MONITORING AND WAGE INCENTIVES: CAPITULATION VS. EFFICIENCY WAGES

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Discussion Paper #70

December 1990

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Study of Economic Organization and Public Policy

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Princeton, New Jersey

The authors gratefully acknowledge support from the John M. Olin Program for the Study of Economic Organization and Public Policy at Princeton University.

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Abstract

This paper investigates the optimality of different wage regimes in an economy with monitoring problems. We investigate the robustness of the claim that efficiency wages are an optimal response to such problems. As well as paying reservation wages, firms have the option of paying capitulation wages which are below reservation wages. We show that this may be rational for firms in both partial and general equilibrium. In general equilibrium, the model may exhibit multiple equilibria in which more than one wage regime is sustainable. Moreover, the economy can be "stuck" in the wrong one, i.e. where welfare is lower. Hence, we consider optimal interventions to achieve the best outcome. This sometimes involves taxing the sector with monitoring problems.

Keywords: monitoring, wage incentives, efficiency wages

JEL Classification: 020, 820

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1. Introduction

Designing wage schemes in situations where monitoring is a problem is a central problem in economics and, not surprisingly therefore, has generated a large literature. Chief among the "solutions" suggested, when monitoring workers' on–the–job performance is costly, is to pay an efficiency wage to motivate workers.[1] The firm is then able to use the rents it creates in the job to enforce hard work. While ideally such rents can be recaptured by demanding that the worker post a bond[2] there are many well recognized difficulties involved in operating such a system.[3]

An alternative form of monitoring is at the point of entry to employment, finding some way of selecting only the most highly motivated workers to the firm, thus minimizing the need to undertake on–the–job monitoring. Clearly, if a means were available for distinguishing motivated workers at–the–door, rather than having to do so on–the–job, then efficiency wages would become redundant as an incentive device.

Typically firms use a combination of both kinds of monitoring. Workers are interviewed, references are sought and past achievements reviewed to ascertain whether an individual is likely to be motivated to work hard. How effective this will be depends upon the industry in question. For example, in the case of academics, past output is usually a reliable guide but for many other occupations, no reliable indicators are available. The technology in the industry will also determine how easy on–the–job monitoring is to undertake. For certain kinds of occupations the shirkers are easily identified. Hence for any given expenditure on monitoring we are likely to observe quite different rates of success between firms in catching those who put in low levels of effort.

This paper identifies a false dichotomy in earlier treatments of these issues. Even if it is difficult to distinguish the motivated in making the hiring decision – the case on which most of the efficiency wage literature has concentrated – it is still unclear whether the appropriate solution to the monitoring problem takes the form of either efficiency or reservation wages. The firm always has the option of paying a wage below the reservation wage and allowing shirkers to shirk. Output will be low but then so will be costs, since workers are paid less and monitoring can be reduced to a minimum. We describe such a situation as paying capitulation wages, since the firm has capitulated in its attempt to solve the monitoring problem which it faces.

We believe that there are good examples of capitulation wages in the real world. A prime example is that of public service jobs in many LDC's. These often involve lower salaries than corresponding private–sector jobs but a widely–perceived compensating opportunity for bribery. An infamous, but far from unique, case is that of Indonesia and Simanjuntak (1979)'s survey of Indonesian university graduates makes the perceptions that we have described very clear. In developed countries too, some jobs seem to have the property that pay is low with slack monitoring of behavior and widespread cheating by employees. This results in fewer people who wish to put in high effort entering the sector. In their extensive study of American worker "deviance"[4], Hollinger and Clark (1983) find that "deviance" is concentrated in jobs with low worker satisfaction (p.85) combined with high opportunities for pilferage and shirking (p.72–77). Key to the decision to shirk is the perception that the company is giving less than the normal benefits to workers:

> Many younger employees expressed that they experienced no remorse or guilt for their deviance because they perceived their work situation as a mutually exploitive one. The company was seen as "ripping them off" and they were simply responding in kind (p.143).

This has long been regarded as a sociological explanation of shirking[5], but here we formalize an economic model which can be described in the same terms: there are equilibria in which a firm (optimally) pays less than the worker's opportunity wage, and the worker (optimally) accepts it and shirks.

The aim of this paper is to formalize some of the ideas discussed so far in the context of a simple model and thus to illuminate the conditions under which different wage regimes are likely to be observed. We show, for a partial equilibrium model, that efficiency wages make sense precisely when at–the–door monitoring is poor while on–the–job monitoring is good. Otherwise, the firm is better off paying either reservation or capitulation wages. The key to our analysis is the development of a simple diagram which shows the different wage regimes as a function of the efficiency of the two types of monitoring that we have discussed.

In a simple two sector general equilibrium model, matters are more complex. It is harder to determine when any wage will be offered. We find a set of overlapping conditions so that the model displays multiple equilibria in the following sense: at any given set of relative prices, it may be rational to pay a particular wage provided that all other firms are doing the same. This, however, can be true for more than one wage regime simultaneously. Under some conditions, these equilibria can be ranked in welfare terms. We thus offer another example of a macro economic "coordination failure" (Cooper and John (1988), Summers (1987)) in which government may simply have a role in switching the economy from a worse equilibrium to a better one.

The remainder of the paper is organized as follows. In the next section, we set out the model. Section 3 presents the comparisons between the wage regimes on grounds of profitability. Section 4 discusses some of the general equilibrium implications of the analysis, while section 5 concludes.

2. The Model

The model that we use is standard. Firms hire infinitely lived workers to perform a productive task. Workers are of two types. The first group are highly motivated: they always work hard because they prefer to feel productive. The second group are poorly motivated and will shirk when it is in their interest to do so. The utility of a highly motivated worker is just w, his wage, while that of an unmotivated worker is w+e if he shirks and w if he puts in the effort required to produce high output. Hence e represents the utility of shirking. Either worker produces $(a+\Delta)$ when working hard and (a) units if shirking.

We assume that a fraction γ of the workers hired by a firm are poorly motivated. This may reflect the fractions of such workers in the population as well as the quality of monitoring at the point of hire. Each period, a fraction of the work force is monitored and those found to have produced low output are dismissed. Let the probability per period of a shirker being caught in this way be (1−q).

There are three possible wages that might be rational for a firm to offer. The first is the lowest wage at which all workers would be willing to come work for the firm. We will call this the *reservation* wage. The second is the lowest wage at which the firm could know that all of its employees were working hard. We will call this the *efficiency* wage. Finally, there is the lowest wage at which anyone at all will show up to work. We call this the *capitulation* wage because it represents an abandonment of any attempt to conquer the moral hazard or adverse selection problems.

We determine the efficiency wage in the standard way[6]. Let V^P denote the value of lifetime earnings in the reservation occupation where the worker earns a wage of ω and has discount rate ρ, that is

(2.1) $$V^P = \omega(1+\rho)/\rho.$$

As well as being dismissed for having low productivity, we shall suppose that there is a probability δ of being dismissed for other reasons each period. The worker discovers whether or not he is to be continued at the beginning of the period. If he is, then he receives his wage, getting the reservation wage of ω otherwise. Production then occurs with a poorly motivated individual choosing whether or not to shirk, for which he will be caught and dismissed with probability (1−q) to earn ω beginning in the following period. Hence, the value of a lifetime of shirking is

$$(2.2)\quad V^S = (1-\delta)(w+e) + \delta\omega + (1-\delta)q\frac{V^S}{1+\rho} + \{1-(1-\delta)q\}\frac{V^P}{1+\rho}.$$

which yields

$$(2.3)\quad V^S = \frac{1+\rho}{1+\rho-(1-\delta)q}\left[(1-\delta)(w + e) + \delta\omega + [1-(1-\delta)q]\frac{\omega}{\rho}\right].$$

In similar fashion, we can find the value of a life for a poorly motivated individual who puts in higher effort

$$(2.4)\qquad V^E = (1-\delta)w + \delta\omega + (1-\delta)V^E/(1+\rho) + \delta V^P/(1+\rho)$$

which, when solved, yields:

$$(2.5)\qquad V^E = \frac{1+\rho}{\rho+\delta}\left[(1-\delta)w + \delta\frac{1+\rho}{\rho}\omega\right].$$

Since the problem faced by a worker is identical when viewed from any point in time the decision of whether or not to a shirk is once and for all, i.e., depends upon whether V^S is bigger than V^E. The efficiency wage equates these two and hence results in the poorly motivated individuals putting in effort. This yields a wage of:

$$(2.6)\qquad w = \omega + e\frac{(\rho+\delta)}{(1-\delta)(1-q)}.$$

As expected this exceeds ω. A rise in the discount rate also increases efficiency wages – it is more expensive to deter shirking of more impatient individuals. Similarly an increase in the turnover parameter δ increases the efficiency wage. The slacker is monitoring, the more costly are efficiency wages for quite natural reasons. Indeed as q tends to one, there is no finite wage which can deter the poorly motivated workers from shirking.

The revenues of a firm that hires N workers at efficiency wages and receives a price of p are given by

$$R_t = pN\{a + \Delta\}. \tag{2.7}$$

These are constant through time and result in discounted profits under efficiency wages of

$$\Pi_{ew} = \left[p(a + \Delta) - \omega - e\frac{(\rho+\delta)}{(1-\delta)(1-q)}\right] N\frac{1+\rho}{\rho}. \tag{2.8}$$

Paying efficiency wages "locks in" the fractions of well and poorly motivated workers since nobody is actually caught shirking and dismissed in equilibrium. If the firm chose to pay a wage of ω, this would not be true and each period would see a reduction in the number of poorly motivated individuals employed by the firm. Hence, to consider the effects of paying reservation wages, we need to model how the composition of the labor force varies over time. Let H_t and L_t denote the numbers of well and poorly motivated individuals respectively. The turnover of the workforce at time t is given by the sum of fires of both types of workers:

$$[1-(1-\delta)q]L_t + \delta H_t = \delta N + (1-\delta)(1-q)L_t, \tag{2.9}$$

where N denotes the size of the workforce. Individuals who are dismissed are assumed to be replaced in a fashion such that a fraction γ of new hires is poorly motivated. However, since this is smaller than the number of poorly motivated who are fired, the stock of poorly motivated workers is declining – following the difference equation:

$$L_{t+1} - L_t = \gamma\delta N - (1-\gamma)(1-q)(1-\delta)L_t. \tag{2.10}$$

This stock decreases over time to attain a steady state value of

$$(2.11) \qquad \bar{L} = \gamma\delta N/(1-\kappa(1-\delta))$$

where $\kappa \equiv (1-(1-\gamma)(1-q))$. It is clear that $\bar{L} < L_0 = \gamma N$ as expected. Equation (2.10) can be solved to yield

$$(2.12) \qquad L_t = \gamma N\frac{(\delta+(\kappa(1-\delta))^t(1-\kappa)(1-\delta))}{(1-\kappa(1-\delta))} \qquad \text{for } t = 0,1,2,...$$

Our next task is to calculate gross revenues to the firm in any period. A firm employing N workers and obtaining p for its product (both assumed to be time invariant) receives gross revenues of

$$(2.13) \qquad R_t = p\{Na + H_t\Delta\} = pN\{a + \left[1 - \gamma\frac{(\delta+(\kappa(1-\delta))^t(1-\kappa)(1-\delta))}{(1-\kappa(1-\delta))}\right]\Delta\}.$$

Since H_t is increasing through time, R_t will be increasing. The present value of gross revenues is

$$(2.14) \qquad \frac{1+\rho}{\rho}pN\{a + \left[1 - \gamma\frac{\delta(1-\kappa(1-\delta)+\rho) + \rho(1-\delta)(1-\kappa)}{(1-\kappa(1-\delta)+\rho)(1-\kappa(1-\delta))}\right]\Delta\}.$$

To obtain net revenues (Π_{rw}) we must deduct the per period wage bill of $N\omega$. Hence, we obtain

$$(2.15) \qquad \Pi_{rw} = \frac{1+\rho}{\rho}N\left[p\{a + \left[1 - \gamma\frac{\delta + \rho}{1-\kappa(1-\delta)+\rho}\right]\Delta\} - \omega\right].$$

Note that this yields the same present value as would be the case if a constant fraction

$\phi \equiv \gamma(\delta+\rho)/(1+\rho-\kappa(1-\delta))$ of the workers were poorly motivated for all time. The decline in L_t through time ensures that ϕ is less than γ, and thus a decrease in ϕ can be thought of as an increase in the *ex post* selection advantage of paying reservation wages. It is straightforward to verify that ϕ is increasing in δ – less random turnover is better for *ex post* selection. It is also increasing in q and ρ. Hence, a smaller probability of being caught implies a smaller advantage through *ex post* selection, as does an increase in the discount rate – the latter because these gains accrue through time and a higher discount rate implies greater impatience.

Our third wage regime occurs when the firm sets wages below the reservation wage and so resigns itself to obtaining only poorly motivated workers who may still prefer taking a job in the sector since at reservation wages they would earn a premium of e. There is now no point in trying to weed out the poorly motivated individuals and hence $q = 1$ optimally[7]. The firm will now find it worthwhile to pay a wage that extracts all of the surplus from the poorly motivated individuals. It is this which we call the capitulation wage and it is straightforward to see that, in the present model, it is equal to

$$w = \omega - e. \tag{2.16}$$

The firm now obtains profits equal to

$$\Pi_{cw} = \frac{1+\rho}{\rho} N\left[pa - \omega + e\right]. \tag{2.17}$$

Whether capitulation wages are ever profitable will depend upon the configuration of the three key parameters in the economy. For high enough a and e the firm will always find it worthwhile producing with capitulation wages. Note that we have not ruled out $\omega - e < 0$. In this case the firm is actually able to sell its jobs. This is not completely fanciful to anyone who has observed the kinds of networks which exist to obtain certain modern sector (especially public sector) jobs in LDC's. Some of the e may there represent gains from bribery incomes.

3. Partial Equilibrium Comparisons Between Wage Regimes

In this section we develop comparisons between the three wage regimes that we have identified. The key to our analysis is a simple diagram (Figure 1) which partitions the parameter space into three parts showing when each of the three wage regimes yields greatest profits to the firm. To construct this, we begin by considering the three decision loci which give values of q and γ for which a firm would be indifferent between any two of the wage regimes on grounds of profitability. Comparing (2.15) and (2.17), it is straightforward to check that reservation and capitulation wages yield the same profits if and only if

$$(3.1) \qquad \gamma = \frac{(\rho + \delta + (1-\delta)(1-q))[(1-\mu)/\mu]}{(\rho + \delta + (1-\delta)(1-q)[(1-\mu)/\mu])},$$

where $\mu \equiv p\Delta/e$ is the (value of output)/(effort) ratio. We assume that $\mu > 1$ since otherwise it will never make sense to make workers put in the higher effort and the choice reduces simply to one of reservation versus capitulation wages. It is easy to check that γ is a decreasing, convex function of q. It is illustrated as the curve XX in Figure 1. In the case of reservation versus efficiency wages, comparison of (2.8) and (2.15) gives a locus with a critical value

$$(3.2) \qquad \gamma = \frac{[\rho + \delta + (1-q)(1-\delta)]}{(1-q)(1-\delta)[1+\mu]}.$$

This defines γ as an increasing, concave function of q which is labelled as YY in Figure 1. Finally, consider the choice between efficiency and capitulation wages (by comparing (2.8) and (2.17)). In this instance, it is easy to see that there is a critical value of q (which is independent of γ) and given by

(3.3) $$q = \frac{(\mu-1)(1-\delta) - (\rho+\delta)}{(\mu-1)(1-\delta)} < 1.$$

This is the horizontal line ZZ in Figure 1. Note that capitulation wages always dominate efficiency wages at the top of the box, since Π_{ew} tends to minus infinity as q tends to one. This is just another way of saying that, for sufficiently weak monitoring, it just is not feasible to deter bribery through the wage, whereas capitulation is always feasible. With these schedules in place, we can characterize the parameter values in which each of the wage strategies is optimal. They are labelled as RW, EW and CW, standing for reservation, efficiency and capitulation wages, respectively.

These loci thus give a picture of three wage regimes and cast light on when we might expect to observe any of them. Reservation wages make sense when γ is low, that is when it is relatively easy to recruit highly motivated individuals from the pool of applicants. This is true for all levels of on the job monitoring. Both capitulation and efficiency wages come into play when it is difficult to recruit those who are going to put in high effort regardless of payment – the highly motivated. The choice between these two options depends however on the capacity for on–the–job monitoring. Efficiency wages only make sense when this capacity is relatively good whereas capitulation makes sense when on the job monitoring is difficult. The latter could be true either because the firm's technology makes it difficult to tell who has shirked or because it is difficult to recruit and/or motivate supervisors. This seems to fit with the idea that low paid, easy going jobs will be accompanied by relatively small amounts of monitoring.

The division between the CW and EW regimes also depends upon Δ. Efficiency wages are naturally preferred in situations where the gains from having workers putting in high effort are greatest. Note that previous contributions to the literature (e.g., Shapiro and Stiglitz (1984), Bulow and Summers (1986)) have assumed, in effect, that a=0 and

γ=1, so that efficiency wages are bound to be optimal. We have shown in this section that relaxing those assumptions gives a dramatically different result: there are three possible optima, one of which actually involves a wage *below* the opportunity wage.

4. General Equilibrium Implications

This section considers some of the general equilibrium implications of our model. Thus we will investigate the simultaneous wage decisions of a large number of perfectly competitive firms. We consider these decisions in a model with two sectors only one of which suffers from a monitoring problem. Matters quickly become complex and for simplicity's sake we concentrate on the choice between paying capitulation and efficiency wages. There are three main interesting results in this regard. First, for certain parameter values both of these wage regimes may be sustainable in the sense that no firm would find it profitable to deviate from the wage strategy if all others adhered to it. In other words, the monitoring problem generates multiple equilibria. Second, welfare may sometimes be higher in a capitulation regime as compared to one where efficiency wages are paid. Third, it is sometimes optimal to subsidize the low wage sector in the economy, contrary to the analysis of others who have looked at government policy in economies with monitoring problems.

To demonstrate these points as simply as possible, we adopt a Ricardian model of an open economy with two sectors. Production in sector 1 is subject to monitoring problems as described above. Sector 2 has no such problem and has a marginal product of labor equal to ω. We assume that entry into both sectors is free, with labor being the only factor of production. Finally, we denote the price of good one by p, while good 2 is the numeraire. The most interesting case to investigate is that where $\omega \in [pa, p(a+\Delta)]$, so that in the absence of a monitoring problem, the economy would have a classical comparative advantage in good 1.

Labor can move freely between the two sectors. We adopt the following conventions regarding the timing of moves between sectors and the memory of firms. If a worker is dismissed or randomly dislocated from a sector 1 job, then she must locate in sector 2. Sector 1 firms do not know the history of workers and therefore hire out of the available pool in sector 2, at random. This being so, any sector 2 worker's probability of being hired into sector 1 in a given period is just the number of positions being filled divided by the number of people in sector 2. Firms are assumed to bid competitively for workers[8]. Applying Bertrand style logic, wages will rise to equal the expected marginal product of labor in each sector. As a result, firms will earn zero profits in equilibrium.

Since each worker faces a random possibility of returning to sector 1 after dismissal, the efficiency wage will be somewhat altered from that of the previous section. Assuming, for the moment, that all firms in sector 1 offer the efficiency wage then, letting V^1 be the value attained in a sector 1 job and V^2 be the corresponding value in a sector 2 job, we have $V^2 = \delta L^1/(N-L^1)\ V^1 + (1 - \delta L^1/(N-L^1))\ (\omega + V^2/(1+\rho))$. Thus

$$V^2 = (1+\rho)\delta L^1 V^1/(\rho L^2+\delta L^1) + (1+\rho)(L^2-\delta L^1)\omega/(\rho L^2+\delta L^1), \tag{4.1}$$

where L^1 is the number employed in sector 1 and N is the total population. If an unmotivated worker were to spend all of his time in sector 1 shirking, the value of a sector 1 job would be:

$$V^s = \delta V^2 + (1-\delta)[w+e + qV^s/(1+\rho) + (1-q)V^2/(1+\rho)], \tag{4.2}$$

while if he were to spend all of his sector 1 time working hard, the value of the job would be:

$$V^e = \delta V^2 + (1-\delta)[w + V^e/(1+\rho)]. \tag{4.3}$$

Setting $V^s = V^e$ and using (4.1) gives the following formula for the *general equilibrium efficiency wage*:

$$(4.4) \qquad w = \omega + e\frac{(\rho+\delta)}{(1-\delta)(1-q)} + \frac{(1+\rho)\,\delta L^1 e}{(1-q)(N-(1+\delta)L^1)}.$$

This differs from (2.6) on account of the final term which depends positively on L^1 – a smaller sized sector two reduces the "punishment" of being fired from sector 1 by reducing the average stay in sector 2. On account of this final term, the economy cannot specialize completely in the good in which it has a (Ricardian) comparative advantage, no matter how large that advantage is.[9]

The size of the workforce in sector 1 is determined by (Bertrand) competition between firms which forces profits to zero. In equilibrium, therefore, the efficiency wage must equal the marginal value product of sector 1 labor, $p(a+\Delta)$. This and (4.4), yield

$$(4.5) \qquad L^1 = \frac{[p(a+\Delta)-w_e](1-q)N}{(1+\rho)\delta e + [p(a+\Delta)-w_e](1-q)(1+\delta)} < N,$$

where $w_e \equiv \omega + e\frac{(\rho+\delta)}{(1-\delta)(1-q)}$.

But will a world in which all sector 1 firms offer efficiency wages sustain itself as a general equilibrium? We shall refer to a wage regime as ***sustainable*** if, given that all other firms are in that regime, it will not pay any firm on its own to deviate by paying another wage. It is easy to see that efficiency wages must always have this property since any lower wage (capitulation or reservation) would result in the firm getting no workers at all! Hence, we have

Proposition 1: Efficiency wages are sustainable in general equilibrium whenever they are profitable, i.e. whenever $p > p_e \equiv w_e/[a+\Delta]$.

Reservation wages are also more complicated to analyze in general equilibrium since it is not possible to assume that the firm has access to a large pool of workers of constant composition from which to draw replacements for its fired and dislocated workers, since the action of each firm firing its own shirkers sullies the pool from which all firms must draw for their replacements. It is possible to analyze this case in detail but in the interests of simplicity, we shall not do so. A more complete treatment of general equilibrium which includes reservation wages is however available from the authors[10].

Turning to capitulation wages, we find that if a sector 1 firm offers a wage which makes unmotivated workers willing to work in sector 1 while motivated workers prefer sector 2, the marginal value product of sector 1 workers, and thus the sector 1 wage, will be pa. Thus a worker will be willing to move to sector 1 only if $pa+e \geq \omega$. The equilibrium in this case will achieve complete separation with all of the motivated workers located in sector 2. Thus we have:

Proposition 2: Capitulation wages are sustainable as a general equilibrium against efficiency wages if and only if $p \in [(\omega-e)/a, p_c]$, where $p_c \equiv [1+(\delta+\rho)/(1-q)(1-\delta)]e/\Delta$.

Proof: See Appendix.

This Proposition delineates a non-empty range of prices provided either that workers are sufficiently productive when they are not working hard, or the monitoring problems in the economy are severe enough. Formally, this is equivalent to either a or q being large enough. This result makes intuitive sense and it also concords with the partial equilibrium results on the choice between the two regimes. The idea behind it is simple. If the price of sector one output is too low, then capitulation wages will not break even. However, since profits for a firm deviating by paying efficiency wages are increasing in p, even though the price increase pushes up labor costs to restore zero capitulation wage profits, a firm will find it worthwhile to switch unilaterally to paying efficiency wages if the price of sector one output is too high, i.e. exceeds p_c.

The reader will have noted that the sustainability conditions given in these two propositions are not mutually exclusive. It is possible to have values of p for which both types of outcome are general equilibria. In fact we can obtain an even stronger result:

Proposition 3: There is a range of prices for which *both* capitulation and efficiency wages are sustainable in general equilibrium if $p_c > (\omega - e)/a$.

Proof: See Appendix.

This result provides a link between the literature on wages when monitoring is imperfect with that on multiple macro economic equilibria. Multiple equilibria have previously been generated by search costs (Stiglitz (1985)), monopolistic competition and increasing returns (Kiyotaki (1988)) and a variety of other mechanisms, tied together analytically in Cooper and John (1988). Here, we have shown that moral hazard in the labor market may be added to this list. This possibility would have been expanded farther had we also considered reservation wages.

Our main interest in this result stems from the possibility that the economy can settle into a socially inefficient general equilibrium, where the wage is either too high or too low. Our next task, therefore, is to investigate this possibility. Welfare will be higher if and only if the sum of workers' incomes and profits, together with the utility from shirking, is greater. It is straightforward to write welfare down in each of the two cases that we are considering:

Efficiency Wages: $N\omega + L_1^e\{p(a + \Delta) - \omega\}$, where L_1^e is as given in (4.5).

Capitulation Wages: $(1-\gamma)N\omega + \gamma Npa + \gamma eN$

Making use of these, efficiency wages will be socially preferred to capitulation wages if and only if

$$(4.6) \qquad (L_e^1/N)[p(a+\Delta)-\omega] - \gamma[pa-(\omega-e)] > 0.$$

If γ is small, this clearly holds since welfare under efficiency wages does not depend on γ while under capitulation wages it is increasing in γ (provided that $p>(\omega-e)/a$). If L_e^1 is small the converse will be true. Intuitively, this could happen because the monitoring problem is so severe that the probability of being rehired into sector 1 after being dismissed for shirking must be very low to enforce hard work in that sector. Formally, this can be seen by noting (using (4.5)) that $\partial L_e^1/\partial q < 0$. Thus capitulation wages are socially preferable when monitoring techniques in sector 1 are poor, i.e., q and γ are high. Finally, efficiency wages are more likely to be preferred when Δ is high, i.e., the value of having workers put in the high effort level is very great. This also makes sense intuitively.

Our final task is to consider corrective government interventions when the economy is "stuck" in a socially inefficient equilibrium. An obvious policy is imposing a tax or a subsidy on sector 1. There are two different functions which this could serve. The first, studied in Bulow and Summers (1986), is to improve on the resource allocation under efficiency wages. A subsidy to sector 1 will be welfare–improving under efficiency wages because labor will be drawn into the high productivity sector.

The second function for fiscal policy is quite different. A tax or subsidy can be used to switch the economy from one wage regime to another. Suppose, for example, that the economy is "stuck" in a capitulation wage regime. Then, a subsidy to sector 1 which raises the producer's price above p_c will bring about a welfare–improving regime switch. Similarly, if the economy is "stuck" in an efficiency wage regime and $(\omega-e)/\Delta < p_e$, then a tax on sector 1 which puts the producer price between $(\omega-e)/\Delta$ and p_e will switch the economy to a capitulation wage regime.

There are two further practical issues worth noting about the role of tax/subsidy policies in our model. First, it may not always be possible to achieve a desired regime switch. For example, if $(\omega - e)/\Delta > p_e$ then in the process of lowering the price so as to make paying efficiency wages unprofitable, one also makes capitulation wages unprofitable. In that case, the problem is just like the other cases of coordination failure that have been studied and the government might try a variety of signaling mechanisms to draw the economy towards the better equilibrium. Second, the simple rule of thumb that emerged in the earlier literature, that it is optimal to subsidize the high wage industry, may turn out to be incorrect. To see this, suppose that in the absence of government intervention, the economy settled into a welfare–inferior capitulation wage equilibrium. Then the optimal fiscal policy would be to subsidize sector 1 in order to switch regimes and then to improve resource allocation within the new regime. But before government intervention, this sector would be the *low–wage* sector. Thus, in picking "winners" the government would have to be more sophisticated than in earlier models that did not allow for capitulation wages.

V. Concluding Remarks.

This paper has considered the determinants of different wage regimes in an economy with monitoring problems. We have reviewed this issue in both partial and general equilibrium settings. In partial equilibrium, things are relatively straightforward. The parameter space can be carved up to indicate which wage regimes are sustainable. In general equilibrium things are less clear cut and more than one type of wage regime may be sustained at any given set of parameter values. Moreover, a sustainable wage regime may not be the appropriate one from the perspective of economic efficiency.

The paper has also introduced a wage regime which inverts the notion that firms should pay a high wage when there is a monitoring problem. We labelled this a capitulation wage regime, since the firm has capitulated in its attempt to solve monitoring difficulties. This regime is sustainable in general equilibrium and may sometimes be socially preferable to paying efficiency wages. In the latter case, a tax on the sector with monitoring problems may sometimes enhance economic efficiency.

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Appendix

Proof of Proposition 2: If a firm were to deviate to paying efficiency wages, then profits per worker would be $p[a+\Delta]-\{pa+e+(\delta+\rho)e/(1-q)(1-\delta)\}$ each period, since the opportunity cost for an unmotivated worker is not ω but $pa+e$[11,12]. This is unprofitable if $p\Delta \leq [1+(\delta+\rho)/(1-q)(1-\delta)]e$. For capitulation wages to be profitable, we require that $p > (\omega-e)/\Delta$. The result now follows after noting the definition of p_c. □

Proof of Proposition 3: The result follows if $p_c > p_e$ and $p_c > (\omega-e)/\Delta$. Let $\pi \equiv (\rho+\delta)/(1-q)(1-\delta)$. Then $p_e > (\omega-e)/\Delta$ if $e[a\pi+(a+\Delta)] > \Delta\omega$ and $p_c > (\omega-e)/\Delta$ if $e[a+\Delta+\pi a] > \Delta\omega$ which are the same condition. Hence we have an interval of prices with multiple equilibria if $p_c > p \geq \max[p_e,(\omega-e)/\Delta]$ and the result follows. □

End Notes

[1]See, inter alia, Calvo and Wellicz (1979), Shapiro and Stiglitz (1984) and Bulow and Summers (1986).

[2]Suggested by Carmicheal (1985) and Becker and Stigler (1974).

[3]These are discussed by Dickens *et. al.* (1989) and further analyzed by Malcomson and Macleod (1988). The latter formally capture the idea that the firm may cheat by dismissing the worker in order to capture the bond. They show that the bond serves a purely redistributive purpose when this is the case.

[4]They define this to include theft on the job, "slow and sloppy workmanship, sick–leave abuse, long coffee breaks", etc. (p.141).

[5]See, for example, the discussion in Hollinger and Clark (1983) and the extensive list of references on page 86.

[6]See, for example, Shapiro and Stiglitz (1984).

[7]Throughout the paper we shall actually hold q fixed. This is somewhat unrealistic. However, it does mean that we shall understate the advantages of paying capitulation wages since we shall not be capturing the reduced costs through reduced monitoring. Holding q fixed serves to make the analysis much less cumbersome and does not distort the results in any direction which cannot be easily understood.

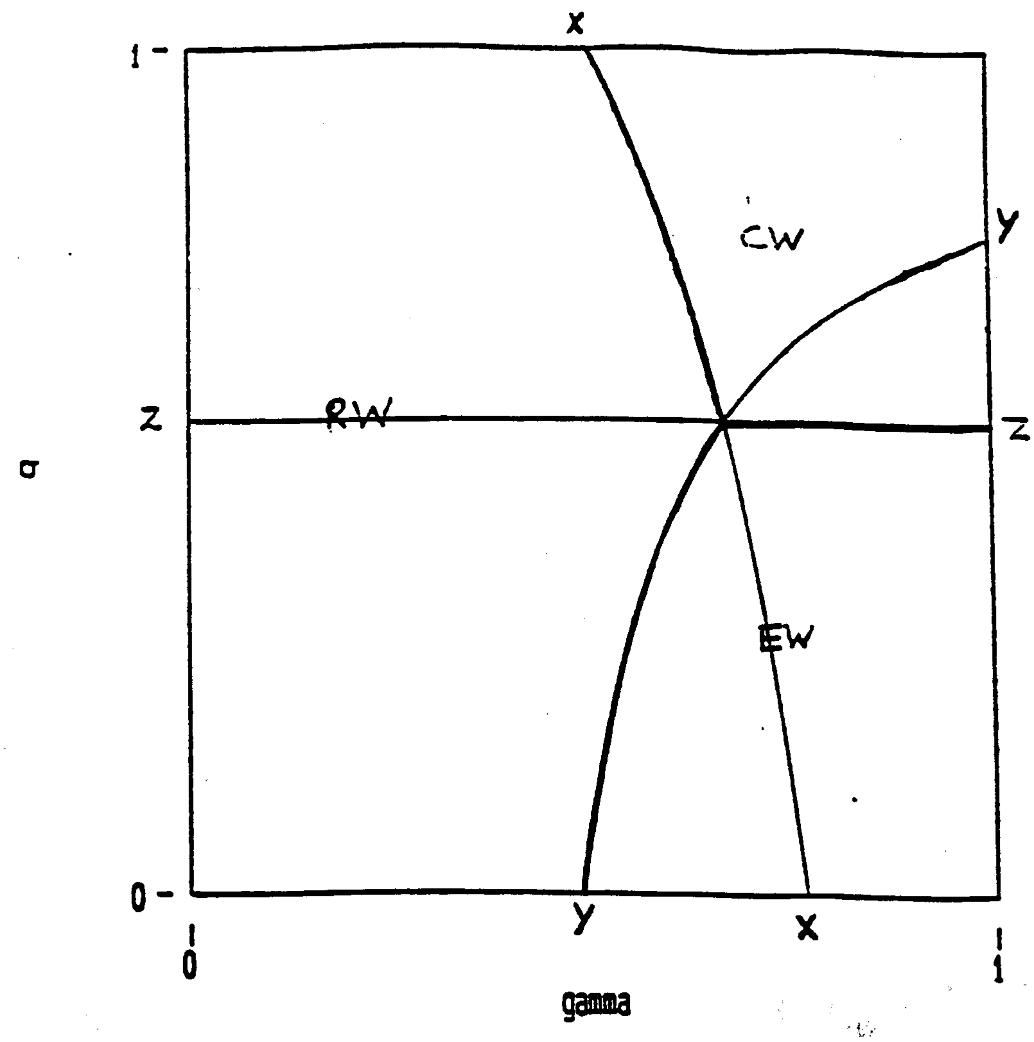
[8]There are no search costs in the model. Thus, if two firms offer different wages, one will receive no applicants. It would be interesting to calculate equilibrium wage distributions under search as in Stiglitz (1985), but it would also hugely complicate the analysis.

[9]This is because the efficiency wage becomes infinite as L^1 tends to $N/(1+\delta) < N$.

[10]Neglecting reservation wages does affect the following results in certain ways. While, as we show below, capitulation wages can be socially preferred to efficiency wages, they are never socially preferable to reservation wages.

[11]A poorly motivated worker who finds himself in sector 2 can be hired immediately back into sector 1 because there no rationing of sector 1 jobs in this equilibrium. Thus, such a worker would never have to settle for a wage of ω.

[12]Note that in this equilibrium the opportunity cost of a low–type is pa+e while that of a high–type is ω which is lower. Thus, contrary to the usual assumption (see, e.g., Weiss(1981)), the less desirable worker actually has more favorable alternatives than the more desirable worker, and this feature is an endogenous fact of general equilibrium. The reader can verify that in the two other types of general equilibrium the opportunity costs of the two types are equal.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