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Flexible and Committed Profit Sharing with Wage Bargaining

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Abstract

In this paper the relationship between profit sharing, employee effort and wage formation is analysed under different relative timings for the determination of base wage and profit sharing. We show that the optimal profit share, decided by firms, under commitment exceeds that under flexibility. This holds true, because by committing itself to a profit share the firm can induce wage moderation, which adds to the returns from using the profit sharing instrument. If the profit share is negotiated it depends positively on the relative bargaining power of trade unions and it has both effort-enhancing and wage-moderating effects.

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I. Introduction

Profit sharing refers to performance-related remuneration mechanisms consisting of a base wage plus a share of profits of firms. It is an empirically important phenomenon in many OECD countries. The OECD Employment Outlook (1995) reports cross-country evidence on profit sharing in OECD countries. Pendleton et. al (2001) present more recent and detailed data on the large proportion of workplaces with financial employee participation, in particular in the form of profit sharing schemes, in EU-countries. For further detailed evidence regarding profit sharing we refer to DICE database collected by CESifo, <http://www.CESifo.de>. As profit sharing schemes are nowadays commonly used, it is important to study their implications.

Weitzman (1985, 1987) conjectured that profit sharing systems would both dampen the business cycle fluctuations of employment and reduce equilibrium unemployment. Holmlund (1991) formally explored the relationship between profit sharing and equilibrium unemployment. He argued that profit sharing will reduce (increase) equilibrium unemployment if and only if the elasticity of substitution between labour and capital exceeds (falls short of) one, while it will have no effect on equilibrium unemployment when the elasticity of substitution between labour and capital is equal to one. Layard and Nickell (1990) show a similar neutrality result in the case of a Cobb-Douglas production function and efficient bargaining. In all these contributions the profit sharing instrument is negotiated and assumed to have no incentive effect on the workers' effort decisions. But this does not lie in conformity with empirical evidence according to which profit sharing enhances effort provision and thereby productivity (see e.g. Wadhvani and Wall (1990), Cahuc and Dormont (1997) and Booth and Frank (1999)).¹

In this paper we first incorporate the productivity effect of profit sharing into our model in an environment with firms facing revenue uncertainty by focusing on a production technology with unit elasticity of substitution between employment and effort. This combines and unifies elements from union bargaining and efficiency wage theories so that we can explore the implications of profit sharing in a more realistic way, which

¹ Furthermore, in many countries profit sharing is embedded in a legal setting, which requires the profit-sharing schemes to be independent of the wage agreements (see, for example, Cahuc and Dormont (1997) or Pendleton *et al.* (2001)).

lies in conformity with empirics. Second, we analyse the following unexplored issue. How does the time sequence between base wage formation and profit sharing impact on both the negotiated wage and the optimal profit share and its determinants?

Section II presents the basic structure of the model and various time sequences for the profit sharing decision. The determination of effort by employees and the employment decision by firms are presented in section III, while section IV investigates the determination of the compensation scheme under flexibility versus commitment in terms of the profit sharing decision as well as the case where the profit share and the base wage are negotiated simultaneously. Finally, we present a brief conclusion.

II. Basic Framework

We consider a representative firm operating in an environment with revenue uncertainty. In conformity with the efficiency wage hypothesis we assume that the output depends not only on the number of workers employed, but also on the effort supplied by each worker, i.e. productivity. By employing L units of labour, each providing effort, a , the revenues accruing to the firm are given by

$$(1) \quad \theta R(a, L) \quad ,$$

where θ denotes a random revenue shock with a cumulative distribution function $F(\theta)$, and a density function $f(\theta)$, with the support $[\theta_{\min}, \theta_{\max}] \subseteq R_+$. We assume that the production function $R(a, L)$ satisfies the conventional properties: $R_a > 0$, $R_{aa} < 0$, $R_L > 0$, $R_{LL} < 0$ and $R_{aL} > 0$.

The profit share, τ , determines what fraction of the firm's profits is transferred to employed workers as part of the contract. The firm unilaterally determines the employment level and the employee the effort level once wages and profit sharing have been determined. As the trade union is formed by homogenous agents and as intra-organizational agency issues within the union are outside the scope of our analysis, the union is assumed to be able to enforce the effort provision by the representative union

member so as to eliminate the potential free rider problems.² We summarise the various alternative timing of decisions made by the firm, the union and the union members in Figure 1.

	Stage 1	Stage 2	Stage 3	Stage 4
(I)	w^N	τ^f	(L, a)	θ
(II)	τ^c	w^N	(L, a)	θ
(III)	Stage 1		Stage 2	Stage 3
(i)	(w^N, τ^N)		(L, a)	θ
(ii)	(w^N, τ^s)		(L, a)	θ

Figure 1: Alternative time sequences of decisions in terms of employment L , effort a , profit share τ , base wage w^N and resolution of uncertainty θ .

The timing structure (I) captures the idea that the negotiated base wage serve as a commitment, which the firm takes as given when it makes its profit-maximizing profit-sharing decision. Subsequent to the profit sharing decision, the firm unilaterally determines employment and the union members effort provision. Finally, once all these decisions are made, uncertainty is resolved. The timing structure (II) exchanges the relative timing of the determination of profit sharing and wage negotiations. This timing highlights a scenario where the firm commits to the profit share in anticipation of the base wage. Finally, the timing structure (III) captures simultaneous determination of profit shares and base wages. In order to compare the results we explore two versions of this relative timing: simultaneous determination of profit shares and wages, where the profit share is negotiated or where the firm sets it.

III. Labour Demand and Effort

The risk-neutral firm decides on employment L so as to maximize the expected profits

² If we were to apply an alternative formulation where individual efforts were not directly observable and workers were heterogeneous, group punishment or reward schemes would have to be used for enforcement (see e.g. Holmström (1982)). This is an important issue for further research.

$$(2) \quad E\pi(a, L) = \int_{\theta_{\min}}^{\theta_{\max}} (\theta R(a, L) - wL) f(\theta) d\theta$$

Conditional on the negotiated base wage and profit share the risk-neutral representative employed union member makes the effort decision in order to maximize the expected utility

$$(3) \quad Eu(a, L) = w + \frac{\tau}{L} \int_{\theta_{\min}}^{\theta_{\max}} (\theta R(a, L) - wL) f(\theta) d\theta - g(a),$$

where the disutility of effort, $g(a)$, is an increasing ($g'(a) > 0$) and convex ($g''(a) > 0$) function of effort. The optimal employment and effort provision is determined by the system of first-order conditions

$$(4) \quad \int_{\theta_{\min}}^{\theta_{\max}} \theta R_L(a, L) f(\theta) d\theta - w = 0$$

and

$$(5) \quad \frac{\tau}{L} \int_{\theta_{\min}}^{\theta_{\max}} \theta R_a(a, L) f(\theta) d\theta - g'(a) = 0.$$

According to (4) the firm chooses the employment level so as to equalize the expected marginal return from labour to the wage cost, while (5) characterizes the determination of effort by a representative employee so as to equalize the expected marginal benefit from effort to the marginal disutility of effort.

In order to make the comparison of results with the earlier literature more transparent, we make the following two parametric specifications for the functional forms of the production technology and the disutility of employee effort.

Assumption R: *The technology is assumed to satisfy the concave production function*

$$R(a, L) = \frac{(aL)^\alpha}{\alpha} \quad \text{with } 0 < \alpha < 1.$$

Assumption G: *The increasing and convex disutility of effort belongs to the class of iso-elastic functions $g(a) = \gamma a^{1/\gamma}$ with $0 < \gamma < 1$.*

Under assumptions R and G the equilibrium condition (4) with respect to the employment decision can be written as follows

$$(6) \quad L^* = \bar{\theta}^\eta w^{-\eta} a^{\eta-1},$$

where $\bar{\theta}$ denotes the expected value of revenue shock and $\eta = 1/(1-\alpha) > 1$ is the direct wage elasticity of labour demand. Labour demand depends negatively on the base wage and positively on the effort of employee.

Analogously, by substituting assumption G into (5) we find that the optimal effort is given by

$$(7) \quad a^* = [\tau w]^\gamma, \quad 0 < \gamma < 1.$$

Hence the optimal effort depends positively on the base wage as well as on profit sharing.

We can now summarize our characterization of the optimal combination of employment and effort provision in

Proposition 1: *Labour demand depends negatively on the base wage and positively on the effort of employees, while effort by employees depends positively on the profit share as well as on the base wage.*

Equation (6) suggests that labour demand does not *directly* depend on profit sharing, which lies in conformity with empirical evidence (see e.g. Wadwani and Wall (1990)) and Cahuc and Dormont (1997)). Profit sharing enhances productivity by stimulating effort provision.³

³ Some aspects of the interactions between wage bargaining and efficiency wage considerations have been previously analysed e.g. in Lindbeck and Snower (1991), Sanfey (1993) and Garino and Martin (2000). In contrast to our analysis, in these papers the effort function was not derived from the employee's objective function.

IV. Wage Bargaining with Flexible and Committed Profit Sharing

IV.1. Base Wage and Profit Share Flexibility

We first analyse the timing structure (I) (see Figure 1), where the firm is flexible by deciding on the profit share after the base wage negotiation. Hence at stage 2 the firm decides on the profit share in order to maximize the expected net profit subject to (6) and (7) and by taking the base wage as given according to

$$(8) \quad \underset{\tau}{Max} \quad (1-\tau)E\pi = (1-\tau) \left[\bar{\theta} \frac{\eta}{\eta-1} (aL)^{\frac{\eta-1}{\eta}} - wL \right]$$

It is shown in Appendix A that the optimal profit share, when it will be decided after wage negotiation, is

$$(9) \quad 0 < \tau^f = \frac{(\eta-1)\gamma}{1+(\eta-1)\gamma} < 1,$$

where $\gamma = \frac{a_\tau \tau}{a}$. Hence, profit sharing depends positively both on γ and on $\eta-1$ so that we have

Proposition 2: *Under flexible profit sharing the optimal profit share depends positively on both the elasticity of effort with respect to profit sharing (γ) and the elasticity of labour demand with respect to effort ($\eta-1$).*

At stage 1 the base wage is negotiated. We apply the Nash bargaining solution, according to which employment and profit sharing are unilaterally determined by the firm, whereas effort is provided subject to the discretion of employees. In line with (3), the objective function of the trade union can be written as $E\hat{U} = L \left[w + \frac{\tau}{L} E\pi \right] + (N-L)b - Lg(a)$, where the first term captures the benefits from employment to employed workers, the

second term the benefits for unemployed union members and the last term denotes the disutility of effort for employed union members. We assume that the threat points of the union and the firm are $EU^o = Nb$ and $E\pi^o = 0$, respectively. The calculation of the union's expected rent captures the idea that all the N workers have incentives to seek employment. Union members, who are left unemployed, have the outside option b . Thus the rent of the union, EU , is calculated to be

$$(11) \quad EU = EU(a^*, L^*) = E\hat{U} - EU^o = L^* \left[w - b + \frac{\tau}{L} E\pi(a^*, L^*) - g(a^*) \right].$$

Applying the traditional Nash bargaining solution the negotiating parties decide on w in order to solve

$$(12) \quad \underset{(w)}{Max} \Omega = [EU]^\beta [(1-\tau)E\pi]^{1-\beta}$$

subject to the labour demand (6) and the effort determination (7), where β and $1-\beta$ describes the relative bargaining power of the union and the firm, respectively. The Nash bargaining solution has to satisfy the following first-order condition

$$(13) \quad \beta \frac{EU_w}{EU} + (1-\beta) \frac{E\pi_w}{E\pi} = 0$$

where the subscript w denotes the partial derivatives with respect to the wage rate. We assume that the sufficient second-order condition for the Nash bargaining solution (13) holds. The determinants of the negotiated base wage w^N can be expressed through the implicit representation

$$(14) \quad w^N = \frac{1 + \frac{\beta}{\eta^* - 1}}{1 + \frac{\tau}{\eta - 1}} b + \frac{1}{1 + \frac{\tau}{\eta - 1}} g(a^*),$$

where $\eta^* = -\frac{wL_w^*}{L^*} = \eta - (\eta - 1)\gamma$ denotes the total wage elasticity of labour demand, which incorporates both the direct negative employment effect and the indirect positive effect via effort provision. Hence profit sharing has two opposite effects on the negotiated base wage: (i) it tends to induce wage moderation as part of the compensation is shifted to the performance-related profit share and (ii) the effort-enhancing effects of profit sharing will also increase the costs of effort provision and thereby increase the “individual rationality” constraint of each union member, which will have a positive effect on the wage rate, ceteris paribus. By substituting the optimal effort (7) into (14) the Nash bargaining solution can be expressed in explicit form (see Appendix B) as follows

$$(15) \quad w^N = \frac{1 + \frac{\beta}{\eta^* - 1}}{1 + \tau \left[\frac{1}{\eta - 1} - \gamma \right]} b \quad .$$

The wage rate increases with the outside option and the bargaining power of the union, and decreases as a function of the total wage elasticity of labour demand. Under the assumption that the wage-moderating effect of profit sharing dominates relative to the cost of effort provision, i.e. if $(\eta - 1)\gamma < 1$, we can now summarize our analysis in

Proposition 3: *The negotiated wage is proportional to the outside option available to the union, increasing in the bargaining power of the union, and decreasing in the total wage elasticity of labour demand. Furthermore, profit sharing will moderate the negotiated base wage if $(\eta - 1)\gamma < 1$.*

The negotiated base wage equation (15) represents a generalization relative to the traditional Nash bargaining solution.⁴

⁴ Our analysis associated with the Nash bargaining solution (15) simultaneously includes profit sharing and efficiency wage considerations. Altenburg and Straub (1999), Bulkley and Myles (1996), Lindbeck

IV.2. Base Wage and Profit Share Commitment

Next we analyse the timing structure (II) (see Figure 1), where the firm commits to the profit share prior to the base wage negotiation. When the firm commits to the profit share, it means that equation (8) is maximized with respect to τ subject to labour demand (6), effort determination (7) and the Nash bargaining solution for the base wage. Using a similar procedure as in Appendix A, the optimal profit share is found to be

$$(16) \quad \tau^c = \frac{(\eta - 1) \left[\gamma - \frac{w_\tau^N \tau}{w^N} \right]}{1 + (\eta - 1) \left[\gamma - \frac{w_\tau^N \tau}{w^N} \right]},$$

for the case when the firm commits itself to the profit share before the wage negotiation (see also Koskela and Stenbacka (2004)).

Based on a straightforward comparison between (16) and (9) we can conclude that $\tau^c > \tau^f$. This means that under commitment the optimal profit share is larger than that associated with flexibility. Furthermore, under commitment the profit share is increasing as a function of γ , $\eta - 1$ and of the elasticity of base wage with respect to profit sharing ($-\frac{w_\tau^N \tau}{w^N}$).

This is summarized as

Proposition 4: *The optimal profit share under commitment exceeds that under flexibility. Furthermore, the profit share under commitment is increasing as a function of the elasticity of effort with respect to profit sharing (γ), of the elasticity of labour demand with respect to effort ($\eta - 1$) and of the elasticity of base wage with respect to profit sharing ($-\frac{w_\tau^N \tau}{w^N}$).*

and Snower (1991) and Sanfey (1993) analyse related issues, but these models do not include profit sharing as an incentive device.

Intuitively, under commitment profit sharing has a wage-moderating effect. This effect adds to the returns from profit sharing. Thus, the optimal profit share under commitment exceeds that associated with flexibility.

IV.3. Base Wage and Profit Share Negotiation

Finally, we analyse the timing structure (III) (see Figure 1), where the profit share and the base wage are determined simultaneously. We first study the negotiated profit share (scheme III(i)) and configuration where the firms decides on the profit share simultaneously with the base wage negotiation (scheme III(ii)).

With simultaneous negotiation the parties decide on w and τ in order to solve

$$(17) \quad \underset{(w, \tau)}{\text{Max}} \Omega = [EU]^\beta [(1-\tau)E\pi]^{1-\beta}$$

subject to the labour demand (6) and the effort determination (7). This gives a negotiated base wage, which formally looks identical to (15). In terms of profit sharing we have the following first-order condition

$$(18) \quad \beta \frac{EU_\tau}{EU} + (1-\beta) \frac{E\pi_\tau}{E\pi} - \frac{1-\beta}{1-\tau} = 0.$$

Solution of equation (18) yields the following implicit representation of the negotiated profit share

$$(19) \quad \tau^N = \frac{\beta + (\eta-1)\gamma - \beta X}{1 + (\eta-1)\gamma - \beta X},$$

where $0 < X = \frac{1}{1 + \frac{A}{A-1} \tau \left[\frac{1}{\eta-1} - \gamma \right]} < 1$ with $A = \frac{1 + \frac{\beta}{\eta^* - 1}}{1 + \tau \left[\frac{1}{\eta-1} - \gamma \right]}$ denoting the mark-up

whereby the base wage w^N exceeds the outside option b (see Appendix C). From (19) we can directly infer that the negotiated profit share is an increasing function of the union's bargaining power, i.e. $\frac{\partial \tau^N}{\partial \beta} > 0$. In particular, by allocating the bargaining power completely to the firm or to the union we obtain the following two special cases

$$(20) \quad 0 < \tau^s \Big|_{\beta=0} = \frac{(\eta-1)\gamma}{1+(\eta-1)\gamma} < 1 \text{ and } \tau^M \Big|_{\beta=1} = 1 \quad .$$

From (20) we can observe that the profit share where the firm decides on the profit share simultaneously with the wage negotiation, i.e. $\tau^s = \tau \Big|_{\beta=0}$, coincides with that associated with flexible profit sharing when the firm decides about it after the base wage negotiation. In other words, the relationship $\tau^f = \tau^s$ holds. Moreover, the negotiated profit share τ^N , is increasing as a function of the trade union's bargaining power. Furthermore, for each $0 < \beta < 1$ presence of the efficiency effect raises the negotiated profit share (see (19) and (20)).

We can now summarize our analysis of the timing structure where the profit share is determined simultaneously with the base wage negotiation.

Proposition 5: *The Nash bargaining solution for profit sharing, when determined simultaneously with the base wage, is increasing in the bargaining power of the union and is higher in the presence of productivity effect when the union has some bargaining power, i.e. $0 < \beta < 1$. Further, when the firm decides on profit sharing simultaneously with the wage bargaining, the optimal profit share is identical to the profit share under flexibility.*

V. Brief Conclusion

This study has offered a new unified framework for analyzing the determination of employment, the effort provided by employed union members, the wage, and profit sharing when firms face uncertainty generated by a stochastic revenue shock. Our analysis focused on the implications for the optimal profit share of the relative timing structure of profit sharing and wage bargaining.

Most importantly, we demonstrated that the optimal profit share under commitment exceeds that under flexibility. This holds true, because by committing to a profit share the firm can induce wage moderation. This wage-moderating effect promotes profit sharing as it adds to the returns from using the profit sharing instrument. Moreover, when the firm decides on profit sharing simultaneously with the wage bargaining, the optimal profit share is identical to the profit share under flexibility. Finally, if the profit share is determined through Nash bargaining, the profit share is higher in the presence of the productivity effect when the trade union has some bargaining power.

Appendix A: Derivation of the optimal profit share with flexibility

The first-order condition associated with the maximization of (8) with respect to τ and subject to (6) and (7) (for given w) is

$$(A1) \quad -\left[\bar{\theta} \frac{\eta}{\eta-1} (aL)^{\frac{\eta-1}{\eta}} - wL\right] + (1-\tau)\bar{\theta} (aL)^{\frac{-1}{\eta}} L a_{\tau} = 0 ,$$

where $a_{\tau} = \frac{\gamma a}{\tau}$, $aL = \bar{\theta}^{\eta} w^{-\eta} a \eta$ and $wL = \bar{\theta}^{\eta} w^{1-\eta} a^{\eta-1} = aL(\frac{w}{a})$. By using these expressions we can rewrite (A1) as follows

$$(A2) \quad wa^{-1} = wa^{-1} \left[\frac{\eta}{\eta-1} - \frac{(1-\tau)\gamma}{\tau} \right]$$

which gives (9).

QED

Appendix B: Derivation of the negotiated wage

This appendix develops the expressions for the terms $\frac{E\pi_w}{E\pi}$ and $\frac{EU_w}{EU}$ in the first-order condition (13) of the Nash bargaining. The optimal employment decision of the firm has to satisfy the first-order condition $E\pi_L = 0 \Leftrightarrow (aL)^{\alpha-1} = \frac{w(1+r)}{a\eta}$. By taking this into

account we find that $E\pi_w = (1+r)\frac{L}{w}\left[\frac{w}{\eta} - \frac{wa_w}{a} - w\right] = (1+r)L[\gamma - 1] < 0$, where the

wage elasticity of effort $\frac{wa_w^*}{a^*} = \gamma$ is constant by (7). Given $E\pi = (1/(\eta - 1))wL$ we can conclude that

$$(B1) \quad \frac{E\pi_w}{E\pi} = \frac{1}{w}[\gamma - 1][\eta - 1] < 0 \quad \text{and} \quad \frac{EU_w}{EU} \text{ can be expressed according to}$$

$$(B2) \quad \frac{EU_w}{EU} = \frac{1}{w} \left[-\eta^* + \frac{w + \frac{\tau}{L}E\pi((\gamma - 1)(\eta - 1) + \eta^*) - g(a^*)}{w - b + \frac{\tau}{L}E\pi - g(a^*)} \right],$$

where $\eta^* = -\frac{wL_w^*}{L^*} = \eta - (\eta - 1)\gamma$. Making use of η^* we can rewrite (B2) according to

$$(B3) \quad \frac{EU_w}{EU} = \frac{1}{w} \left[\frac{(\eta^* - 1) \left[g(a^*) - w - \frac{\tau}{L}E\pi \right] + \eta^* b}{w - b + \frac{\tau}{L}E\pi - g(a^*)} \right].$$

Substituting (B1) and (B3) into equation (13) of the text yields (14) and (15). **QED**

Appendix C: Derivation of the negotiated profit share

This appendix develops the expressions for the terms $\frac{E\pi_\tau}{E\pi}$ and $\frac{EU_\tau}{EU}$ in the first-order condition (18) associated with the Nash bargaining for profit sharing and solves it to produce equation (19). We first find that $E\pi_\tau = E\pi \frac{L_a a_\tau}{L}$ so that by using the properties of labour demand (6) and effort (7) equations we end up with

$$(C1) \quad \frac{E\pi_\tau}{E\pi} = \frac{(\eta - 1)\gamma}{\tau}.$$

Differentiating $EU = L \left[w - b + \frac{\tau}{L} E\pi - g(a) \right]$ with respect to τ yields

$EU_\tau = \left\{ [1 - \gamma(\eta - 1)] + \frac{\tau}{E\pi} E\pi_\tau \right\} E\pi - \frac{Lg(a)}{\tau} + \frac{EU}{L} L_\tau$. Using the properties of the labour demand and the profit function we get

$$(C2) \quad \frac{EU_\tau}{EU} = \frac{(\eta - 1)\gamma}{\tau} + \frac{E\pi}{EU} - \frac{g(a)}{\tau \left[w - b + \frac{\tau}{L} E\pi - g(a) \right]}$$

Now we can re-express the first-order condition (18) as

$$(C3) \quad \frac{(\eta - 1)\gamma}{\tau} + \frac{\beta}{\tau} \left[\frac{EU - L(w - b)}{EU} \right] - \frac{(1 - \beta)}{(1 - \tau)} = 0$$

After some manipulation we end up with

$$(C4) \quad \tau^N = \frac{(\eta - 1)\gamma + \beta(1 - X)}{1 + (\eta - 1)\gamma - \beta X},$$

$$\text{where } 0 < X = \frac{1}{1 + \frac{A}{A-1} \tau \left[\frac{1}{\eta - 1} - \gamma \right]} < 1 \text{ with } A = \frac{1 + \frac{\beta}{\eta^* - 1}}{1 + \tau \left[\frac{1}{\eta - 1} - \gamma \right]}. \quad \text{QED}$$

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