitigate this problem. They can lower the unemployment induced by the strategic interaction, but will not make it disappear completely.

Appendix

Unobserved rejected wage offers

So far, we have assumed that Principal 2 can observe the wage that Principal 1 offered to the agent in period one. For we have the lower segment of the labor market in mind, this is foremost plausible in case the agent accepted the offer. In this segment wages may typically be inferred from the naming of the job, e.g. because a wage table has been negotiated between employers and unions. As to the case of rejected offers, however, our assumption would require an intermediating institution keeping record of rejected wage offers by the agent (e.g. a state-run employment agency). In the following, we discuss the changes that would result from an alternative setup where the specific wage that has been rejected cannot be observed by Principal 2 (while rejection itself remains observable).

Following backward induction, we see that the acceptance decision of each type of agent to the wage offer by Principal 2 remains unaltered. By contrast, the formation of beliefs can no longer condition on rejected wages. From the perspective of Principal 2, the wage in period one w_1 now represents a censored variable. Let $\hat{w}_1$ denote the observed wage (where $\hat{w}_1 = 0$ indicates no observation). Principal 2 now forms his belief on the basis of $\hat{w}_1$. It is clear that all agents accept any wage offer above $\bar{\theta}$. Therefore, an observation of $\hat{w}_1 \geq \bar{\theta}$ reveals no information so that $\mu^* \left(\underline{\theta}|\hat{w}_1\right) = p$. On the other hand, an accepted wage offer $\hat{w}_1 < \bar{\theta}$ identifies the agent as being of low type, $\mu^* \left(\underline{\theta}|\hat{w}_1\right) = 1$. If the wage offer is rejected, inference becomes more complicated. Let $\Gamma(w_1)$ be the equilibrium distribution function of wage offers by Principal 1 conditional on $w_1 < \bar{\theta}$. The posterior belief of Principal 2 upon observing a rejection is the probability of observing a low type and a rejection divided by the overall probability of rejection. The former evaluates as $p \int \left(1 - q^* \left(w\right)\right) \Gamma' \left(w\right) dw$, the latter as $\int \left(1 - pq^* \left(w\right)\right) \Gamma' \left(w\right) dw$. Principal 2's belief thus reads

$$\mu^*\left(\underline{\theta}|\hat{w}_1\right) = \begin{cases} p & \text{if } \hat{w}_1 \geq \bar{\theta} \\ \frac{p\int(1-q^*(w))\Gamma'(w)dw}{\int(1-pq^*(w))\Gamma'(w)dw} & \text{if } \hat{w}_1 = 0 \\ 1 & \text{if } 0 < \hat{w}_1 < \bar{\theta} \end{cases}.$$

Observe that for all rejections the belief is a fixed number not depending on w_1. Denote this number by

$$\bar{\mu} = \frac{p\int\left(1-q^*\left(w\right)\right)\Gamma'\left(w\right)dw}{\int\left(1-pq^*\left(w\right)\right)\Gamma'\left(w\right)dw}.$$

The indifference condition (7) simplifies to

$$w_1 = \delta\bar{\theta}\left[1 - G\left(\frac{\bar{\theta}}{1-\bar{\mu}}\right)\right]. \tag{16}$$

Implicitly, this defines a threshold value $\bar{w}_1$ above which low-type agents always accept and below which they always reject. This means that

$$q^*(w_1) = \begin{cases} 0 & \text{if } w_1 < \bar{w}_1 \\ \in [0,1] & \text{if } w_1 = \bar{w}_1 \\ 1 & \text{if } w_1 > \bar{w}_1 \end{cases}.$$

Consequently, the integral defining $\bar{\mu}$ reduces to

$$\begin{aligned} \bar{\mu} &= \frac{p\Gamma\left(\bar{w}\right)}{\Gamma\left(\bar{w}\right)+\left(1-p\right)\left(1-\Gamma\left(\bar{w}\right)\right)} \\ &= \frac{p\Gamma\left(\bar{w}\right)}{1-p\left(1-\Gamma\left(\bar{w}\right)\right)}. \end{aligned} \tag{17}$$

Combining (16) and (17), we obtain

$$\begin{aligned} \bar{w} &\leq \delta\bar{\theta}\left[1-G\left(\frac{\bar{\theta}}{1-\frac{p\Gamma(\bar{w})}{1-p(1-\Gamma(\bar{w}))}}\right)\right] \\ &= \delta\bar{\theta}\left[1-G\left(\left[1-p-p\Gamma\left(\bar{w}\right)\right]\frac{\bar{\theta}}{1-p}\right)\right] \end{aligned}$$

as a combined equilibrium condition. In case there exists a $\bar{w}$ satisfying the above condition with equality, this pins down $\bar{w}$.

For the no-revelation case of the original model, $\delta > \left[1 - G\left(\frac{\bar{\theta}}{(1-p)}\right)\right]^{-1}$, there is no $\bar{w} < \bar{\theta}$ that fulfills the combined equilibrium condition. Hence, $\bar{w} = \bar{\theta}$.The partial-revelation and the standard case, $\delta < \left[1 - G\left(\frac{\bar{\theta}}{(1-p)}\right)\right]^{-1}$, imply that a $\bar{w} < \bar{\theta}$ exists meeting the equilibrium condition with equality.

Thus, for the model with unobserved rejected wage offers, strategic unemployment still is an equilibrium phenomenon. However, the solution of the model becomes much more complicated as we need to solve also for Γ in equilibrium. Put differently, we cannot determine an explicit equilibrium of the subgame conditional on the wage of Principal 1 without solving his problem of optimal wage offers.

References

[1] Clark, Andrew E. and Andrew. J. Oswald (1994): "Unhappiness and Unemployment", *Economic Journal*, Vol. 104, Issue 424, pp. 648-59.

[2] Frey, Bruno S. and Alois Stutzer (2002): "What Can Economists Learn From Happiness Research?", *Journal of Economic Literature*, Vol. 60, Issue 2, pp. 402-35.

[3] Hart, Oliver D. (1983): "Optimal Labour Contracts under Asymmetric Information: An Introduction", *Review of Economic Studies*, Vol. 50, Issue 1, pp. 3-35.

[4] Hart, Oliver D. and Jean Tirole (1988): "Contract Renegotiation and Coasian Dynamics", *Review of Economic Studies*, Vol. 55, Issue 4, pp. 509-40.

[5] Ma, Ching-to A. and Andrew M. Weiss (1993): "A Signaling Theory of Unemployment", *European Economic Review*, Vol. 37, Issue 1, pp. 135-57.

[6] Moore, John (1985): "Optimal Labour Contracts when Workers have a Variety of Privately Observed Reservation Wages", *Review of Economic Studies*, Vol. 52, Issue 1, pp. 37-67.

[7] Vincent, Daniel R. (1998): "Repeated Signalling Games and Dynamic Trading Relationships", *International Economic Review*, Vol. 39, Issue 2, pp. 402-35.

[8] Winkelmann, Liliana and Rainer Winkelmann (1998): "Why Are the Unemployed So Unhappy? Evidence from Panel Data", *Economica*, Vol. 65, Issue 257, pp. 1-15.