PROFIT SHARING RECONSIDERED: EFFICIENCY WAGES AND RENEGOTIATION COSTS

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Weitzman (1983, 1984, 1985, 1986 and 1987) strongly advocated policy measures to introduce profit sharing. His recommendations consisted of tax deductions on incomes derived from a share on profits. The basis for these incentives is the association of profit sharing and two sorts of externalities. First, if the economy is characterised by short run wage rigidity, profit sharing reduces short run unemployment. Second, profit sharing might reduce long run unemployment.

Until 1985, profit sharing was justified in terms of its short run properties, and both contracts were considered to have the same long run equilibrium. This long run isomorphism was broken when both contracts were compared under hypotheses attempting to explain involuntary unemployment in the long run.

A first microeconomic foundation for long run wage rigidity is the insider-outsider hypothesis. In Weitzman's (1987) insider-outsider analysis a sharing contract has a lower NAIRU than its wage counterpart, due to the decrease in insiders' power, when, first, the employer retains the employment decision, and second, there is no absolute collusion. Problems of stability of a share contract at full employment are added now to justify tax incentives, as the median worker will always (individually) prefer a decrease in the share parameter, implying that the economy converges to the wage system. Trade union's objectives change (Mitchell, 1987, Fung, 1988 and 1989, Pohjola, 1987, Jackman, 1988, and Hoel and Moene, 1988): the consideration of firms' profits in their own objective function lead to the superior Pareto properties of the share system[1].

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[1] In some cases, the gains for workers and firms are, in part, obtained at the expense of consumers and the unemployed (Fung, 1989, Nuti, 1987, and Mitchell, 1987). Nuti (1987) and Mitchell (1987) analyze the likely effects of profit sharing on industrial relations. It seems that profit sharing tends to decrease the monopoly effect of trade unions while increasing the beneficial voice effect. It also tends to a larger level of trade union

Hoel and Moene (1988) show that this result depends on an exogenous share parameter, not subject to bargaining[2], suggesting the government should fix the sharing parameter. Georges (1998) also require that the share parameter is not subject to bargaining for a positive employment effect.

Weitzman (1986) considered a second possibility for an effect of profit sharing on the NAIRU. If long term unemployment is largely inertial, or hysteresis-like (Blanchard and Summers, 1987, and Layard and Nickell, 1986 and 1987), by reducing short run fluctuations, profit sharing produces a lower rate of inertial unemployment.

Efficiency wage models are a third explanation for long run wage rigidity. Weitzman (1987) briefly acknowledged that both payment systems converge to the same long run equilibrium, while the share system can amplify short run employment fluctuations depending on the value of the parameters. It seems that the short run is again interpreted as nominal pay parameters rigidity, an explicit assumption in Levine (1989), John (1991) and Koford and Miller (1991), who share Weitzman's conclusions both for the long as well as the short run. The first two articles considered an unobservable effort version of efficiency wage models, while the third refers to turnover costs.

Section I analyzes the effects of profit sharing in a standard efficiency wage model. A slightly modified version of the classical paper by Shapiro and Stiglitz (1984) is used. Observable total or team output (required for the possibility of profit or output sharing) is associated with an optimal contract with a positive value of sharing, which has a higher employment level than what Weizman called a "wage economy". In the simplest model, if profit sharing is possible, a pure wage contract is not a Nash equilibrium and the unique Nash equilibrium is a sharing contract, that in the aggregate might produce full employment.

This means that if sharing is feasible, shirking efficiency wages would not longer be a good explanation for involuntary unemployment unless additional assumptions are incorporated to explain why sharing might not be introduced. In this line, insiders reluctance is not attractive, as the explanation for unemployment would not be moral hazard, but insiders' power. Risk aversion of workers has been extensively studied by the implicit contract literature (see Malcomsom, 1999, and references in pp. 2300-2301). Renegotiation costs are a third interesting alternative and is considered in section II. It is shown that the incorporation of renegotiation costs might not only explain why profit sharing is not introduced but also imply the existence of two possible Nash equilibrium, one

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centralization (for a dissenting view see Estrin et al., 1987), further increasing the importance of institutional objectives.

[2] If not, the economy will tend to the wage system.

dominating the other in terms of total output and employment.

Another limitation of the literature analyzing the effect of profit sharing under an efficiency wage hypothesis is the analysis of short run fluctuations assuming exogenous nominal pay rigidity. However, efficiency wage models are designed to provide microeconomic foundations for involuntary unemployment, they are an attempt to replace the assumption of an exogenous nominal wage for wage rigidity arising from rational behavior. It seems inconsistent to combine them. At least, if the assumption of rational agents is not dropped altogether, renegotiations costs have to be explicitly modelled to justify this short run nominal rigidity.

In addition, as discussed above, both payment systems are likely to have different renegotiations outcomes. Given different long run equilibria, the comparison in terms of the behavior in the neighbourhood of the steady state is less justified, and for large shocks renegotiations are more likely to invalidate the nominal rigidity assumption.

Aside from these limitations, the essential conclusion of the literature analyzing short run fluctuations under efficiency wages is in line with critiques using a more general framework (Nordhaus, 1998, Cooper, 1988, John, 1991): the smaller fluctuations that Weitzman claims for the share economy will depend on the particular form of the production function and the labor supply function. This critique has been devastating, as revealed by the scarce attention devoted to the issue in the last part of the 90s.

Section III considers two caveats in this argument: share firms have in fact a better response than the one previously considered in the literature and even, if this better response is not possible, it can take advantage of short term pay flexibility if shocks are not firm specific.

Section IV considers the empirical evidence regarding profit sharing, which seems consistent with the framework discussed in this article, although more work would be needed to confirm more precisely its main arguments. Section V concludes.

I. **Sharing and shirking**

A) The simplest model

If the level of effort negatively affects the utility of workers and workers' effort can be imperfectly monitored, there must be a punishment the firm can use against its workers to compel them to perform at the desired level of effort. The combination of wages above market clearing and unemployment is the punishment emphasised by shirking versions of efficiency wage models. This is

one possibility among many. First, shirking might be deterred by using increasing earnings profiles (Lazear, 1981). If fired, a shirker loses his seniority within the firm. Second, a worker's reputation after being fired for shirking, might be damaged (this and other additional possibilities are considered in Malcomsom, 1999). Third, a shirker might be denied the payment of his wage during the period or lose the right to severance pay. Fourth, workers might post bonds before joining a firm, and lose them if caught shirking (Carmichael, 1985)[3].

A fifth alternative punishment, our concern, is some form of effort contingent contract, including output or profit sharing, blocked shares, and so on. If a worker's income is a function of output, it is thereby made a function of his own effort, and therefore the level of effort enters worker's utility twice: directly, as the disutility of effort and indirectly, through the utility of consumption goods bought with income. For any finite disutility of effort and utility function strictly increasing in consumption, it is theoretically possible to find a finite sharing parameter above which the second effect dominates the first. This is the kind of problem analyzed in the literature on optimal labor contracts under moral hazard[4].

Shapiro and Stiglitz (1984) restricted the form of punishment to a positive probability of unemployment and the form of the contract to a fixed wage rate. Their assumption is *"that other specific factors (for example, exogenous noise or the absence of employee-specific output measures) prevent monitoring of effort via observing output"*. This has been interpreted as equivalent to assuming either (i) unobservable or (ii) not verifiable individual output, but not total output, which seems a less reasonable assumption. With respect to (ii), MacLeod and Malcomsom (1987 and 1989) have proven that wage contracts contingent upon non-verifiable (but observable to both the employer and the worker) individual effort can be self-enforcing[5]. Articles comparing wage

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[3] A debate has been centered on whether bonding does in fact occur or not. Capital constraints faced by workers have been advocated to explain why bonding can not eliminate the moral hazard problem (Charmichael, 1990).

[4] Seminal articles on the principal-agent problem include Mirrlees (1976), Holmström (1979 and 1982), Grossman and Hart (1983) and Radner (1985). Holmström (1982) contains the fundamental results for a principal with many agents. Under risk neutrality and unbounded wealth, the first best outcome can be enforced using group penalties. McAfee and McMillan (1991) extend Holmström's results to adverse selection simultaneous to moral hazard, proving that linear output contingent contracts yield the same profits than monitoring individual contributions at zero costs.

[5] When output is not verifiable, a self-enforcing contract requires that the continuation of the employment relationship generates a surplus for both parties. Involuntary unemployment implies a surplus accruing to employed workers. Carmichael (1990, p.279) considers forms of surplus different from unemployment. Profit sharing reduces the surplus of employed workers, shifting income distribution from employees to employers. This is a feature of profit sharing, which is often neglected. In fact, though not in the context of efficiency wage models, profit sharing has already been favoured on these grounds. In Aoki (1984) and Fitzroy and

and profit share economies might be classified within interpretation (i). Levine (1989), John (1991) and Moene (1990) explicitly assumed that knowledge of profits requires knowledge of total output, but concluded that, under moral hazard, both types of contracts are isomorphic in the long run. This is equivalent to assume an infinite number of workers in each individual firm, such that each workers' own shirking does not affect his/her income. However, as suggested by the optimal labor contract literature, for any finite number of workers, a share economy has higher employment and output than a wage economy. This result is verified in our basic model before turning to consider other factors that might be inocorporated to explain why profit sharing is not more widespread.

In what follows, a slightly modified version of Shapiro and Stiglitz (1984) shirking model is used. Workers maximise a utility function dependent on income (y) and effort (e), workers are risk neutral and effort takes values 0 or 1 only. An unemployed worker receives unemployment benefits of $\overline{w}$. Following Shapiro and Stiglitz (1984) workers are infinitely lived, have a pure rate of time preference r, and maximize:

$$\int_0^\infty (y(t) - e(t)) \exp(-rt) dt \qquad (1)$$

The firm must choose a wage such that it discourages workers from shirking. Each firm production function is:

$$q = q(l, m) \qquad q_1 > 0, q_2 < 0, q_{11} \leq 0, q_{22} \geq 0 \qquad (2)$$

l is labor input and m is the number of shirkers. This specification allows an equilibrium with $m = l$ and a positive output[6].

Shirking detection yields immediately to contract termination. The firm has an exogenously given supervision technology summarized by α, the exogenous probability of shirking detection[7]. b is the exogenous probability of job separation due to other reasons.

By including a part of the costs of shirking into the income of every worker, profit sharing affects the incentives to shirk. Ley y^S be the income of an employed shirker and y^N the income of an employed nonshirker. If B is the profit sharing parameter and p is the price of output, the income loss

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Mueller (1984), firm specific-assets generate an ex-post-bargaining problem over surplus division. Rational workers may collude themselves to obtain a surplus share in non-pecuniary form restricting effort. Profit sharing reduces the incentive for workers to economize effort (see also Fitzroy and Kraft, 1987).

[6] Black and Garen (1991) have used a similar specification, to allow for an equilibrium with full employment (where all workers shirk), as opposed to an efficiency wage equilibrium.

[7] Holmström and Milgrom (1994), Allgulin and Ellingsen (1998) and Allgulin (1999) have studied endogenous monitoring within the context of shirking models. Their findings do not affect the results that follow.

for each worker considering the possibility of shirking is given by $z = y^N - y^S = (Bp/l)(q(l,m) - q(l,m+1))$, where m is the number of other workers shirking, considered as given by each individual. This allows for an additional punishment not considered by Shapiro and Stiglitz (1984) and papers analyzing the short run effect of profit sharing under efficiency wages due to either moral hazard or labor turnover.

To prevent shirking, the firm must set pay parameters such that workers prefer not to shirk. The income accruing to a no-shirker is $y^N = w(1-B) + Bpq(l,m)/l$. Assuming workers prefer to be honest if they are indifferent between either shirking or not, the firm sets z and y such that the expected life-time utility of not shirking is greater than or equal to the expected life-time utility of shirking.

To obtain a stable Nash equilibrium (NE), an additional modification to the simplest model is required. In what follows, the probability of obtaining a job after dismissal is lower for shirkers that have being detected than for those that have being fired due to other reasons. This might be due, for example, to the requirement of good references by previous employers. Call the first probability *s* and the second *a*. In what follows it is important that s be finite even at full employment, for a stable solution.

Let V_E^S be the expected lifetime utility of an employed shirker, V_E^N the expected lifetime utility of an employed nonshirker, V_u^S the expected lifetime utility of an unemployed that has been fired due to shirking detection and V_u^N the expected lifetime utility of an unemployed that has been fired due to other reasons.

The fundamental asset equation for an employed shirker is:

$$rV_E^S = y^S + b(V_u^N - V_E^S) + a(V_u^S - V_E^S) \tag{3}$$

And for a nonshirker, it is:

$$rV_E^N = y^N + b(V_u^N - V_E^N) \tag{4}$$

These can be solved to:

$$V_E^S = \frac{y^S + bV_u^N + aV_u^S}{r + b + a} \tag{5}$$

$$V_E^N = \frac{y^N - e + bV_u^N}{r + b} \tag{6}$$

To prevent shirking, the firm must ensure no-shirking forever is the sub-game perfect equilibrium of a game between workers, where the firm determines the payoff associated with each strategy. The no-shirking condition faced by the individual firm, taking the life-time utility of unemployment as given, is:

$$y \geq e + \frac{(r+b)}{a}(e-z) + rV_u^S + b(V_u^S - V_u^N) \qquad (7)$$

The impact of profit sharing on the incentives to shirk can be appreciated in (7). Under the pure wage system, z is zero. For given *l*, the value of *z* can be increased by augmenting B. This does not affect other parameters determining y in (7) and therefore the level of income required to deter shirking is reduced. Other effects associated with the introduction of profit sharing might operate in the same direction. As the introduction of profit sharing makes the income of each worker a function of the performance of other workers and the costs of the firm, workers have an incentive to take measures to increase the former and to reduce the latter (Fitzroy and Kraft, 1987)[8]. For example, each worker might help in monitoring the effort of others, increasing the probability of detection for each level of supervision. They might also impose social sanctions on shirkers that might increase the costs of being detected (Kandel and Lazear, 1989). Conversely, good performances might be rewarded. Effort standards of teams might increase.

In general, any change reducing the size of the firm increases the punishment effectiveness of profit sharing and reduces the rate of unemployment. A similar effect occurs if sharing is linked to the performance of the worker's division, for example, creating an internal market for the division's output[9]. This might also increase the self-perception of the division as a team and might reduce conflicts that under profit sharing might arise when the organisation is experiencing a difficult period. Examples of these conflicts would be that of two separate divisions, each one blaming the other for bad performance, and that of workers suspecting management is cheating to reduce pay. There is no reason against combining sharing of different levels of firm's output, even with assesments of individual performance wherever possible[10]. If identification is to be further enhanced it would be interesting, following Olson (1971), to link profits with the provision of collective goods that workers

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[8] See Barron and Gjerde (1997) and Che and Yoo (2001) for recent work on this issue.

[9] Limiting the size of the reference group increases the relevance of workers with respect to either monitoring or social retaliation. Moreover, in small groups, each one tends to perceive itself as being essential in achieving the desired goal.

[10] Weiss (1987) has suggested that group incentives might reduce the performance of the most productive workers.

would find it difficult to obtain (pension funds, sport facilities).

B) The aggregate conditions

There are F identical firms and the aggregate production function is given by Q=Q(L,M), where L=F*l* is total employment and M is the total number of shirkers. Full employment is efficient, i.e., if N is the fixed total labor supply, $Q_1(N,0) > e$ and $Q_1(N,N) > 0$. Assume also that the value of unemployment benefits does not preclude full employment, i.e., $Q_1(N,0)$ e + $\overline{w}$ and $Q_1(N,N)$ $\overline{w}$. The interesting case is $Q_1(N,0) \geq e + Q_1(N,N)$.

The general equilibrium solution requires defining the expected life-time utility of unemployment, which is different for shirkers and nonshirkers:

$$rV_u^S = \overline{w} + s(V_E^S - V_u^S) \tag{8}$$

$$rV_u^N = \overline{w} + a(V_E^N - V_u^N) \tag{9}$$

Which can be solved for V_E^S and V_E^N. Replacing (5) and (6) in (8) and (9), a lifetime utility of an employed nonshirker higher than or equal to the lifetime utility of an employed shirker defines the aggregate no-shirking condition:

$$y^N \geq e + \overline{w} + (e - z)\frac{(a + b + r)(r + s)}{(a + r)\boldsymbol{a}} \tag{10}$$

In steady state, there is no shirking and the stock of the unemployed is given and, therefore, the probability of employment is given by the equality of the flows into and out of this stock, namely bL=*a*(N-L). The impossibility of full employment in Shapiro and Stiglitz (1984) model is a consequence of the fact that as L approaches N, a tends to infinity. In (10) this does not occur, as long as the last term in the right hand side does not approach infinity when a does[11]. In fact its limit is $(e-z)(r+s)/\alpha$.

The maximisation of profits by the individual firm is constrained in this model by the no-shirking condition and by the behavior of other firms, as better conditions offered by other firms might lead workers to quit. To consider the "no-leaving" condition (or the supply price of labor) was not necessary in Shapiro and Stiglitz original model, but it is if the effects of profit sharing are to be

[11] The level of s might be a function of the level of employment. What is important is that it remains finite even in full employment.

analyzed. Assuming a nonshirking equilibrium prevails, the no-leaving condition for firm i is given by:

$$y^{(i)} \geq \frac{ay^{(-i)} + re + r\overline{w}}{r + a}$$

(11)

where superscripts (i) and (-i) refer to the value of the variable in firms (i) and (-i), ie. all other firms, respectively (effort in 11 also refers to working in other firms, but we are assuming all firms are identical except regarding the value of B they set). If full employment with no shirking is attained, competition in the labor market implies $y^{(i)}=Q_1(N,0)$.

As total pay in other firms must fulfill the no-shirking condition, the no-leaving condition (11) solves to:

$$y^{(i)} \geq e + \overline{w} + \frac{a(a+b+r)(r+s)}{\alpha(a+r)^2}(e - z^{(-i)})$$

(12)

The efficiency wage problem arises whenever the technology of monitoring is such that (10) is not fulfilled at full employement, i.e., whenever the punishment of a lower probability of finding employment for shirkers is not enough to get rid of the moral hazard problem. In this case, the firm might resort to alternative punishments, as for instance profit sharing. Suppose that an efficiency wage equilibrium with unemployment and wages determined by the no-shirking condition prevails. If unemployed workers can credibly commit themselves to work for an income lower than the market wage, they might be employed. Since the market wage is above the reservation wage of unemployed workers, the latter might accept an output or profit sharing contract specifying a value of z high enough so that their commitment to work for an income below the market wage be credible. It is credible and convenient for the firm to set B such that z in (10) is such that y^N is below the market wage but above the reservation wage (12). Therefore, the possibility of drawing up contracts contingent on total output might provide the unemployed with an effective tool to undercut employed workers. In this sense, the prevalence of involuntary unemployment is equivalent to the existence of unexploded opportunities for trade that are mutually beneficial to two parties: the firm and the unemployed.

In fact, it is trivial to show that in this simple model and in line with the optimal contract literature, if profit sharing is feasible, a pure wage system is not a Nash equilibrium unless full

employment is feasible without sharing (which is not a very interesting special case). Some degree of sharing is optimal for any firm. Moreover, if there is no limit to the feasible degree of sharing, full employment would be the unique Nash equilibrium of the economy. Both proofs are presented in the Apppendix[12].

The situation is described in figure 1. The no-shirking condition (10) is represented by NS and the nonleaving condition (12) is NL. The pure wage system equilibrium is $\underline{y}$ and $\underline{l}$. As there is no full employment, it is easy to check that NS is binding and NL is not. Introducing profit sharing or increasing its value, each firm might relax its no-shirking condition until (11) becomes binding. Call z^*, y^* and l^* the optimal response of firm i if all firms are playing $\underline{y}$, $\underline{z}$ and $\underline{l}$. Then z^* is given by:

$$z^* = \frac{re}{a+r} + \frac{a\underline{z}}{a+r} \tag{13}$$

If all firms adopt z^*, NS shifts to the position of NL before the change and the no-leaving condition shifts to the right. Then the no-shirking condition might be relaxed again, increasing z. It would be convenient for an individual firm to deviate increasing B (ie. z) until NS coincides with NL, which occurs only when full employment is reached.

The value of B required to completely deter shirking at full employment might be very high and even above 1. Firms and workers might be reluctant to agree a sharing parameter above a certain threshold, well below 1. An optimal level of sharing below the one required to completely deter shirking might be the consequence of different factors that have not being taken into account in this simple model, as for instance risk aversion of workers, the possibility of manipulation of accounting profits, restrictions imposed by the legal system or endowment constraints. On the other hand, the firm might be reluctant to introduce profit sharing due to a loss of control over investment decisions (Matthews, 1985, and Meade, 1986).

As discussed in the last section, the firm might also benefit from linking sharing to the performance of smaller teams, increasing the value of z for a given share parameter.

In any case, the central message of this section is clear: if there is a moral hazard problem and output or profits are measurable and verifiable, the pure wage system is not a NE and there would be a unique NE with sharing. The problem is now how to make a shirking version of efficiency wage hypothesis on its own compatible with unemployment if profit sharing is feasible. Only then can wage

[12] Note that a full employment NE is stable only because s<a and s remains finite. Otherwise, there would be no stable NE in this model, unless other punishments are established for shirkers. For instance, the loss of seniority or of severance pay might produce similar results.

and share economies different short and long run behaviors be compared.

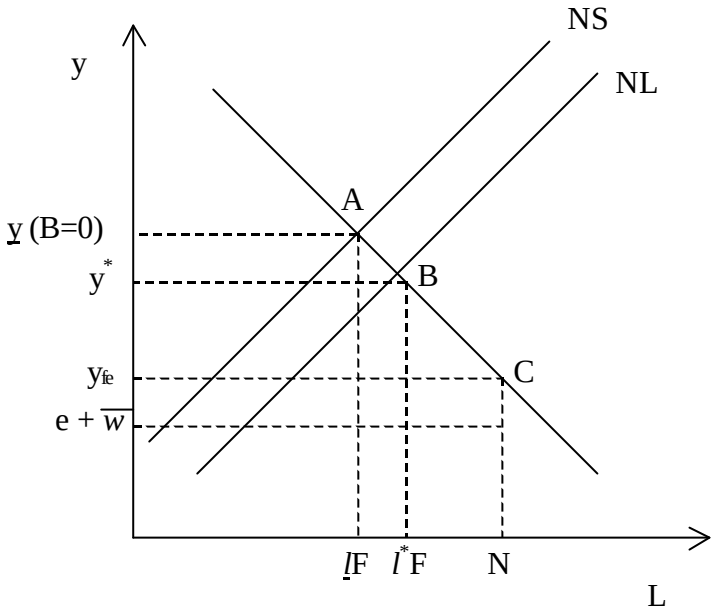

Figure 1. Deviation from the wage system

The question, in other words, is what can prevent a mutually beneficial trade between unemployed and the firm from occuring. This question has been already stated by Carmichael (1990) on the basis of bonding and remains an open question to date. A first possible explanation is that employed workers might oppose the change. As stated, the criticism that unemployment is the result of unexploded gains from trade has been raised against trade union models. The firm might offer to compensate employed workers, keeping their income constant, while at the same time hiring unemployed workers at lower pay. The hiring of unemployed workers increases the value of a, but employed workers might be deterred from shirking given the level of income, by increasing the fraction of pay accruing as a share on profits. Consequently, employed workers might oppose the change should they foresee that the hiring of those unemployed will decrease their power to refrain the firm from reducing their total pay by further increasing the sharing parameter.

The previous argument takes us, in fact, back to the insider-outsider model. That is, the above explanation for wages above market clearing would be union power, not moral hazard. Or in other words, moral hazard is a problem because unions have the power to deter the firm from

introducing a punishment different from unemployment, namely profit sharing. If unions have that power, then the market wage might be given by the right hand side of (10), with z=0, or any other value above it. The role of moral hazard, at the most, might be restricted to provide a natural focal point for negotiation.

The question is, then, if in the absence of unions or when unions have very little power, there is something else that might be precluding the firm from introducing profit sharing. In other words, can moral hazard on its own explain involuntary unemployment? One possibility is analyzed in the next section.

II.- **Contract costs and Nash Equilibrium**

There might be different costs associated either to a movement from a fixed wage contract to a sharing contract, or to an increase in the sharing parameter. For example, immediately after the introduction of profit sharing workers might require a transition period to get used to this form of payment before considering it at face value. Or the change in the contract might have legal cost, or renegotiations costs, due to cultural rigidities involved in agreeing on the adequate level of the sharing parameter or simply due to the opposition of workers to this kind of innovation. Let us summarize the cost of the increase in the level of sharing by $k(B,\phi)$, where ϕ stands for the fraction of firms in that economy that have already implemented a certain level of sharing. k affects only profits for the firm and increases with B while decreasing with ϕ.

The intuition of what follows is simple. The sustainability of a wage above market clearing depends on the lack of incentives of an individual firm to deviate, which, apart from the above, depends on the limits imposed by the no-leaving condition. If all firms are playing the pure wage equilibrium, then it might not be possible for an individual firm to deviate from this strategy because this deviation is limited by the possibility that workers leave,- which sets a limit to the value of sharing that a single firm might introduce on its own interest given the behavior of other firms,- and the benefits of the deviation might be smaller than the cost of changing the contract. Hence, both profit sharing and "efficiency wages" pure wage contracts might be NE of the competitive game. Then external co-ordination would be needed to achieve the superior profit sharing NE. This would be the efficiency wage counterpart of Weitzman's claim: profit sharing is a contract with externalities that the individual firm does not internalize.

Consider an initial situation with involuntary unemployment, either with z=0 or with z>0 but

not large enough to achieve full employment. The firm has two options: to increase the level of sharing or to maintain its pay parameters. In the standard analysis the firm would prefer to increase the sharing parameter, if the change in profits is positive:

$$\frac{d\Pi}{dB} = \int_0^{\infty} \left[(pq_1 - y)(\frac{dl}{dB}) - l\frac{dy}{dB} \right] [\exp(-rt)dt] - k_1 \qquad (14)$$

The firm might implement the change if (14) is positive and if the increase in B can increase employment by moving the no-shirking condition, while at the same time reducing total pay. The first term of (14) is 0, from the first order condition of profit maximization. The second term, the change in y is limited by the no-leaving condition and the third term is negative. The firm might move the no-shirking condition (10) by replacing the optimal response z^* given by (13). Let y^* denote that value and $\underline{y}$ the original value of total pay, meeting the initial no-shirking condition, binding for the firms playing $\underline{z}$. Then the maximum reduction in total pay for any firm considering individually to deviate is given by:

$$\underline{y} - y^* = \frac{r(r+s)(a+b+r)}{\boldsymbol{a}(a+r)^2}(e - \underline{z}) \qquad (15)$$

This is the value for dy/dB in (14). If the present value of this reduction in pay multiplied by the number of workers is higher than the cost of changing the contract, the firm would introduce sharing, and increase *l* (according to the derivative of the first order condition).

This is less likely the higher the value of B, as a higher value of B implies higher k, lower possible reduction in total pay (as can be verified deriving 15 with respect to B) and lower increase in output (lower reduction in total pay and $q_{11}<0$). Therefore a full employment equilibrium might not be achievable. It is even likely that a pure wage equilibrium prevails due to historical reasons, if $k(0,\phi)$ is high enough. In addition, while it is plausible that k' increases with dB no matter its initial value, it is even more intuitive that the cost function might have an important discontinuity if the initial value of B is zero. This might be due to stronger cultural rigidities if workers have not had a sharing contract before or because it is costly for workers to monitor profits. This would make the movement away from the pure wage system more difficult.

Let us further explain the situation with the help of figure 1. Suppose that a symmetric NE with pay above market clearing prevails. The equilibirum is at point $\underline{y}$ and $\underline{l}$. The benefits of individual

deviation are limited by the no-leaving condition, because the firm must pay workers at least a level of income higher than the expected income of leaving the firm. Only firm i, the potential deviator, considers NL as its binding restriction. The curve NS represents the no-shirking condition, binding for all firms playing ($\underline{y}$,$\underline{z}$). By deviating, firm i can reduce its pay to y^*, given by (11), and increase its employment to l^*. The increase in profits is given by the area AB($\underline{y}$-y^*). The discounted value of this area forever might be smaller than the cost of changing the contract in the first place. However, if all firms agree to move simultaneously to an aggregate profit maximizing equilibrium, the new equilibrium would be at point C, with $y=y_{fe}$ and lF=N, and the gains for each firm would be the area AC($\underline{y} - y_{fe}$). The discounted value of this (bigger) area is more likely to exceed the costs of changing the contract than the previous area.

The coordinated move relaxes the restriction imposed by the no-leaving condition. If the costs of changing the form of payment exceeds the discounted value of the first area, while at the same time they are smaller than the discounted value of the second area, there would be an externality of the massive introduction of profit sharing that an individual firm can not take into account. The economy is characterized by multiple Nash equilibrium, those with higher sharing dominating the others in terms of aggregate output and employment. This is a new externality to add to Weitzman's arguments to justify his proposal of tax incentives one and a half decades ago.

On the other hand, after an innovation has occurred, the likelihood of a new change decreases, as an even higher rate of unemployment would be needed to make another deviation profitable. This is a perverse dynamics in the adaptation of firms that seemingly implies sub-optimal levels of profit sharing. If the economy is in a downturn, with unemployment continuously rising, a level of unemployment might be reached for which the benefits of changing the form of payment exceed its costs, and firms will deviate, increasing B. However, this new level of B is limited by the no-leaving condition, that all firms take as given. Once the new level of B has been reached, an even higher unemployment rate might be needed for another change in the form of payment. At least, the deviation will tend to reduce unemployment, facilitating the economic recovery.

III. **Short run fluctuations**

The literature comparing share and wage economies short run response to shocks under efficiency wages has considered both economies have the same long run equilibrium and turned to compare their short run response to shocks assuming pay parameters stickiness. As discussed in

section I, under a shirking efficiency wage hypothesis a share economy exhibits higher employment and output than a wage economy, and therefore it is not appropriate to compare their response to short run output fluctuations assuming they are isomorphic in the long run. Renegotiation costs, among other factors, might explain why sharing is not more widespread.

On the other hand, to retain the assumption of rational behavior of firms, renegotiation costs must be explicitly considered to explain short run pay parameters rigidity (Gray, 1976 and 1978, Taylor, 1980, and Fethke and Policano, 1984)[13]. In this case, the analysis must focus on small fluctuations. For large fluctuations, the benefit of renegotiation will be larger than attendance costs, and pay parameters would accomodate to the new economic conditions. Given different long run equilibrium between wage and profit sharing economies in our efficiency wage model, these small fluctuations are unlikely to reverse the conclusion of a larger employment in the latter. However, the question deserves deeper consideration, as it is the basis for Weitzman more important argument in favour of tax incentives for sharing arrangements.

In fact, in a more general context than efficiency wage models, Nordhaus (1988) and John (1991) have convincingly argued that a sharing equilibrium might exhibit higher short run unemployment if the labor supply price is introduced into Weitzman original framework. This can also be the case in our analysis, where the labor supply price is explicitly introduced by the no-leaving condition. If it becomes binding due to a negative shock affecting the firm, total pay in a share firm might fall below what is needed to deter workers from leaving. The same might occur if the negative shock affects the conditions for nonshirking. The framework used so far might highlight some important considerations not previously considered in the literature.

Let us consider the no-shirking condition. The negative shock reduces output and, through the sharing parameter, the level of pay. The firm might be required to fire workers to fulfill the condition. The shock also might affect the difference between q(l,0) and q(l,1) in the right hand side of (10). If the shock is aggregate, it might also affect the probability of employment, a.

[13] Before Weitzman's proposal, Mitchell (1982) recognised that a profit sharing contract restored real wage flexibility without the attending negotiating costs. Thus far, nothing more has been done along this line of research. For example, when the profits of the firm are included in the objective function of unions, the incentives to renegotiate when the firm is facing short run problems might be higher. This tends to reduce employment fluctuations in bad states while transitory gains in good states are more adequately distributed.

The impact of the shock in (10) can be decomposed in two parts: the reduction in total pay (y=w(1-B)+Bpuq(*l*,m)/*l*) in the left hand side of (10), which is the first effect mentioned in the last paragraph, and the change in the conditions for no-shirking (right hand side), which are the two last effects above.

Let us consider the first effect, assuming the right hand side of (10) does not change. For the individual firm the no-shirking condition is negatively sloped as z increases as employment falls. Let us first disregard that problem considering that the no-shirking condition of the individual firm is a fixed value (which is the case of the no-leaving condition, which does not depende on the level of the firm's employment). If the value of pay detering shirking does not change then the optimal response of the firm to a shock reducing labor productivity would be to fire workers until the value of labor productivity equals that value of pay. This is precisely the response of the wage firm.

The share firm might be in trouble. Following John (1991), let us consider an unforecastable random shock *u* affecting the production function linearly. If workers do not shirk, total pay is then given for the share firm by y = w(1-B)+Bpuq(l,0)/*l*. Then, after choosing B and w, any variation of the level of employment or in *u* affects the level of pay. Given *u* the effect of changes in the level of employment in the level of pay is given by:

$$\frac{dy}{dl} = \frac{B}{L} pu\left[q_1(l,0) - \frac{q(l,0)}{l} \right] \qquad (16)$$

Which defines a locus (y-*l*) that might have a positive or negative slope depending on the characteristics of the production function. For positively sloped or horizontal (y-*l*) schedule (for instance any homogenous function of degree higher than 1) it is clear that the share firm can not solve its problem of profit maximization after the negative shock occured given the alternatives of payment discussed so far. The reduction in pay due to the negative shock can not be reversed reducing employment and therefore it is not possible for the share firm to fulfill the no-shirking condition.

If renegotiation is costly, the optimal response of the share firm in that situation would be to reduce employment to the same level of the wage firm and pay these workers a once and for all bonus to deter them from shirking[14]. Such a bonus is likely to have very low marginal costs, unless the legislation complicates its payment.

On the other hand, if the (y-*l*) schedule is positively sloped, it is possible that for some lower

[14] The alternative would be to accept workers shirking and accomodate the level of employment to that situation.

level of employment the associated level of pay fulfills the no-shirking condition. If that occurs at a lower level of employment than the one that would have been selected by the wage firm, then the share firm would again prefer to pay a once and for all bonus and select the wage firm level of employment.

If the level of employment associated with the level of pay fulfilling the no-shirking condition is above the wage firm level of employment the reduction of employment would be lower in the share firm. Note that this point would not be in the labor demand curve, and therefore another equilibrium with less employment but larger pay might exist where the (y-*l*) schedule intersects the first order condition.

Now consider the possibility that the no-shirking condition moves after the shock. The effect in employment for a wage firm is given by the differentiation of the first order condition, as long as the right hand side with z=0 can only fall after the negative shock. This is precisely the problem with the wage firm, as the left hand side of (10) is fixed in the short run, it can not benefit from the reduction of the opportunity cost of workers.

For analyzing the behavior of the share firm, it is important to consider the reasons why the no-shirking condition might move. First, the NS curve in (10) might move if z changes. This change will depend on the derivatives of the production function with respect to the number of shirkers, and as this has not been studied so far, it is not possible to use standard properties to determine whether z increases or decreases after the shock. If the no-shirking condition was binding, a reduction in z due to the shock will tend to induce shirking and the firm might be obliged to fire workers to prevent shirking[15].

Fortunately, with regard to the comparison of share and wage economies, the conclusion is unambiguous. z would always be positive and therefore it would remain to the right of the curve associated with z=0, and therefore this effect on its own would never yield a higher level of unemployment in a share economy as compared to the wage economy. If the shock increases z, the NS condition is relaxed, and the insulating properties of the share economy are enhanced. The effect is also likely to be small as compared to the effect of labor market conditions specially for aggregate shocks, as we turn to look immediately.

A second and more important reason for the no-shirking condition to move, and this time

[15] It is also possible that the firm sets a value of B high enough to ensure workers do not shirk even after negative shocks. This might not be possible due to other restrictions on the maximum feasible level of B.

also the no-leaving condition, is the change in labor market conditions. Both would be relaxed following the reduction in the probability of employment. This relaxation would be more important the more aggregate the shock is. The share firm can take advantage of this change in external conditions, but not the wage firm, as it is constrained by its fixed wage. The new equilibrium would be at the point where the new first order condition intersects the new no-shirking condition, a point that can be ensured through paying a once and for all bonus, or a level of employment above it, which might be obtained if the (y-l) locus has a negative slope.

The situation is depicted in figure 2. The initial equilibrium is at the intersection of $pu_0q_1(l,0)$ and NS_0 at point A. After the shock the first order condition shifts inwards, to $pu_aq_1(l,0)$ and the no-shirking condition shifts to the right, the more, the more aggregate the shock is. The new equilibrium of the wage firm is at point B. On the contrary, provided the share firm can pay the once and for all bonus, the optimal level of employment would be along the new labor demand schedule, where it intersects the new NS curve, at point C, if the (y-l) locus is as depicted in the lowest schedule in figure 2, or if the (y-l) locus is such as the other schedule depicted in the figure, either in the intersection with NS_1 or $pu_0q_1(l,0)$, depending on which ones yields higher profits.

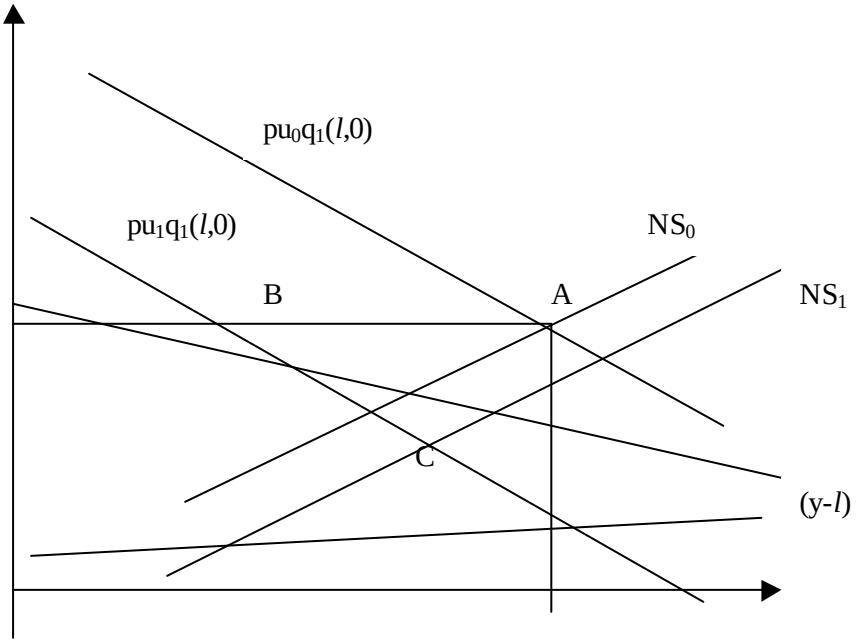

Figure 2. Different short run responses to shocks

Note that the shift in the no-shirking condition reduces the bonus that must be paid to deter workers from shirking (if the shock is aggregate enough, the need for the bonus might be completely eliminated). Therefore, due to this effect, equilibrium employment in a share economy is greater the more aggregate the negative shock, which is a very desirable property to atenuate fluctuations.

In summary, the possibility of paying a once and for all bonus reinstall Weitzman argument of better short run macroeconomic properties of a share economy. This once and for all bonus is consistent with rational behavior as it is likely to have very low marginal costs, as the firm is not required to negotiate for paying this extra benefit to her workers. Note that this important result does not depend on the fact that there are problems of moral hazard or not, as it holds either for the no-shirking or the no-leaving condition. On the other hand, the better performance is greater the more aggregate the shock is, a result which is independent of the possibility of paying the once and for all bonus. The more aggregate the shock is, the greater the advantage a firm can make of the short run flexibility provided by profit sharing.

IV. **A bird eye look at the empirical evidence**

The model outlined in this article is consistent with some of the evidence used against Weitzman's original arguments. For instance, profit sharing might exist in many firms and with different levels (Blanchflower and Oswald, 1988) and still be desirable to encourage its adoption through tax incentives. Firms might regard the total level of remuneration as the marginal cost of labor (Wadhani and Wall, 1990) but still the sharing part of total pay would be associated to a higher level of output and employment.

Formal tests of the above model have to be specially deviced, but at least the model does not seem at odds with the empirical literature. For instance, it is consistent with large employment but lower wages in share firms if profit sharing is used to reduce shirking. However, limits are imposed by the no-leaving condition, and therefore these effects might be small in magnitude.

Bradley and Estrin (1992) found evidence that profit-sharing enhances employment levels for the British retail trade sector. Kruse (1992) found that profit-sharing is concentrated in high employment size classes in a sample of 3000 American firms, as did Cable and Wilson (1990) with a sample of 61 West German firms and Hart and Hubler (1991) using the German Socio-Economic Panel. On their findings, Cable and Wilson (1990) suggest: "The general picture appears to be one in which profit sharing is used... essentially as a group-bonus device to elicit high levels of workers'

effort in relatively large firms." (p. 552). Hart and Hubler (1991) also found that no-profit sharing workers exhibit relatively higher unemployment risk and probability to change firms, which is consistent with the insulation to negative shocks provided by profit sharing as well as with turnover type efficiency wage models. This is also confirmed by Azfar and Danninger (2001) using the National Longitudinal Survey of Youth, who find that employees participating in profit sharing were less likely to separate from their job and received more training.

As the relaxation of the no-shirking condition after the introduction of profit sharing would be associated with higher profits, the model is also consistent with Bhargava (1994), Richardson and Nejad (1986) and Cable and Wilson (1989). For instance, Bhargava (1994) found an increase of long run profitability by nearly 30%.

Concerning our main new argument for short run behavior, the payment of a once and for all bonus in profit sharing firms facing negative shocks have not received much attention in the literature. Profit sharing has grown pari pasu with lump sum payments in the union sector of the American economy (Bell and Newmark, 1993), but the authors regard lump sums as alternatives to profit sharing. More work is needed to confirm a possible association of both kind of schemes for individual firms facing negative shocks.

In fact a continous effort model, required to reconcile profit sharing with higher average productivity (unless in the alternative equilibrium without sharing all workers shirk), might accomodate most possible diverging results. In a 1-0 model such as the one used above, higher employment associated with more sharing requires lower marginal and average productivity for a downward sloping labor demand curve. Combining the latter with a continous effort model migh explain why reported productivity gains seem often small in magnitude (for instance, up to 8% in Cable and Wilson, 1989, between 7,9 to 11% in Kruse, 1992, or negligible in Blanchflower and Oswald, 1988), as they are a combination of more employment (less binding no-shirking condition), which reduces productivity, and more effort (as a response to the fact that own effort affects each individual's income), which increases productivity[16]. Is is also consistent with Bradley and Estrin (1992) finding of greater levels of employment (less binding nonshirking condition) but no significant effect on remuneration (increase in effort offseting the reduction in productivity due to the higher level of employment). The second effect dominating the first is required to explain Cable and Wilson

[16] Kruse (1992) noted, however, that this apparently small magnitude might be economically significant, as with an output elasticity of 0,25 a productivity increase of 1% is equivalent to increasing the capital stock by 4%. It must be acknowledged that Cable and Wilson (1990) found a much larger effect of 20-30%.

(1989) finding of higher wages in share firms.

V.- **Conclusions**

In a shirking model, profit sharing reduces the incentives to shirk by including the costs of workers' potential shirking into their income. Workers might also take measures to reduce the possibility that other workers shirk. The punishment effect of profit sharing explains why, if the sharing parameter is not limited, profit sharing removes the possibility of involuntary unemployment due to moral hazard. If exogenous restrictions are imposed on the maximum value of the sharing parameter, its relaxation reduces unemployment. The same occurs when the number of firms increases or when the basis for sharing is a measure of the performance of divisions of the firm.

Profit sharing reduces the surplus accruing to employees. As sharing imposes an additional punishment for shirking, the penalty of losing a job with income above the reservation utility can be reduced or even eliminated. Total pay in each job declines and employment expands. This shift in income distribution has been also emphasized in models where firm specific assets generate an ex-post bargaining problem over surplus division and by insider-outsider models.

Different assumptions might endogenously impose limits to the feasible level of profit sharing. Although it might be important, union's power to oppose profit sharing has very little appeal because union's power and not moral hazard would be the ultimate explanation for involuntary unemployment. A more appealing explanation is that the change of the contract might have costs. If the actual contract played by all firms is a pure wage contract, the benefits of individual deviation to a sharing contract in terms of pay reduction, although positive, are smaller than the benefits of a co-ordinated move to profit sharing. This is due to the fact that the no-leaving condition imposes restrictions on the maximum deviation of any individual firm. The discounted benefits of unilateral deviation might be lower than the costs associated with the change in the form of payment, while the benefits of a co-ordinated move might be larger. In other words, if changing the form of contracts has costs, profit sharing has externalities in terms of long run employment and output that individual firms fail to consider.

In the short run, renegotiation costs explain nominal pay parameters rigidity arisen from rational behavior. A negative shock is adjusted by wage firms firing workers. A once and for all bonus might be used by the share firm to remain in the labor demand schedule even in the short run.

In this case, employment would never be greater in the short run in a wage economy. As share firms benefit from short run flexibility in total pay, their employment adjustment would always be lower than in a wage firm. The superior short run performance of a share economy is higher the more aggregate the negative shock is.

The model is consistent with the empirical evidence, but more work would be needed along this line to really confirm or reject the arguments.

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APPENDIX 1

Proposition 1.If profit sharing can be introduced, a pure wage system is not a Nash equilibrium unless full employment is feasible without sharing.

Proof: One possible equilibrium is Q(N,N), as analyzed by Black and Garren (1991). In that case, firms are not facing the moral hazard problem and there is full employment and all workers shirk. Let us turn to the other case, where workers are shirking and full employment is not attainable, which is the case analyzed in Shapiro and Stiglitz (1984). Firm i makimizes profits subject to (10) and (12). Suppose a wage system (z=0) is a Nash equilibrium. In this case (10) is binding and (12) is not, for any r>0. Then firm i might introduce profit sharing (which implies z>0), relaxing the no-shirking condition (a positive z reduces the value of the right hand side of 10). This enables the firm to reduce y and expand employment. The limit to this reduction in y is set by the right hand side of (12). Let z^* and y^* be the optimal response for firm i if the other firms are playing a pure wage contract, then $z^* \geq$ re/(a+r) (the value of z might reduce the value of y along 10 up to the limit set by the right hand side of 12 which is taken as given by any individual firm). Then $z^*>0$ for any $a \neq \infty$, which contradicts the beginning of the paragraph. QED

Proposition 2. If profit sharing is feasible to a sufficient degree, full emplomentis the unique Nash equilibrium of the economy.

Proof: The case of interest is the one where full employment is not attainable under the wage system. Suppose $\underline{L} < N$ is a Nash equilibrium. The value of y associated with that level of employment, $\underline{y}$, is given by the first order condition, $Q_1(\underline{L},0) = \underline{y}$. The value of $\underline{y}$ and the corresponding value of $\underline{z}$ must meet (10) and (12). As for any r>0 and $\underline{L}<N$ (10) is more binding than (12), the value of $\underline{y}$ and $\underline{z}$ are given by (10), and the potential deviator would take them as given for the other firms. The potential deviator considers (12) as its binding restriction, and considers to reduce y^N in (10) by increasing the value of z (increasing B). As the limit to reducing y^N is ultimately given by the binding restriction (12), the optimal response z^* for firm i if the other firms are playing $\underline{y}$ and $\underline{z}$ is given by (13).

The optimal response z^* would be higher than $\underline{z}$ unless (i) $a \rightarrow \infty$, which occurs at full employment, in which case $z = \underline{z}$, or (ii) e $\underline{z}$, in which case the value of y fulfilling the nonshirking

condition (10) is below e + $\overline{w}$, which implies it is not binding, which in turn implies full employment. Full employment is also the case where (10) is not stricter than (12). The fact that the optimal response of firm i to any level of sharing in other firms is to further increase sharing unless the value of sharing is high enough for full employment proves that full employment is the unique NE.

QED