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Efficiency Wage, Commitment and Hysteresis

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ABSTRACT. – The efficiency wage model is usually thought of as a plausible model of the natural rate of unemployment which has little to say about its dynamics. This paper establishes that if firms pay efficiency wages and have some degree of commitment over their employment policy, then employment dynamics exhibit hysteresis. The implied behaviour of unemployment, however, is more similar to the one genrated by a firing costs model rather than the insider/outsider model. Hence the model does not exhibit as much persistence as the insider/outsider model.

Salaire d'Efficience, Engagement et Hystérésis

RÉSUMÉ. – Le modèle de salaire d'efficience est généralement considéré comme un modèle plausible du taux naturel de chômage, mais qui a peu à dire sur sa dynamique. Cet article montre que si les entreprises peuvent s'engager sur leur politique d'emploi future, alors la dynamique de l'emploi exhibe des propriétés d'hystérésis.

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1 Introduction

One of the criteria that one can use to assess the value of a theory of unemployment is its ability to explain its observed *persistence*. For example, LINDBECK and SNOWER [1990] claim that the insider/outsider model is superior to the efficiency wage model because the former can explain unemployment persistence (see, for example, BLANCHARD and SUMMERS [1986]), while the latter cannot. The purpose of this paper is to demonstrate that this statement is somewhat exaggerated, because the efficiency wage model has the potential of generating unemployment persistence.

The main reason for this is the following: suppose a worker is paid an efficiency wage in order to prevent shirking. Then this worker will have more incentives to shirk if he expects to be fired in a downturn. This will make him relatively costly. Accordingly, if the firm can commit itself on an employment policy which reduces the probability that this worker will be fired, it will save money because it will have to pay this worker less. In this attempt to reduce this probability, the firm will necessarily adopt an employment policy such that employment has a tendency to stay where it is and does not react strongly to shocks, thereby implying persistence.

More precisely, we construct an efficiency wage model where if the firm can commit its employment policy, it will look identical to the one that would be obtained if there were linear firing costs, implying the existence of corridor effects and hysteresis. Furthermore, this "shadow firing cost" is proportional to the rent generated by the worker's incentive problem. If however the firm cannot commit, no persistence will arise, because once the shock has occured there is an incentive for the firm to renege on its commitment and set employment equal to the myopic optimum. Workers will recognise this, which will increase wages, and decrease profits relative to the commitment case.

In addition to that, the model provides some insights on where firing costs might come from: it can be shown that if the firm has to pay a severance payment to those workers who are fired without having shirked, then the outcome is the same as under commitment. Of course, there are other ways to achieve commitment: for example, some large firms (e.g, IBM) have a reputation not to fire in downturns.

The paper is divided into three sections: Section 1 sets up the model and derives the wage equation. Section 2 derives labour demand in the presence or the absence of commitment, and shows how hysteresis can arise in this model. Section 3 shows how the commitment solution can be achieved by establishing a severance payment equal to the "shadow firing cost".

1.1. The Model

The model is a stochastic extension of the shirking model of SHAPIRO and STIGLITZ [1984]. Time is continuous. Workers provide an unobservable effort, which can take the values 0 or e. If they shirk, they are detected with probability q per unit of time. We assume bonding is prohibited, so that dismissal is the highest cost a firm can impose on a worker to punish him. The possibility of bonding has been a long controversy, and we will ignore it; for a comprehensive study, see KATZ [1986]. In our model, efficiency wage is the only way to induce effort so that the employed will enjoy rents and involuntary unemployment will arise in equilibrium. MACLEOD and MALCOMSON [1989] have shown that under certain conditions, paying a bonus may improve over the allocation implied by efficiency wages. However, their assumptions are rather special because they work in the context of a discrete-time model where the base wage (but not the bonus) *has* to be paid *before* firing is decided. Here we have a continuous-time model where firing occurs immediately after shirking is detected. In the absence of bonding, the firm clearly cannot impose a higher penalty than the one associated with losing one's job [1]. This clearly implies, as long as monitoring is imperfect, that workers must enjoy *rents* over the unemployed. That is, the expected present discounted value of being employed has to be strictly higher than the present discounted value of being unemployed (since the value of being caught shirking *cannot* fall below the value of being unemployed, a consequence of the no-bonding assumption). The essence of our persistence result is the existence of this rent: a higher expected probability of being fired increases labor costs because higher wages must be paid to prevent the rent from falling in expected terms [2].

The economy consists of a continuum of identical firms subject to a common aggregate shock. The shock follows a Poisson process, so that at any given date firm i's revenue function is $\theta f\left(l_i\right)$, where l_i is its labour force. There is a constant probability λ per unit of time that θ changes, and we shall call such an event a "shock". In this case the new θ is drawn from a constant distribution with density $g\left(\theta\right)$. Hence when there is a shock, the new value of θ is independent from the past. The total mass of firms is equal to one, so that since all firms are identical, aggregate employment is always equal to employment in any given firm:

$$L = l_i = l$$

In the remainder of the text, we shall use L to denote either aggregate or individual employment, and use l for individual employment only when the distinction matters, *i.e.* when it is neccessary to distinguish between the variable that the firm can influence and the one it cannot. A worker's instantaneous utility is equal to the difference between the wage he perceives and his effort, *i.e.*:

$$u_t = w_t - e$$

if he works and:

$$u_t = w_t$$

1. In other words the distinction between bonuses and wages is irrelevant since both are lost immediately after the worker is caught shirking.
2. In the model developed below, we restrict ourselves to (Markov) wage policies that only depend on the current relevant state variables. One could consider more complex policies such as rising wage profiles, etc. However, as long as these policies have to meet the requirement that employed workers must earn rents, the argument about persistence is unchanged.

if he shirks. Workers and firms have the same discount rate r. We assume there are no quits, which greatly simplifies the computations and allows to highlight the phenomenon we are interested in (this assumption is discussed in the conclusion).

We look for the solution in the following form: we assume that at any given time t, employment L in all firms is a function of the current shock θ and of the value of employment $\tilde{L}$ which prevailed before the last change in θ.

$$L = L_0\,(\theta,\, \tilde{L})$$

In the remainder of the text, tildas will denote values which prevailed before the last shock and hats values which will prevail after the next shock.

There will be persistence if and only if $dL/d\tilde{L} > 0$. Since θ is drawn from a distribution which is independent from the past there is no reason a priori to expect persistence. Notice that we implicitly assume that employment only changes when there is a shock (this is proved in the appendix). We assume that the wage is equal to $w(\theta, L)$. Hence we specify it as depending directly on current employment. (This discrepancy is due to the fact that in this model, the wage is essentially a forward-looking variable, whereas employment will depend on past employment if the firm can commit.)

We now derive the no-shirking condition and characterise wage behaviour.

Let $V\,(\theta,\, L)$ (resp. $U\,(\theta,\, L)$) be the present discounted value of an employed (resp. unemployed) worker's utility stream when current employment is L and the current shock is θ. Then, since in equilibrium workers will not shirk, one has:

$$V\,(\theta,\, L) = (w\,(\theta,\, L) - e + \lambda V^*\,(L))/(r + \lambda) \tag{1}$$

Where $V^*\,(L)$ is an employed person's expected discounted utility conditional on having a shock. We assume that if the shock is such that part of the labour force is fired, then the probability of being fired is uniform across workers. One must have:

$$\begin{aligned} V^*\,(L) = \int_0^{\theta} \Bigg[& \frac{L - L_0\,(\hat{\theta},\, L)}{L}\, U\,(\hat{\theta},\, L_0\,(\hat{\theta},\, L)) \\ & + \frac{L_0\,(\hat{\theta},\, L)}{L}\, V\,(\hat{\theta},\, L_0\,(\hat{\theta},\, L)) \Bigg] g\,(\hat{\theta})\, d\hat{\theta} \\ & + \int_{\theta}^{+\infty} V\,(\hat{\theta},\, L_0\,(\hat{\theta},\, L))\, g\,(\hat{\theta})\, d\hat{\theta}. \end{aligned}$$

This equation simply says that if firing occurs, then the new value $\hat{\theta}$ must be less than the current value θ, and in this case the probability of becoming unemployed is equal to $(L - L_0\,(\hat{\theta},\, L))/L$, the number of people being fired divided by total employment, while the probability of being retained is $L_0\,(\hat{\theta},\, L)/L$. If $\hat{\theta}$ exceeds θ, then the worker is sure to be retained. Notice that although the current θ is used as a bound in the integral, this is just a convenient way to state that the integral is over the range of employment values which are lower than the current one, so that V^* does not in fact depend on θ but just on L.

This equation can be rewritten:

$$(2)\ V^*(L) = EV(\hat{\theta},\, L_0(\hat{\theta},\, L)) + \int_0^{\theta} \left[\frac{L - L_0(\hat{\theta},\, L)}{L} \left(U(\hat{\theta},\, L_0(\hat{\theta},\, L)) - V(\hat{\theta},\, L_0(\hat{\theta},\, L)) \right) \right] \times g(\hat{\theta})\, d\hat{\theta}$$

Where E is the expectations operator with respect to the random variable $\hat{\theta}$.

If the worker shirks, then his utility is:

$$(3) \qquad V_s(\theta,\, L) = \frac{w(\theta,\, L) + \lambda V^*(L) + qU(\theta,\, L)}{r + \lambda + q}$$

The no shirking condition will be satisfied if and only if $V(\theta,\, L) \geq V_s(\theta,\, L)$. Since in equilibrium the employed will enjoy rents, firms will always be able to attract workers and hence choose w such that this condition holds with equality. Plugging (1) and (3) into this yields:

$$(4) \qquad w(\theta,\, L) + \lambda V^*(L) = e(r + \lambda + q)/q + (r + \lambda)\, U(\theta,\, L)$$

implying that V and U must be linked through the following equation:

$$(5) \qquad V(\theta,\, L) = U(\theta,\, L) + e/q$$

The same equation holds in the stationary model of SHAPIRO and STIGLITZ.

Plugging (5) into (2) yields:

$$(6) \qquad V^*(L) = EV(\hat{\theta},\, L_0(\hat{\theta},\, L)) - \frac{e}{q} \int_0^{\theta} \frac{L - L_0(\hat{\theta},\, L)}{L}\, g(\hat{\theta})\, d\hat{\theta}$$

We now derive the expression for an unemployed person's utility. We assume that the unemployed are paid a constant compensation $\overline{w}$ per unit of time. Since there are no quits, their only chance to get a job is if there is a shock such that employment rises. Hence $U(\theta, L)$ is determined as follows:

$$(7) \qquad U(\theta,\, L) = (\overline{w} + \lambda U^*(L))/(r + \lambda)$$

Where $U^*(L)$ is an unemployed person's expected discounted utility conditional on having a shock. U^* can be written, in a fashion similar to V^*:

$$(8) \quad U^*(L) = EU(\hat{\theta},\, L_0(\hat{\theta},\, L)) + \int_{\theta}^{+\infty} \frac{L_0(\hat{\theta},\, L) - L}{N - L} \times \left(V(\hat{\theta},\, L_0(\hat{\theta},\, L)) - U(\hat{\theta},\, L_0(\hat{\theta},\, L)) \right) g(\hat{\theta})\, d\hat{\theta}$$
$$= EU(\hat{\theta},\, L_0(\hat{\theta},\, L)) + \frac{e}{q} \int_{\theta}^{+\infty} \frac{L_0(\hat{\theta},\, L) - L}{N - L}\, g(\hat{\theta})\, d\hat{\theta}$$

Where N is total labour force. It is now possible to eliminate V^* and U in equation (4) and to get an equation relating the wage to employment policy. For this, use (7) and (8) to express $EU\,(\hat{\theta},\ L_0\,(\hat{\theta},\ L))$ as a function of $U\,(\theta,\ L)$:

$$(9)\qquad EU\,(\hat{\theta},\ L_0\,(\hat{\theta},\ L)) = (r+\lambda)\,U\,(\theta,\ L)/\lambda - \overline{w}/\lambda - \frac{e}{q}\int_{\theta}^{+\infty}\frac{L_0\,(\hat{\theta},\ L)-L}{N-L}\,g\,(\hat{\theta})\,d\hat{\theta}$$

Then plug (5) then (9) into (6):

$$(10)\qquad V^*\,(L) = (r+\lambda)\,U\,(\theta,\ L)/\lambda - \overline{w}/\lambda - \frac{e}{q}\int_{\theta}^{+\infty}\frac{L_0\,(\hat{\theta},\ L)-L}{N-L}\,g\,(\hat{\theta})\,d\hat{\theta} + e/q - \frac{e}{q}\int_{0}^{\theta}\frac{L-L_0\,(\hat{\theta},\ L)}{L}\,g\,(\hat{\theta})\,d\hat{\theta}$$

Substituting (10) into (4) yields the *No Shirking Condition*:

$$(11)\qquad w = e\,(1+r/q) + \overline{w} + \frac{\lambda e}{q} \times \left[\int_{\theta}^{+\infty}\frac{L_0\,(\hat{\theta},\ L)-L}{N-L}\,g\,(\hat{\theta})\,d\hat{\theta} + \int_{0}^{\theta}\frac{L-L_0\,(\hat{\theta},\ L)}{L}\,g\,(\hat{\theta})\,d\hat{\theta}\right]$$

This equation is the one which drives all our results. It equates the current wage to the reservation wage ($\overline{w}+e$) plus a rent which is equal to the product of *e/q*, a measure of the ”seriousness” of the incentive problem, and the sum of three terms: the discount rate, the expected firing probability and the expected hiring probability. The higher the interest rate, the more heavily discounted the punishment for shirking. The higher the hiring probability, the less costly it is to become unemployed. The higher the firing probability, the less effective firing becomes as a punishment. We shall call the contribution of this last term the “firing premium”.

The firm cannot influence an unemployed’s hiring probability since it depends on *aggregate* variables. However, it can influence the firing probability since it only depends on its own decisions. Therefore, by choosing an employment policy which lowers this probability, it can save money by reducing the wage it must pay in order to deter shirking. The next section examines how this phenomenon leads to corridor effects and persistence.

2 Labor Demand Dynamics and Persistence

We now derive the firm's optimal labour demand when the wage is described by equation (11). We first study the case where the firm cannot commit its employment policy and then the case where it has some commitment. We first re-write equation (11) to highlight the difference between aggregate employment (that the firm cannot influence) and firm-level employment:

$$(12) \qquad \begin{aligned} w &= e\,(1 + r/q) + \overline{w} + + \frac{\lambda e}{q} \\ &\quad \times \left[\int_{\theta}^{+\infty} \frac{L_0\,(\hat{\theta},\, L) - L}{N - L}\, g\,(\hat{\theta})\, d\hat{\theta} \right. \\ &\qquad \left. + \int_0^{\theta} \left[\frac{l - l_1\,(\hat{\theta},\, l,\, L_0\,(\hat{\theta},\, L))}{l} \right] g\,(\hat{\theta})\, d\hat{\theta} \right] \\ &= w\,(L,\, l) \end{aligned}$$

Where l is individual employment which is always equal in equilibrium to aggregate employment. Here we have assumed that the individual firm determines its own employment level as a function $l = l_1(\theta,\, \tilde{l},\, L)$ of its own past employment and current aggregate employment (which intervenes through the part of the wage which the firm cannot influence). Of course in equilibrium one will have $l = L$ at all times and the aggregate employment function will be determined by the equation $L_0\,(\theta,\, L) = l_1\,(\theta,\, L,\, L_0\,(\theta,\, L))$ for all L.

The No Commitment Case [3]

In the no commitment case, the firm's optimal labour demand is derived using standard dynamic programming; let $P\,(\theta,\, L)$ be the firm's expected value of future discounted profits when the current shock is θ and aggregate employment is L. Then one has:

$$P\,(\theta,\, L) = \underset{l}{\text{Argmax}}\ \left([\theta F\,(l) - w\,(L,\, l)\, l] + \lambda\, E\, P\,(\hat{\theta},\, L_0\,(\hat{\theta},\, L))]\right)/(r + \lambda)$$

The solution to this optimisation problem gives the firm's employment rule $l_1\,(\theta,\, \tilde{l},\, L)$. It is clear that this optimisation problem is entirely forward

3. In Sections 2 and 3, we write the optimisation problem as if the firm were constrainted to maintain employment constant between two shocks. It is shown in the appendix that this constraint is actually not binding, and that relaxing it yields the same solution.

looking and hence the employment level $\tilde{l}$ which prevailed before the shock will have no influence on employment. The premium due to the possibility of being fired has already been paid and there is no incentive for the firm to alter it. Therefore $l_1\left(\theta,\, \tilde{l},\, L\right)$ depends only on θ and L. The optimal solution is just given by the first order conditions:

$$\theta F'\left(l\right) = w + l\partial w/\partial l$$

Which together with the equality $l = L$ and equation (12) determines the response of employment to shocks, which does not exhibit persistence.

The Commitment Case

We now assume that the firm can credibly set its employment response to the next shock before this shock has happened. Therefore, by reducing the probability of being fired in case of a shock, it can reduce the wage it has to pay *now*. This will, as we are going to see, generate hysteresis.

Suppose that current employment in the firm is l and that the firm determines now $\hat{l} = l_1\left(\hat{\theta},\, l,\, \hat{L}\right)$, *i.e.* what employment will be when there is a shock which changes θ into $\hat{\theta}$. Current employment l is now fixed by previous commitments. The firm will now maximise:

$$P\left(\theta, L, l\right) = \left[\theta F(l) - l w_0\left(L\right) - \frac{\lambda e}{q} l \int_0^{\theta} \left[\frac{l - l_1\left(\hat{\theta},\, l,\, L_0\left(\hat{\theta},\, L\right)\right)}{l}\right] g\left(\hat{\theta}\right) d\hat{\theta} \right.$$
$$\left. + \lambda E P\left(\hat{\theta},\, L_0\left(\hat{\theta},\, L\right),\, l_1\left(\hat{\theta},\, l,\, L_0\left(\hat{\theta},\, L\right)\right)\right)\right] / (r + \lambda)$$

Where $w_0\left(L\right) = e\left(1 + r/q\right) + \overline{w} + \dfrac{\lambda e}{q}\left[\displaystyle\int_{\theta}^{+\infty} \frac{L_0\left(\hat{\theta},\, L\right) - L}{N - L}\, g\left(\hat{\theta}\right) d\hat{\theta}\right]$

This maximisation is now with respect to $l_1\left(\theta,\, l,\, L_0\left(\hat{\theta},\, L\right)\right)$ for all values of $\hat{\theta}$. A solution to our problem is a couple of functions P and l_1 which satisfy the above maximisation program and the functional equation $L_0(\theta, \tilde{L}) = l_1(\theta, \tilde{L}, L_0(\theta, \tilde{L}))$ for all θ and $\tilde{L}$. The response of employment to shocks is then just given by the function L_0 and there will be persistence if $dL_0/d\tilde{L} \neq 0$.

As can be seen from this program, the first order conditions are different depending on whether $\hat{l}$ is less than, equal to or greater than l.

If $\hat{l} < l$, then the first order condition is:

$$e/q + \partial P/\partial l\left(\hat{\theta},\, \hat{L},\, \hat{l}\right) = 0$$

This will happen if and only if θ is less than θ_m, where θ_m is defined by $e/q + \partial P/\partial l\left(\theta_m,\, \hat{L},\, l\right) = 0$.

If $l\left(\hat{\theta},\, l\right) > l$, the F.O.C is:

$$\partial P/\partial l\left(\hat{\theta},\, \hat{L},\, \hat{l}\right) = 0$$

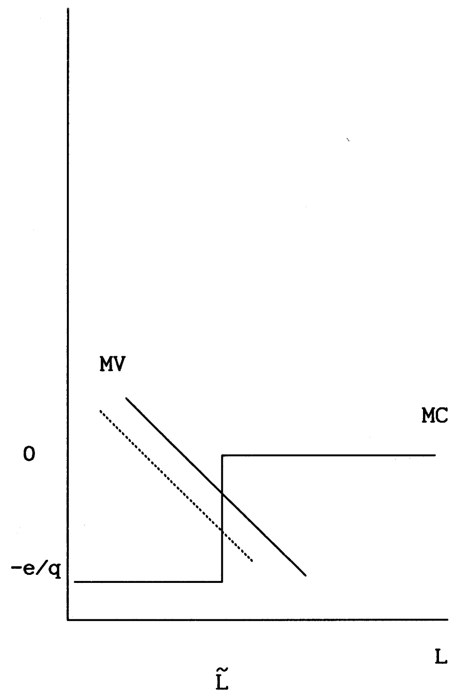

FIGURE 1

This will happen if and only if θ is more than θ_M, where θ_M is defined by $\partial P/\partial l\,(\theta_M,\ \hat{L},\ l) = 0$.

If $\hat{\theta}$ is between θ_m and θ_M, then $l_1\,(\hat{\theta},\ l,\ \hat{L}) = l$, and in this case $-e/q < \partial P/\partial l\,(\hat{\theta},\ \hat{L},\ l) < 0$.

Hence the optimal employment policy exhibits corridor effects exactly as if there was a firing cost equal to *e/q* per worker fired. This is because any additional firing in a given state of nature where firing occurs increases the "firing premium" part of the wage that the firm has to pay before a shock occurs. The dynamics of employment are thus very similar to the one obtained when there are linear adjustment costs (See for example BENTOLILA [1987]). Figure 1 shows how employment is determined in a given period: the MV locus depicts the marginal value of employment, $\partial P/\partial l\,(\theta,\ L,\ L)$, computed at $l = L$; the MC locus depicts the "marginal firing cost", *i.e.* $-e/q$ when employment goes down and 0 when it goes up. This schedule has a step at the level of employment $\tilde{L}$ which prevailed before the last shock. The current aggregate employment level is determined by the intersection of the two loci.

Clearly, as depicted in Figure 1, employment will not move in response to a small shock (*i.e.* a shock which maintains the marginal value of labour at $l = \tilde{l}$ between $-e/q$ and 0). Hence small shocks have no effect on employment.

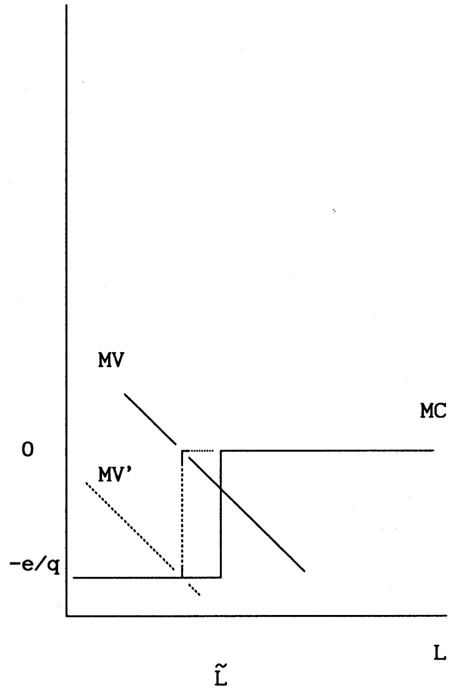

FIGURE 2

Consider now the effect of a big negative shock, illustrated in Figure 2. Suppose it lowers the marginal value of labour by enough to imply a decrease in employment. The MV locus shifts from MV to MV′. More importantly, the step in the MC locus which will be relevant when the next shock occurs shifts to the left. Suppose now that the shock is reversed so that the MV locus shifts back to its previous location. Then as can be seen from the picture employment does not go back to its previous value. This is because the relevant "maginal firing cost" is not the same when employment goes up as when it goes down. Hence big temporary shocks have permanent effects on employment.

3 Firing Costs as a Commitment Device

One can question the realism of the assumption that firms can exert some commitment ex-ante on their employment response to a shock. Several points can be made to alleviate this doubt.

First, it seems that some firms are successful in establishing a reputation of being reluctant to fire workers. IBM is a well-known example. This fact both indicates the relevance of the incentive effect of a greater job security and suggests that it is actually possible for a firm to commit.

Second, there exist several ways for firms to tie their hands and make it costly to fire workers. Choosing a technology with costly training and specific investment in human capital, for example, can be one way of doing so. Another possible way is to include in the labour contract a severance payment in case the worker is dismissed for a reason other than shirking. In this section, we show that the commitment outcome of the previous section can be exactly obtained if there is such a severance payment equal to e/q. To see this, notice that in such a case equation (1) is unchanged, whereas equation (2) becomes:

$$\text{(13)} \qquad V^*(L) = EV(\hat{\theta}, L_0(\hat{\theta}, L)) + \int_0^{\theta} \left[\frac{L - L_0(\hat{\theta}, L)}{L} (s + U(\hat{\theta}, L_0(\hat{\theta}, L)) - V(\hat{\theta}, L_0(\hat{\theta}, L)) \right] g(\hat{\theta})\, d\hat{\theta}$$

where s is the value of the severance payment. The analysis of the incentives to work is also unchanged, so that equations (3), (4) and (5) still hold. If $s = e/q$ then equation (13) becomes:

$$V^*(L) = EV(\hat{\theta}, L(\hat{\theta}, L))$$

so that the no shirking condition becomes:

$$\text{(14)} \quad w = e(1 + r/q) + \overline{w} + \frac{\lambda e}{q} \int_{\theta}^{+\infty} \frac{L_0(\hat{\theta}, L) - L}{N - L} g(\hat{\theta})\, d\hat{\theta} = w_0(L)$$

Hence the firing premium disappears. This is because the firm, using the severance payment, rebates the utility loss from losing one's job to the workers who are dismissed without having shirked. Hence it does not have to compensate them ex-ante by paying them a firing premium.

It can be seen quite simply that in the case where the firm pays a severance payment $s = e/q$ and the wage evolves according to equation (14), employment is identical to the one derived under commitment in the previous section. To see this, consider how employment is determined just after a shock. Let the present discounted value of profits *disregarding current severance payments* (but taking into acount future firing costs) be $Q(\theta, L, l)$, where L is current aggregate employment and l, the choice variable, current individual employment. Then clearly Q verifies the equation:

$$Q(\theta, L, l) = \left[\theta F(l) - l w_0(L) - \frac{\lambda e}{q} l \int_0^{\theta} \times \left[\frac{l - l_1(\hat{\theta}, l, L_0(\hat{\theta}, L))}{l} \right] g(\hat{\theta})\, d\hat{\theta} + \lambda EQ(\hat{\theta}, L_0(\hat{\theta}, L), l_1(\hat{\theta}, l, L_0(\hat{\theta}, L))) \right] / (r + \lambda)$$

Hence it follows exactly the same equation as P in the previous section. Furthermore, to determine Q in the current period, the firm maximises:

$$Q\,(\theta,\ L,\ l) - e/q\mathrm{Max}\,(\tilde{l} - l,\ 0).$$

Where $\tilde{l}$ is the level of employment which prevailed right before the shock. Hence the first-order conditions are exactly the same as in the commitment case of the previous section, with P being replaced by Q. Hence for any value function $P\,(\theta,\ L,\ l)$ and employment function l_1 which is solution to the previous section's problem, $Q = P$ and $l = l_1\,(\theta,\ \tilde{l},\ L)$ are a solution to this section's problem, yielding an identical behaviour of employment.

4 Conclusion

The main conclusion of this paper is that a great deal can be learned from extending the efficiency wage model to take dynamic phenomena into account. In particular, we have shown that provided the firm has some power of commitment over its employment policy, the shirking model can explain hysteresis in a fashion similar to linear adjustment costs. In addition to that, the model provide some insights as to where firing costs might come from: in order to achieve such commitment, it is in the interest of firms to embody severance payment provisions into labour contracts.

As in the case of linear adjustment costs, the amount of persistence that can be explained by such a model should not be overstated. First, a temporary shock has a persistent effect only until a new shock occurs. For instance, in the example of Figure 2, suppose that in the future there is an unusually large positive shock, so that employment will rise. Then if there is a shock now, its effect will persist only until this large shock occurs.

Second, voluntary quits allow firms to adjust to a negative shock, so that shocks will have persistent effects only for a transitory period until quits have allowed the firm to reach the myopic optimum. However, two points should be made which mitigate this problem. First, voluntary quits are highly procyclical (See for example BURDA and WYPLOSZ, [1990]) so that they go down precisely when they are needed to adjust. Second, when there is heterogeneity in the labour force, it is unlikely that quits will diminish the labour force in the way firms would have liked; for example, only the best workers might quit; or voluntary quits might be allocated across divisions of a given firm in an uneven way, incompatible with the desired distribution of labour force reductions across these divisions. The result of this is that there will always be a positive probability of losing one's job in a recession, which restores the argument made in this paper.

The main conclusion of the paper is that the efficiency wage model should not be dismissed on the grounds that it does not have interesting things to say about the dynamics of unemployment. Further research should focus on the empirical relevance of the effects studied in this paper versus those emphasised on by the insider/outsider literature such as membership effects (It is true that in a lot of European countries, unions and bargaining play an important role in wage determination. However, there are a lot of countries (France, the U.S) which have a very small rate of unionisation and nevertheless exhibit considerable unemployment persistence. Furthermore, the outcome of bargaining is not always respected, since there are a lot of sectors with considerable wage drift.)

Proof of the Constancy of Employment between two Shocks

First, notice that if employment varies between two shocks, then the wage equation becomes:

$$(A1) \qquad w = e\,(1 + r/q) + \overline{w} + \frac{\lambda e}{q} \times \left[\int_{\theta}^{+\infty} \frac{L_0\,(\hat{\theta},\, L) - L}{N - L}\, g\,(\hat{\theta})\, d\hat{\theta} + \int_{0}^{\theta} \left[\frac{l - l_1\,(\hat{\theta},\, l,\, L_0\,(\hat{\theta},\, L))}{l} \right] g\,(\hat{\theta})\, d\hat{\theta} \right] + \frac{e}{q}\ \mathrm{Max}\,(-\dot{l},\, 0) + \frac{e}{q}\ \mathrm{Max}\,(\dot{L},\, 0)$$

since the wage premium must take into account the probability of being fired between t and $t + dt$ if there is a reduction in the labour force in the absence of a shock, as well as the corresponding probability of being hired if unemployed.

In the *no commitment case*, it is obvious that the firm will choose a constant employment policy: it will determine employment by solving the following problem:

$$P\,(\theta,\, L) = \mathrm{Argmax}\,(\theta F\,(l) - wl)\, dt + (1 - rdt)\,[(1 - \lambda dt)\, P\,(\theta,\, L + \dot{L}dt) + \lambda dt\, EP\,(\hat{\theta},\, L_0\,(\hat{\theta},\, L))]$$

Where w is defined by equation (A1), and the firm has no action on the two additional terms: the second one, because it depends on aggregate variables, and the first one, because it cannot commit at t on its employment policy at $t + dt$.

The first-order condition to this problem is the same as in the text, implying a constant employment policy. Since $\dot{l} = \dot{L} = 0$, the wage will be the same as in the text, and hence the solution will be identical.

In the commitment case, we consider that at t the firm commits on employment at $t + dt$, whether a shock has happened or not. Hence at t l_t

is fixed and the firm determines $l_1(\hat{\theta}, l, \hat{L})$ and $\dot{l}$ by solving the following optimisation problem:

$$\begin{aligned} P(\theta, L, l_t) \\ = \underset{\hat{l}, \dot{l}}{\text{Argmax}} \Bigg[\theta F(l) - l w_0(L) - \frac{\lambda e}{q} \int_0^\theta \frac{l - l_1(\hat{\theta}, l, \hat{L})}{l} g(\hat{\theta})\, d\hat{\theta} \\ - \frac{e}{q} \text{Max}(-\dot{l}, 0) \Bigg] dt \\ + (1 - r dt)\left[(1 - \lambda dt) P(\theta, L + \dot{L} dt, \dot{l} dt)\right. \\ \left. + \lambda dt\, EP(\hat{\theta}, \hat{L}, l_1(\hat{\theta}, l, \hat{L}))\right] \end{aligned}$$

where $w_0(L)$ now includes the term in $\dot{L}$ in the wage equation.

The first-order conditions with respect to the values of $\hat{l}$ are exactly the same as in the text. The first order conditions with respect to $\dot{l}$ imply that $\dot{l} = 0$ if and only if:

$$-e/q \leq \partial P / \partial l(\theta, L, l) \leq 0$$

Which is always true given the F.O.C for $\hat{l}$. Hence employment will be constant between shocks and identical to the solution derived in the text, since P, w and l_1 will follow the same equations.

Exactly the same argument can be made in the case with a severance payment equal to *e/q*.

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