

Union-Firm Bargaining Under Alternative Pay Schemes: Does Performance Related Pay Fair Better?

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Abstract

This paper compares and contrasts equilibrium outcomes under right-to-manage bargaining (RTM) and efficient bargaining (EB) corresponding to two alternative pay schemes, fixed wage vis-a-vis piece-rate. It shows that with a strong labour union, bargaining over piece-rate generates higher social welfare than bargaining over fixed wage. Moreover, in case of piece-rate pay scheme, social welfare under RTM exceeds that under EB, if the union is very strong. It also shows that, under EB, in case of piece-rate wage schedule output, union's payoff, profit, and social welfare are higher, but employment is lower than fixed wage pay scheme. However, under RTM the wage rate, output, and union's payoff are not necessarily higher in case of piece-rate wage schedule compare to fixed wage pay scheme.

Key words: Bargaining, Fixed wage, Piece-rate, Social welfare, Union

JEL Classifications: J33, J51, L21, C78, D60

I Introduction

Bargaining over labour contracts between a firm and its labour union is a widely observed phenomenon in the real world. Large number of studies have attempted to explain different aspects and consequences of collective bargaining. However, as far as wage is concerned, existing models of collective bargaining - 'right-to-manage bargaining' (henceforth, RTM) in which firms and unions negotiate over wages only (following Nickell and Andrews, 1983)

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or ‘efficient bargaining’ (henceforth, EB) in which both wages and employment are negotiated with unions (based on McDonald and Solow, 1981)¹ - assume that time consistent fixed wage rate is the bargaining agenda, do not consider piece-rate wage schedule.

Offering performance related pay, e.g. piece-rates, rather than fixed wage is a quite general practice in many modern firms (Shearer, 2004; Haley, 2003; Lazear, 2000) due to its positive impact on productivity. The underlying reason behind such practice is, piece-rate pay scheme helps to eliminate the moral hazard problem. This result is well documented in the literature. Analyzing data of garment factory operated in Napa, California, Hamilton et al. (2003) argue that group piece-rate is more beneficial for the firm than individual piece-rates. Utilizing plant level monthly time-series data over a 10 year period on ITC limited, India, Bhattacharjee (2005) has shown that group based incentive pay has positive and significant impact on productivity. Looking at data of last ten years, from the year 1996 to 2005, on 10 small-scale manufacturing firms in Pune, India, we find that 7 firms have adopted group-based incentive pay schemes, and out of those 7 firms all workers are unionised in 4 firms. Moreover, firms which were able to get rid of fixed-wage pay scheme are doing better, profit of those firms have increased by more than 10 % due to change in pay scheme (Dixit, 2006). Given these empirical evidences, it is important to examine the impact of piece-rate on social welfare and on firms’ performance when workers are unionised and bargains over employment and/or piece-rate. To the best of our knowledge, a model of collective bargaining which considers piece-rate as a bargaining agenda is not yet available in the literature.

Instead of bargaining over fixed wages, the firm may adopt the following bargaining agenda. Each worker will get the reservation wage rate plus an amount which is in proportion to total output produced; and that proportionate factor, which we will call as piece-rate, will be determined through bargaining.

Then the questions are as follows. Does bargaining over piece-rate generate more output, employment, and profit compared to fixed wage bargaining? Does labour union prefer piece-rate over fixed wage. Which bargaining agenda, fixed wage *vis-a-vis* piece-rate, is socially desirable? Does EB leads to higher SW compared to RTM even in case of piece-rate pay scheme? This paper attempts to answer these questions.

First, we consider RTM in which the union-firm pair bargains over the piece-rate only. We find that, in case of piece-rate wage schedule, the labour union loses in terms of employment. However, it gains in terms of wage rate, if the productivity of labour improves beyond a critical level due to piece-rate pay scheme. Output might be higher or lower in case of piece-rate wage schedule depending upon the magnitude of the positive impact of piece-rate pay scheme on productivity. It is found that the interests of the firm and the union may be in conflict. The firm always prefers piece-rate wage schedule, but if productivity of labour under piece-rate pay scheme is not above a critical level, the labour union prefers fixed wage pay scheme.

Next, under EB the wage rate, output, union's payoff, firm's profit and social welfare are higher in case of piece-rate wage schedule. However, employment is lower in case of piece-rate wage schedule.

Finally, comparing social welfare under RTM in which piece-rate is the bargaining agenda and EB we find that social welfare in case of RTM is greater than social welfare under EB, if the union is very strong. This finding is in sharp contrast to the widely known result that EB is always preferred to RTM from social welfare point of view, irrespective of the union's bargaining power.

II The Model

Our model has two players: one firm and its labour union. The labour union is sufficiently large (having N member) to meet the labour demand in the firm. The firm and its labour union bargain over the level of employment and/or wage. The bargaining power of the labour union is γ ($0 \leq \gamma \leq 1$), and the bargaining power of the firm is $(1 - \gamma)$. Union membership is exogenously given. The union is risk neutral and tries to maximise the net wage bill (see e.g. Oswald, 1982; Booth, 1995; Pencavel, 1991; Petrakis and Vlassis, 2004) $U = (w - r)l$ over and above the reservation wage bill rN , where w is the total wage per unit of labour and r is the reservation wage rate. l is employment in the firm, with $N \geq l$.²

The firm is the monopoly producer and its production technology is assumed, for simplicity, to be CRS: $q = \theta l$, where q is the amount of output and l is the level of employment. θ is the marginal (average) productivity of labour. The market demand curve is assumed to be linear: $p = A - q$. The firm's objective is to maximise the profit $\Pi = pq - wl$.

We consider two alternative pay schemes: fixed wage and piece-rate. Large number of empirical studies find that performance related pay enhances firms' performance and productivity of labour significantly, we have mentioned few foremost studies before. Moreover, theoretical literature on incentive pay explicitly argues that performance related pay, e.g. piece-rate, performance bonus, etc., helps to eliminate moral hazard problems and induces workers to exert higher level of effort. In line with these findings, we consider that $\theta = 1$, if workers are paid the fixed wage rate w ; and $\theta > 1$, if workers are paid according to the piece-rate wage schedule $w = r + \beta q$. Such type of piece-rate wage schedule may be called as group piece-rate, since the wage rate depends on the total output produced by the union rather than by individual workers.

It can be explicitly derived that workers will have higher productivity under piece-rate following standard models of incentive pay. One can consider a representative worker and analyze it's labour-leisure choice under alternative pay schemes to understand the underlying mechanism which leads to the choice of higher level of effort and hence higher productivity under piece-rate.³ Such analysis is very well known and has taken place in

textbooks. So, we prefer to use the end result of this analysis, instead of explicitly deriving it in this paper, and focus on main questions of this paper.

Fixed wage

First, let's consider the fixed wage pay scheme. A firm as an organization would like to maximise the joint payoff $Z = pq - rl$. Since $p = A - q$ and $q = l$ it reduces to

$$Z = \max_l (A - l)l - rl$$

It is easy to see that the solution of the problem is:

$$l^* = \frac{A-r}{2}$$

The problem with the RTM model is that the firm and the worker bargain over the wage only. The union wants to extract rents and therefore demands a wage above the workers' reservation wage and this distorts the hiring decision and the output level of the monopolist. Under EB this problem does not occur because the firm and the union bargain over both output and wages. In a way we can think of this as a sequential procedure. First, the two parties choose the efficient output level and then they divide the surplus.

To see this, it is useful to write down the the optimization problems behind RTM and EB.

RTM

The RTM model is solved via backward induction. In the second stage the firm chooses l given the *fixed* wage w . Formally,

$$l_f^T = \arg \max \Pi = \arg \max (A - l)l - wl$$

The solution is $l_f^T = \frac{A-w}{2}$. The subscript f denotes that there is fixed wage pay scheme, and superscript T denotes that the bargaining is RTM.

Thus, for any $w > r$ the monopolist will choose an inefficiently low level of output. Next, in the first stage, the pair bargains over the fixed wage, anticipating the ex-post employment level is given by l_f^T . Formally,

$$w_f^T = \arg \max [(w - r)l]^\gamma [(A - l)l - wl]^{1-\gamma} \text{ s.t. } l = \frac{A-w}{2}$$

The above problem has a well known solution. Namely,

$$w_f^T = r + \gamma \left(\frac{A-r}{2} \right).$$

Finally, substituting w_f^T into the expression for l_f^T yields

$$l_f^T = \frac{2-\gamma}{2} \frac{A-r}{2} < \frac{A-r}{2} \quad \forall 0 < \gamma < 1.$$

The payoffs of the union and the firm, and social welfare (measured as the sum of consumer surplus and producer surplus) will be as follows

$$\begin{aligned} U_f^T &= \frac{\gamma(2-\gamma)}{8}(A-r)^2 \\ \Pi_f^T &= \frac{(2-\gamma)^2}{16}(A-r)^2 \\ SW_f^T &= \frac{3(2-\gamma)^2}{32}(A-r)^2 \end{aligned}$$

EB

Next, consider the standard EB in which both the fixed wage rate and employment level are simultaneously determined through bargaining. The optimization problem for a firm and union that bargain over l and w is given by

$$\max_{w,l} [(w-r)l]^\gamma [(A-l)l - wl]^{1-\gamma}$$

After some straight forward calculations we obtain

$$\begin{aligned} l_f^E &= l^* = \frac{A-r}{2} \\ w_f^E &= r + \gamma\left(\frac{A-r}{2}\right) \end{aligned}$$

Hence the output choice is jointly optimal. In this case payoffs of the union and the firm, and social welfare will be as following.

$$\begin{aligned} U_f^E &= \frac{\gamma}{4}(A-r)^2 \\ \Pi_f^E &= \frac{1-\gamma}{4}(A-r)^2 \\ SW_f^E &= \frac{3-2\gamma}{8}(A-r)^2 \end{aligned}$$

The superscript E denotes that the bargaining is EB.

It is straight forward to see that $SW_f^E > SW_f^T$, $\forall \gamma \in (0, 1]$. That is, *if workers are paid a fixed wage, EB is preferred to RTM from the social welfare point of view, irrespective of the union's bargaining power.*

Piece-rate

Finally, let's consider the piece-rate wage schedule $w = r + \beta q$, where w is the total wage per unit of labour. Each worker receives the reservation wage rate (r) plus an amount proportional to the total output produced (βq). The proportionate factor β is the piece-rate. Clearly, under such pay scheme the workers' participation constraint is always satisfied.

Moreover, under piece-rate pay scheme the average (marginal) productivity of labour is, $\theta(> 1)$, greater than that under fixed wage pay scheme.

RTM

Let's consider the determination of output and wages under RTM with the piece-rate wage schedule. In this case the pair bargains over β in the first stage. Ex-post the firm can therefore change the wage by manipulating l in the second stage. Such type of adjustment in wages is not possible in case fixed wage pay scheme.

In the second stage, the firm's output choice is now governed by

$$l_p^T = \arg \max \Pi_p = (A - \theta l)\theta l - (r + \beta\theta l)l,$$

since $q = \theta l$, and so,

$$l_p^T = \frac{A\theta - r}{2\theta(\theta + \beta)},$$

where the superscript T denotes that the bargaining is RTM and the subscript p denotes piece-rate wage schedule.

To solve the equilibrium value of β we need to solve the following optimization problem

$$\begin{aligned} \beta = \arg \max & [(w - r)l]^\gamma [(A - \theta l)\theta l - (r + \beta\theta l)l]^{1-\gamma} \\ \text{s.t. } & l_p^T = \frac{A\theta - r}{2\theta(\theta + \beta)} \end{aligned}$$

Solving the above problem we get $\beta = \theta\gamma$.⁴

So, the equilibrium wage rate, level of employment, output, payoffs of the union and the firm, and social welfare will be as follows

$$\begin{aligned} w_p^T &= r + \frac{\gamma}{1 + \gamma} \frac{\theta A - r}{2} \\ l_p^T &= \frac{\theta A - r}{2\theta^2(1 + \gamma)} \\ q_p^T &= \frac{\theta A - r}{2\theta(1 + \gamma)} \\ U_p^T &= \frac{\gamma}{4(1 + \gamma)^2} (\theta A - r)^2 \\ \Pi_p^T &= \frac{(\theta A - r)^2}{4\theta^2(1 + \gamma)} \\ SW_p^T &= \frac{3 + 2\gamma}{8\theta^2(1 + \gamma)^2} (\theta A - r)^2 \end{aligned}$$

Clearly, higher bargaining power of the union will lead to higher piece-rate and wage; but the level of employment and output decrease as the union's bargaining power increases.

On the other hand, increase in productivity will lead to higher wage rate and output, but lower level of employment.

Comparing equilibrium wage rates under alternative pay schemes, fixed wage *vis-a-vis* piece-rate, we find that workers will get higher wages under piece-rate pay scheme, if the average productivity of labour is greater than a critical level, $\theta > 1 + \gamma - \frac{\gamma r}{A}$ (> 1). However, employment is lower in case of piece-rate pay scheme than that of fixed wage pay scheme irrespective of the level of productivity of labour. Output is higher under piece-rate pay scheme (q_p^T) than that under fixed wage pay scheme (q_f^T), if the unions bargaining power is such that $\gamma(1 - \gamma) < \frac{2r}{A-r}$ and $\theta > \frac{2r}{2r - \gamma(1 - \gamma)(A - r)}$; otherwise $q_p^T < q_f^T$. These observations leads to following proposition.

Proposition 1. *In case of bargaining over piece-rate the labour union loses in terms of employment; however, it gains in terms of wage rate, if the productivity of labour improves beyond a critical level due to piece-rate pay scheme. Output might increase or decrease, if there is a change in pay scheme from fixed wage to piece-rate, depending upon the magnitude of the positive impact of piece-rate pay scheme on productivity.*

Moreover, we find that the union's payoff is higher in case of bargaining over piece-rate, if $\theta > \frac{2r^2}{2Ar - (1 + \gamma)r(A - r)\sqrt{2(2 - \gamma)}} = \theta_1$, say. The profit of the firm is higher under piece-rate pay scheme for all $\theta \geq 1$. Social welfare, sum of consumers surplus and producers surplus, is greater under piece-rate pay scheme, if the union's bargaining power $\gamma > 0.37$ for any value of θ greater than 1. Alternatively, if $\gamma \leq 0.37$, we must have $\theta > \theta_0$ for social welfare to be greater under piece-rate pay scheme, where $\theta_0 = \frac{2r^2}{2Ar - r(A - r)(2 - \gamma)(1 + \gamma)\sqrt{\frac{3}{3 + 2\gamma}}}$ ($< \theta_1$).

So, if the productivity of labour does not improve beyond a critical level due to change in pay scheme from fixed wage to piece-rate, the firm is better off at the cost of the union. There is no obvious way to resolve this conflict. The union-firm pair may bargain over the menu of bargaining agenda, fixed wage *vis-a-vis* piece-rate, to mitigate this problem. Legal and institutional rules might also play a role to resolve this conflict.

From social welfare point of view, it is better to make the bargaining over piece-rate mandatory, if the union is strong or if the productivity of labour improves above a critical level (θ_0) due to implementation of piece-rate pay scheme. Note that the social welfare maximizing policy will always be in favour of the firm, but that may deprive the labour union.

Proposition 2. *Bargaining over a piece-rate leads to higher social welfare as compared to bargaining over fixed wage, if the union is strong ($\gamma > 0.37$) or if the productivity of labour improves above a critical level (θ_0) due to shift from fixed wage to piece-rate pay schedule. The firm always prefers piece-rate pay scheme. However, if productivity of labour under piece-rate pay scheme is less than θ_1 , the labour union prefer fixed wage pay scheme.*

EB

Next, we extend the analysis to EB in which the union-firm pair bargains over the piece-rate (β) and employment level (l) simultaneously. In this case the bargaining problem can be written as

$$Max_{\beta, l} [\beta l^2]^\gamma [l\{\theta A - \theta(\theta + \beta)l - r\}]^{(1-\gamma)}$$

Solving the above problem we get $\beta = \theta\gamma$, which is same as in case of RTM. The equilibrium wage rate, level of employment, output, payoffs of the union and the firm, and social welfare will be as follows

$$\begin{aligned}w_p^E &= r + \gamma \frac{\theta A - r}{2} \\l_p^E &= \frac{\theta A - r}{2\theta^2} \\q_p^E &= \frac{\theta A - r}{2\theta} \\U_p^E &= \frac{\gamma(\theta A - r)^2}{4\theta^2} \\\Pi_p^E &= (1 - \gamma) \frac{(\theta A - r)^2}{4\theta^2} \\SW_p^E &= (3 - 2\gamma) \frac{(\theta A - r)^2}{8\theta^2}\end{aligned}$$

Proposition 3. *Under EB the wage rate, output, union's payoff, firm's profit and social welfare are higher in case of piece-rate wage schedule. However, employment is lower in case of piece-rate wage schedule.*

Comparing the equilibrium outcomes under piece-rate wage schedule we find that employment, wage rate, output and union's payoff are greater, but profit is lower under EB than that under RTM. Under fixed wage pay scheme, wage rate is same under EB and RTM. It is to be noted that if productivity of labour remains same under alternative pay schemes, i.e. if $\theta = 1$, outcomes of EB are not sensitive to bargaining agenda, which is not the case under RTM.

Comparing social welfare under RTM and EB we find the following.

Proposition 4. *In case of piece-rate wage schedule, the social welfare is higher under RTM than under EB, if the labour union is very strong ($\gamma > 0.78$).*

Generally, it is argued that social welfare under EB is greater than RTM irrespective of relative bargaining strength of the union. Proposition 4 is in sharp contrast to this common knowledge. EB does not necessarily lead to higher social welfare always. It depends on the

bargaining agenda about wages and on the union's bargaining power. However, from the efficiency point of view and from the labour union's and the firm's joint payoff maximization point of view EB is superior than RTM even in case of piece-rate pay scheme.

If the productivity of labour remains same under two alternative pay schemes, which may be a very special case, it can be shown that (a) in case of RTM, bargaining over piece-rate leads to higher social welfare as compared to bargaining over fixed wage, if the labour union is strong, and there is a potential conflict of interest between the firm and the labour union over bargaining agenda; (b) outcomes of EB are not sensitive to bargaining agenda regarding wages; and (c) Proposition 4 holds true.

III Conclusion

We have compared outcomes of two alternative bargaining agenda about wages, piece-rate *vis-a-vis* fixed wage rate, under RTM and EB. We find that under RTM social welfare is greater in case of bargaining over piece-rate, if the union is strong. Moreover, if the union is very strong, social welfare under RTM exceeds social welfare under EB in case of piece-rate wage schedule. It holds true even if the productivity of labour remains same under two alternative pay schemes. This is a novel finding of this paper.⁵

We also find that the firm always prefers to bargain over piece-rate, irrespective of the bargaining protocol. On the other hand, the labour union's preference over bargaining agenda depends on the bargaining protocol and difference in productivity under alternative pay scheme. So, the possibility of conflict of interest of the firm and the union can't be ruled out. There is no obvious way to resolve this conflict. From social welfare point of view it is better to go for piece-rate than fixed wage, if the labour union is strong.

Moreover, we document that under EB the wage rate and output are higher, but employment is lower in case of piece-rate wage schedule. On the other hand, under RTM employment is lower in case of piece-rate wage schedule, but if the positive impact of piece-rate pay scheme on productivity is not sufficiently high, the wage rate and output might be lower than in case of fixed wage pay scheme.

It might be interesting to extend this analysis by relaxing the assumption of monopoly firm. Adopting piece-rate as the bargaining agenda might be strategically advantageous to firms under oligopoly. Analysis of union-firm bargaining over piece-rate *vis-a-vis* fixed wage under incomplete information regarding intrinsic motivation of workers and/or market demand seems to be useful also. We think these are beyond the scope of this paper, but we hope to pursue in future.

Notes

¹Recently Kraft (1998) has analyzed 'co-determined bargaining' in which only employment level is the bargaining agenda, as is the case for co-determined firms in Germany.

²The expected wage bill of the risk neutral union can be written as $\frac{l}{N}w + (1 - \frac{l}{N})r = \frac{1}{N}[(w - r)l] + r$. Clearly, maximization of expected wage bill boils down to maximization of $U = (w - r)l$, since N and r are assumed to be exogenously given.

³ It is to be note that, in the production technology $q = \theta l$, l is the number of workers employed in the firm, not the units of labour with desired level of effort.

⁴This is the only legitimate solution of the above maximization problem.

⁵ We note that, if we consider only consumer surplus as the welfare criterion, EB bargaining remains the best choice since the consumer surplus maximizing strategy would be to simply maximise quantity. However, this cannot be consistent with the preference of the firm since the firm's profit is decreasing in the wage.

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