Profit Sharing, Wage Formation and Strategic Outsourcing under Labor Market Imperfection

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Abstract

We combine profit sharing and outsourcing, if the wage for worker is decided by a labor union to analyze how does the implementation of profit sharing and outsourcing affect individual effort and the bargained wage? When the wage elasticity of effort is smaller than one higher outsourcing decreases wage formation but higher profit sharing will have ambiguous effect on wage formation. Under strategic outsourcing when the wage elasticity of effect is equal to one, higher outsourcing will have an ambiguous effect on committed profit sharing, while wage will have no effect. The firm implements committed profit sharing scheme and strategic outsourcing is higher than flexible outsourcing when wage elasticity of effort is smaller than one. When the elasticity of effort in terms of wage is only one, optimal committed outsourcing is the same as in the case of flexible outsourcing and higher outsourcing due to lower outsourcing cost will have a negative effect of the firm's committed profit sharing.

JEL Classification: E23, E24, J23, J33, J82

Keywords: strategic outsourcing, profit sharing, employee effort, labor market imperfection

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I. Introduction

Wage differences constitute a central explanation for the increasing business practice of international outsourcing across industries (see e.g. Stefanova (2006) concerning the East-West dichotomy of outsourcing). It is important to mention that Amiti and Wei (2005) emphasize the big difference in labor costs as the main explanation for the strong increase in outsourcing of both manufacturing and services to countries with low labor costs. Of course one reason for these wage gaps is the difference of labor market institutions. In most western European countries the wage is still determined by bargaining between firms and trade unions, but e.g. in eastern European or Asian countries there is either no wage bargaining or trade unions are much weaker.

Since Western European firms have the opportunity to buy foreign intermediate goods after knowing the domestic wage levels and so the marginal production cost, this will affect the domestic wage formation process for both types of workers. To induce to abstain from external procurement of intermediate goods, Western European firms need lower marginal cost. Since both wages for skilled and unskilled affect the marginal production cost, there are two components to reduce marginal cost. If lower wages are not possible, firms have to raise their productivity. One channel to increase productivity is to stimulate workers’ effort. The firm may introduce a profit sharing scheme that lets workers participate in the firm’s success. The implementation of profit sharing will induce incentives to increase effort and thus productivity for given wage levels.

Empirical studies show that profit sharing is an important phenomenon in many OECD countries.\(^1\) However, only high skilled workers, such as managers, often realize profit sharing as a part of their income. So they participate in the firm’s success, which is positively influenced by their effort. However, this dampens the advantage of domestic production and increases outsourcing activities. As profit sharing is now commonly incorporated in the compensation schemes and international outsourcing has recently increased, e.g. in Western EU-countries and

\(^1\) Pendleton et al. (2001) have presented detailed data on profit sharing schemes in 14 OECD countries. For further evidence regarding the incidence of profit sharing, see also Estrin et al. (1997) and Conyon and Freeman (2004).
in the United States, it is important to study the implications of profit sharing and wage bargaining in the presence of outsourcing.

Concerning the analysis of the effect of outsourcing on compensation schemes under wage bargaining there are two focuses in the literature, the cases of committed outsourcing and flexible outsourcing. While in the committed case, outsourcing takes place before wage bargaining\(^2\), but in the flexible case outsourcing is decided after wage bargaining. Our focus in this paper is to assume that outsourcing is strategic, i.e. determined before domestic labour demand and wage formation.\(^3\)

Concerning the effect of profit sharing, Koskela and Stenbacka (2006) have studied the differences between committed and flexible profit sharing in terms of wage formation but in the absence of outsourcing. We extend the literature of strategic outsourcing by implementing profit sharing as a part of the compensation scheme. The idea behind the implementation of profit sharing is that this will induce incentives to increase effort and so productivity for given wage level. Profit sharing will also affect the wage formation, what could lead to a lower base wage since a part of the former wage level is substituted by profit income. Since only the base wage enters marginal cost, in this case outsourcing will decrease.

In contrast to Koskela and König (2009), in this paper we combine profit sharing and outsourcing if the wage for worker is decided the labor union, but effort is decided by the worker. In this context we analyze the following questions associated with strategic outsourcing and committed profit sharing under imperfect domestic labor market in the case when profit sharing affects effort. First, what is the relationship between wage formation, profit sharing and outsourcing under strategic outsourcing? Second, will the firm implement the strategic profit sharing scheme if homogenous workers decide individually about effort provision? Third,

\(^2\) See e.g. Perry (1997) for an overview about the relationship between outsourcing and wage bargaining. Also e.g. Danthine and Hunt (1994), Zhao (2001), Chen et al. (2004), Buehler and Haucap (2006) and Koskela and Stenbacka (2009) have analyzed strategic outsourcing issue in the absence of profit sharing. Holcomb and Hitt (2007) have studied strategic outsourcing by integrating transaction-based cost theory (TCT) and resource-based view (RBV) logics also in the absence of profit sharing.

\(^3\) Chen et al. (2004) have analyzed strategic incentive for international outsourcing by focusing further trade liberalization, but in the absence of profit sharing.
are the determinants of committed profit sharing decided before wage formation different relative to flexible outsourcing decided after wage formation?

We find that profit income and wage have an individual effort-augmenting effect and thus increase productivity and wage elasticity of effort depends on the parameter of disutility of effort so that it can be smaller, equal to, or higher than one. Moreover, in the case of wage elasticity of effort being smaller than one, higher wage and higher outsourcing will increase the total wage elasticity of labor demand, while higher profit sharing will decrease the total wage elasticity of labor demand. In the presence of strategic outsourcing when the wage elasticity of effort is smaller than one, higher outsourcing decreases wage formation, whereas higher profit sharing will have an ambiguous effect on wage formation and when profit sharing elasticity of labor demand is smaller than one. When the wage elasticity of effort is one, higher outsourcing decreases wage formation, whereas higher profit sharing will have a negative effect on wage formation when profit sharing elasticity of labor demand is smaller than one. For individual effort provision, the firm optimally implements a committed profit sharing scheme and strategic outsourcing is higher than flexible outsourcing when wage elasticity of effort is smaller than one. Finally when the elasticity of effort in terms of wage is only one optimal committed outsourcing is the same as in the case of flexible outsourcing and higher (lower) outsourcing due to lower (higher) outsourcing cost will have a negative (positive) effect of the firm committed profit sharing.

We proceed as follows. Section II presents the time sequences of decisions in terms of outsourcing, employment, effort wage formation and profit sharing. Also labor demand and employee effort are presented. Section III investigates the wage formation by monopoly labor union with committed profit sharing and strategic outsourcing and Section IV studies optimal committed profit sharing and strategic outsourcing. Finally, we present conclusions in section V.

II. The Basic Framework and Optimal Labor Demand and Individual Employee Effort
We assume that output depends not only on domestic labor and international outsourcing, but also on the effort by workers, i.e. the workers’ productivity. This lies in conformity with the efficiency wage hypothesis.\(^4\) We analyze the following timing decision, which captures the idea that the representative firm is strategic to decide about the amount of outsourcing before wage determination and domestic labor demand, and also commits to profit sharing before wage determination. After the firm has decided about profit sharing and outsourcing, the monopoly trade union sets the wage subject to labor demand and effort determination. If the wage, profit share level and outsourcing are known, the representative worker decides on effort provision. We summarize these timing decisions in Figure 1 and analyze these in the following sections. The decisions at each stage are analyzed by using backward induction.

Figure 1: \textit{Time sequences of decisions in terms of outsourcing, employment, effort, wage formation and profit sharing}

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>outsourcing (M) and profit sharing (\tau)</td>
<td>wage formation (w)</td>
<td>labor demand (L) and effort determination (e)</td>
</tr>
</tbody>
</table>

First we characterize the optimal labor demand by the representative firm and the effort by the representative worker by taking profit sharing, outsourcing and wage formation as given in earlier stages. The concave production function in terms of decreasing returns to scale with respect to effective labor and outsourcing is presented

\[
F(\bar{\tau}L, M) = \frac{1}{\alpha} (\bar{\tau}L + M)^\alpha, \quad \text{with} \quad 0 < \alpha < 1, \tag{1}
\]

where the price of the output is normalized to unity, \(L\) is the amount of domestic labor and \(M\) the firm’s labor input acquired from external suppliers through

\(^4\) See e.g. the book edited by Akerlof and Yellen (1986), which includes the main initial efficiency wage papers about (i) shirking models, (ii) labor turnover models, (iii) adverse selection models and (iv) sociological models.
outsourcing as given here. The parameter $\overline{\tau}$ describes the total average effort of the firm’s worker, where the average effort is defined as $\overline{\tau} = \frac{1}{L} \sum_{i=1}^{L} e_i$, so that the impact of provision of an additional unit of effort by a single worker is $\frac{\partial \overline{\tau}}{\partial e_i} = \frac{1}{L}$. As one can see from equation (1), we assume that domestic effective labor, $\overline{\tau}L$, and outsourcing, $M$, are perfect substitutes.

II.1. Domestic Labor Demand

The firm decides on domestic labor to maximize the profit function

$$\max_L \pi = \frac{1}{\alpha} (\overline{\tau}L + M)^{\alpha} - wL - f(M).$$

by taking the average effort, $\overline{\tau}$, the negotiated wage, $w$, profit sharing, $\tau$, and outsourcing, $M$, as given. For the cost of outsourcing, we assume there are some other costs associated with outsourcing such as the price of the intermediate goods. Such costs could be costs for transport, which are exponential increasing with higher outsourcing. To allow for an exponential cost increase, we model a quadratic cost function, $f(M) = \frac{1}{2} cM^2$ with $f'(M) > 0$ and $f''(M) > 0$.

The first-order condition of (2) is

$$\frac{\partial \pi}{\partial L} = \overline{\tau} \cdot (\overline{\tau}L + M)^{\alpha-1} - w = 0$$

can be expressed as

$$L = w \frac{1}{1-a} \overline{\tau}^{1-a} - \frac{M}{\overline{\tau}},$$

In the case of perfect substitutability domestic labor demand is a negative function of both wage and the amount of outsourcing and a positive function of effort.

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5 A specification, which is also common in the literature, describes effort as the fraction of working hours that the worker actually works. Since the number of working hours is normalized to 1, the choice of an individual is $e_i \in (0;1)$ and thus $(1-e_i)$ characterizes the fraction of time spent shirking. Following this $\overline{\tau}L$ is the whole actual working time.
Higher outsourcing will decrease domestic labor demand, which lies in conformity with empirics. However, labor demand does not directly depend on profit sharing, which also lies in conformity with empirical evidence.

In the presence of outsourcing the direct own wage elasticity of the labor, \( \eta_w = \frac{\partial \ln w}{\partial w L} \), and the effort elasticity of the labor, \( \eta_e = \frac{\partial \ln e}{\partial e L} \), can be written as follows

\[
\eta_w = \frac{1}{1-\alpha} \left( 1 + \frac{M}{\bar{e} L} \right) > 1, \\
\eta_e = \frac{\alpha}{1-\alpha} + \frac{1}{1-\alpha} \frac{M}{\bar{e} L} = \eta_w - 1 > 0.
\]

II.2. Individual Employee Effort

By following the literature we assume for the employed worker that the utility function is additively separable in income and effort, where the utility depends positively on the wage and profit income and negatively on the disutility of effort. The employed worker receives an income of \( y \), which includes both the wage \( w \) and the profit income \( \tau \frac{\pi}{L} \) so that the overall remuneration can be written as \( y = w + \tau \frac{\pi}{L} \). The idea behind this is that the workers are assumed a team. The whole team gets the profit share \( \tau \cdot \pi \), what is distributed equally to the member. However, to get the profit income, it causes effort provision of a worker. Since worker dislikes effort provision, it is associated with a disutility, which can be describe by \( g(e) \), where \( g(e) = \gamma \cdot e^{1/\gamma} \) is assumed to be a convex function with \( 0 < \gamma < 1 \) so that \( g'(e) = e^{(1/\gamma)-1} > 0 \) and \( g''(e) = [(1/\gamma)-1]e^{(1/\gamma)-2} > 0 \).

Since the profit is equally distributed, every (homogenous) worker gets the same per capita profit income, but he/she realizes the individual disutility for providing a certain effort level. Thus there is space for a free-rider behavior by the single worker, which means that there is an incentive for shirking. The biggest

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6 See e.g. Görg and Hanley (2005).
7 See e.g. Wadwani and Wall (1990) and Cahuc and Dormont (1997).
problem of firm’s owner is to solve this moral hazard problem and to verify the individual effort. However, in the discussion of the free-rider problem interaction of the group member and peer pressure are often neglected. Due to the implementation of profit sharing there are incentives in the group to internalize the externalities of free-riding and avoiding shirking, since it set some incentive to observe each other and interact. This can build up a peer pressure to provide the individual effort resulting from individual utility maximization and eliminate the moral hazard problem concerning the free-rider behavior. Following Kandel and Lazear (1992), we motivate this peer pressure as a social group norm. Due to the observation, the individual falls shame or guilty if the individual effort is below this norm, since it lowers the income for each of the team member. However, also an effort above the norm will decrease the individual utility, since now the other team member will feel shame. Thus any deviation from the norm will lead to a utility loss. Therefore, the peer pressure function can be written simply as \( P(e) = (\overline{e} - e)^2 \), where \( \overline{e} \) is the social norm and defined as the average effort of all other worker than \( i \).

From this framework we can write the utility of a single employed individual in (5a) and of an unemployed individual in (5b)

\[
v = w + \tau \frac{\pi^*}{L} - \gamma e^{1/\gamma} - (\overline{e} - e)^2, \quad (5a)
\]
\[
\overline{v} = b. \quad (5b)
\]

---

8 In the literature of efficiency wage models this is solved with paying a higher wage than the competitive level, see Salop (1979), Shapiro and Stiglitz (1984) and the book edited by Akerlof and Yellen (1986), which includes as the standard efficiency wage models, i.e. shirking models, labour turnover models, adverse selection models and sociological models.

9 See the analyses by Holmstrom (1982), Holmstrom und Milgrom (1990) und Varian (1990). Radner (1986) shows, that in repeated games under certain conditions the free-rider problem can be eliminated even if the players cannot observe other players’ actions or information, but can only observe the resulting consequences.

10 Within this framework, we assume that every group member can verify the effort of the others, but the firm owner cannot do this. It should also be emphasized, that the shirking or over motivated members are punished. However, this punishment is a utility loss and not an income loss, where the utility loss can be interpreted as mental harassment or social exclusion.
The worker’s problem is to choose the level of individual effort to maximize its utility. For simplicity of analysis, suppose that observation of team member is costless and that the group norm is not affected by the individual effort. In what follows \( \frac{\partial \bar{e}}{\partial e} = 0 \). \(^{11}\) Thus the optimal individual provided effort level results from individual utility maximization of (5a) with respect to effort, which yields the first-order condition \(^{12}\)

\[
v_e = \frac{\pi_e^*}{L} - e^{(1/\gamma)-1} + 2(\bar{e} - e). \tag{6}
\]

Since we focus on individual effort determination, the effect on employment will be not taken into account. Therefore, \( \pi_e = F_e \) holds. Using our production function, and \( \bar{e} = \frac{1}{L} \sum_{i=1}^L e_i \), which leads to \( \frac{\partial \pi}{\partial e_i} = \frac{1}{L} \), we obtain \( F_e = F_e \cdot \bar{e} = (\bar{e}L + M)^{e-1} \).

Inserting the labour, equation (3), we find for the individual effect on profit \( \pi_e = F_e = w/\bar{e} \). Since we also assume Nash-behaviour, where every worker takes the effort of the others as given, the individual chooses an effort level equal to the group norm. However, every group member faces the same calculus, which means that the group norm corresponds to the average effort level. Assuming homogeneous workers, the average effort level equals individual effort and thus effort level which would be chosen without any peer pressure. Finally, we have \( e = \bar{e} = \bar{e} \). Using this, we get from solving equation (6) the effort function

\[
e = \bar{e} = \left( \frac{\pi \cdot w}{L} \right)^{\gamma}. \tag{7}
\]

Therefore, the optimal effort by the representative worker is influenced by the income parts, but outsourcing will have no direct effect.

\(^{11}\) In our framework we assume Nash behavior, where every worker chooses his/her effort taking the effort of others as given. So there is no effect of effort provision by the other workers and thus no effect on the social norm. See also Lin et al. (2002).

\(^{12}\) The index \( i \) has been dropped for notational convenience.
Since changes in wage and profit income affect all workers, every single worker will adjust its effort and thus the average effort will change. These effects we derive by taking the differential of effort function (7), which gives
\[
\frac{d\bar{e}}{dw} = \frac{\gamma(1+\eta_w)}{1+\gamma(\eta_w-1)} \bar{e} > 0 \quad \text{and} \quad \frac{d\bar{e}}{d\tau} = \frac{\gamma}{1+\gamma(\eta_w-1)} \tau > 0,
\]
so that the wage and profit sharing enhance productivity by increasing effort provision and positively affect labor demand indirectly, which lies in conformity with empirics.\(^{13}\)

Important for the next analysis is the wage elasticity of effort. In our framework we find using the notation
\[
\phi = \frac{d\bar{e}}{dw} = \frac{\gamma + \gamma \eta_w}{1 - \gamma + \gamma \eta_w} < 1 \quad \text{as} \quad \gamma > \frac{1}{2},
\]
so that the elasticity of effort in terms of wage is only one if we have the specific parameter \(\gamma = 1/2\) for the disutility of effort.\(^{14}\) According to (9) the effort elasticity increases (decreases) if the disutility of effort becomes less (more) convex. Since we are interested in the effect of profit sharing if the wage is determined by a labor union, we assume \(\gamma < 1/2\). The reason for that assumption is that only in this case the wage setting by the labor union would be bindings. The profit sharing elasticity of effort is positive, i.e. \(\phi^* = \frac{d\bar{e}}{d\tau} = \frac{\gamma}{1+\gamma(\eta_w-1)} > 0\).

We can now summarize our findings as.

**Proposition 1:** Profit income and base wage have an individual effort-augmenting effect and thus increase productivity and wage elasticity of effort depends on the parameter of disutility of effort so that it can be smaller, equal to, or higher than one.

In the next cases we concentrate mainly the implications of the case when the wage elasticity of effort does not exceed one so that \(\phi \leq 1\).

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\(^{13}\) See e.g. Booth and Frank (1999), Cable and Wilson (1990), Cahuc and Dormont (1997), Kruse (1992), Lynn Hannan (2005) and Wadhwani and Wall (1990).

\(^{14}\) In a dynamic efficiency wage model in the absence of outsourcing Jellal and Zenou (2000) have received the same result in terms of effort wage elasticity.
III. Wage Formation by Monopoly Labor Union and with Strategic Outsourcing and Committed Profit Sharing

Now we analyze the timing structure when the representative firm commits to profit sharing before the wage formation by allowing for their effects on labor demand and effort determination by taking also outsourcing as given.

We analyze the wage formation by the monopoly union (see also Cahuc and Zylberberg (2004), p. 401-403) by assuming that the union behaves utilitaristic in the presence of effort determination. Therefore the objective function of monopoly labor union is assumed to be $V = vL + (N - L)\pi$, which we can rewrite by using equations (6a) and (6b) to maximize the surplus anticipating domestic labor demand and effort determination according to

$$\begin{align*}
\max_w & \quad V = (w - g(\bar{e}) - b)L + \tau \pi^* + bN, \\
\text{s.t.} & \quad L = w \left( \frac{1}{1-a} \frac{\alpha}{\bar{e}^\alpha} - \frac{M}{\bar{e}} \right) \quad \text{and} \quad e = \bar{e} = \left( \frac{\tau \cdot w}{L} \right)^\gamma,
\end{align*}$$

where $b$ captures the exogenous minimum income for labor union members $N$.

We get as the first order condition

$$\begin{align*}
V_w = L \left[ \frac{dL}{dw} \left( w - b - g(\bar{e}) \right) + \tau \frac{d\pi^*}{dw} \frac{w}{L} + w \left( 1 - \frac{d\pi(\bar{e})}{dw} \right) \right] = 0,
\end{align*}$$

where the overall wage effect on the profit includes the direct wage effect and the indirect effect via effort, so that $\frac{d\pi}{dw} = -\left(1 - \phi\right) \cdot L < 0$ when $\phi < 1$. Using this and $\frac{dg(\bar{e})}{dw} = \frac{\bar{e}^{1/\gamma} \cdot \phi}{w}$ as well as the total wage elasticity of labor
\[ \eta = -\frac{dL}{dw} \frac{w}{L} = \eta_w(1 - \phi) + \phi = \frac{\gamma + (1 - \gamma)\eta_w}{1 - \gamma + \gamma\eta_w} \]

the first-order condition (10) can be solved to

\[ w = \frac{\eta b + \varepsilon^{1/\gamma} (\eta\gamma - \phi)}{\eta - 1 + \tau(1 - \phi)}. \]

We can see from equation (11) that profit sharing will affect the wage in different ways. The first working channel is the direct effect, which one can see in the denominator of (11), while the second is an indirect effect via the total wage elasticity and via effort, respectively via the wage elasticity of effort. Starting with the direct effect, which is described in the denominator of (11), we see that this one can be distinguished into two working channels. The first part of the term \( \tau(1 - \phi) \) describes the substitution effect. This effect will decrease the base wage, which means that a former part of the base wage is substituted by profit income. Since wage changes also affect effort provision, there will be in the second part of the term in an elasticity channel. Since a higher wage will decrease profit and therefore profit income, so that it increases the resulting utility loss for the union respectively their member. Due to this increasing effect on the union’s marginal costs, higher profit sharing will induce a less aggressive wage setting.

We now turn to a detailed mathematically analysis between profit sharing and wage formation originally in the case when the wage elasticity of effort is smaller than one, where the different working channels are demonstrated explicitly.

By using \( \varepsilon = \left( \frac{\tau \cdot w}{L} \right)^{\gamma} \) we can rewrite equation (11) as follows

\[ w = \frac{\eta}{\eta(1 - \frac{\gamma\varepsilon}{L}) + \tau(1 - \phi(1 - \frac{1}{L}))) - 1} b \]

and in this case by using \( \eta = \frac{\gamma + (1 - \gamma)\eta_w}{1 - \gamma + \gamma\eta_w} \) (see Appendix A) and \( \phi = \frac{\gamma + \gamma\eta_w}{1 - \gamma + \gamma\eta_w} \) (equation (8)) this gives the following wage formation equation
\[
 w = \frac{\gamma + (1 - \gamma)\eta_w}{(\eta_w - 1)(1 - 2\gamma + \frac{\gamma}{L}) + \tau(1 - 2\gamma + \frac{\gamma}{L})} \quad b = A(w,M,\tau)b. \quad (11')
\]

It should be emphasized that the wage is an implicit form as both the numerator and denominator in the mark-up factor, \(A(M,w,\tau)\), depend on wage \(w\) in a non-linear way via labor demand and direct wage elasticity of labor demand.

We now turn to a detailed analysis between profit sharing and wage formation in the case when outsourcing is strategic and the wage elasticity of effort is smaller than one. By implicit differentiation of (11’) with respect to profit sharing and outsourcing gives
\[
\frac{dw}{d\tau} = \frac{A_{\tau}b}{1 - A_{\tau}b} \quad \text{and} \quad \frac{dw}{dM} = \frac{A_{M}b}{1 - A_{M}b}
\]
and by substituting \(b = w/A\) we can characterize these effects on wage formation as
\[
\frac{dw}{d\tau} = \frac{A_{\tau}w}{1 - A_{\tau}w} \quad \text{and} \quad \frac{dw}{dM} = \frac{A_{M}w}{1 - A_{M}w} \quad (12)
\]

where \(1 - \frac{A_{\tau}w}{A} > 0\) under the sufficient, but not necessary, assumptions \(\frac{d\eta_w}{dw} \geq 0\) as the wage elasticity of effort does not exceed one, i.e. \(\phi \leq 1\) and \(\tau(1 - \gamma)(1 - \frac{1}{L}) \leq 1\) (see Appendix B). In terms of profit sharing in Appendix B the first term in \(\frac{A_{\tau}w}{A}\) is positive under the assumptions \(\tau \leq \left[1 - \gamma(1 - \frac{1}{L})\right]^{-1}\) and \(\gamma < 1/2\). Concerning the second term the elasticity of labor demand in terms of profit sharing is \(\frac{dL}{d\tau} \frac{\tau}{L} < 1\) as \(\frac{M'}{vL} < \frac{1}{\gamma}\) so that under this assumption the second term is negative so that under these assumptions the effect of profit sharing on wage formation is a priori
ambiguous. The profit sharing effect on wage formation is \( \frac{A_w}{A} = ? \) in the case \( \phi < 1 \) (see Appendix B), so that

\[
\frac{dw}{d\tau} = \frac{A_w}{A} = ? \quad \text{as} \quad \phi < 1
\]  

(13a)

The outsourcing effect on the mark-up is \( \frac{A_{Mw}}{A} < 0 \) as \( \phi < 1 \) (see Appendix B) so that

\[
\frac{dw}{dM} = \frac{A_{Mw}}{A} < 0 \quad \text{as} \quad \phi < 1
\]  

(13b)

under the sufficient, but not necessary, assumption \( \tau \leq \left[1 - \gamma (1 - \frac{1}{L})\right]^{-1} \). Therefore, higher outsourcing will lower the wage formation by the monopoly union when \( \phi < 1 \).

We can summarize our findings as.

**Proposition 2:** In the presence of strategic outsourcing when the wage elasticity of effort is smaller than one higher profit sharing will have an ambiguous effect on wage formation when \( \tau \leq \left[1 - \gamma (1 - \frac{1}{L})\right]^{-1} \) and when profit sharing elasticity of labor demand is smaller than one, \( \frac{dL}{d\tau} < 1 \), whereas higher outsourcing decreases wage formation under the sufficient, but not necessary assumption \( \tau \leq \left[1 - \gamma (1 - \frac{1}{L})\right]^{-1} \).

The negative relationship in Proposition 2 between low skilled wage and outsourcing can be motivated as follows. Higher outsourcing means for given wage
level a more elastic low skilled labor demand. Thus the opportunity for the labor
union to set higher wages falls. To avoid outsourcing and make integrated
production more attractive, the monopoly union reacts with a decreasing low skilled
wage.\footnote{This lies in conformity with empirics concerning evidence from various countries, e.g. Feenstra and Hanson (1999), Hijzen et al. (2005), Hsieh and Woo (2005), Egger and Egger (2006), Geishecker and Görg (2008) and Munch and Skaksen (2009).}

However, we can analyze the impact of profit sharing on wage for the
special case $\gamma = 1/2$ so that in this case the elasticity of effort in terms of wage is
one, i.e. $\phi = 1$. In this case, the effects of profit sharing and outsourcing cost can be
expressed as

$$
\left. \frac{dw}{d\tau} \right|_{\phi=1, \gamma=1/2} = \frac{w}{\tau} \left( \frac{dL}{d\tau} L \right)^{-1} = \frac{1}{2} \frac{w}{\tau} \left( \frac{dL}{d\tau} L \right) \left( 1 - \frac{dL}{dw} \right) > 0 \quad \text{as} \quad \frac{dL}{d\tau} L < 1
$$

(14)

where

$$
\left. \frac{dL}{d\tau} L \right|_{\gamma=1/2} = \frac{\alpha + \frac{M}{\tau L}}{2 - \alpha + \frac{M}{\tau L}} < 1
$$

$$
\left. \frac{dw}{dM} \right|_{\phi=1, \gamma=1/2} = \frac{dL}{dM} \frac{w}{L} = \frac{1}{2} \frac{dL}{dM} L < 0,
$$

(15)

where $-\frac{dL}{dw} L = 1$.

We can now summarize these special findings as.

**Corollary 1:** In the presence of strategic outsourcing when the base
wage elasticity of effort is one

(a) higher profit sharing will have a negative effect on wage formation

when profit sharing elasticity of labor demand is smaller than one, and
(b) higher outsourcing will decrease wage formation.

IV. Optimal Committed Profit Sharing and Strategic Outsourcing

Concerning the timing structure, presented in Section II, the representative firm has been assumed to commit to profit sharing and outsourcing to maximize profit subject to domestic labor demand (3), effort determination (7) and wage formation (11') so that we first analyze optimal committed profit sharing as

\[
\max_{\bar{\pi}} \bar{\pi} = \left(1 - \tau\right)\left[\frac{1}{\alpha} \left(\bar{\epsilon}L + M\right)^\alpha - wL - \frac{1}{2} cM^2\right] \quad \text{s.t.} \quad (16)
\]

\[
L = w^{\frac{1}{1-\alpha}} \frac{\bar{\epsilon}^{\frac{\alpha}{1-\alpha}}}{\bar{\epsilon}^{\frac{\alpha}{1-\alpha}}} - \frac{M}{\bar{\epsilon}}
\]

\[
e = \bar{\epsilon} = \left(\frac{\tau \cdot w}{L}\right)^{\gamma},
\]

\[
w = \frac{\gamma + (1 - \gamma)\eta_w}{(\eta_w - 1)(1 - 2\gamma + \frac{\tau\gamma^2}{L}) + \tau(1 - 2\gamma + \frac{\gamma}{L})} \cdot b.
\]

From (16) we get the first-order condition is \(-\pi^* + (1 - \tau)\pi^*_c = 0\), where the indirect profit is \(\pi^*_c = \frac{1 - \alpha}{\alpha} w^{\frac{a}{1-\alpha} \bar{\epsilon}^{\frac{a}{1-\alpha}}} + \frac{wM}{\bar{\epsilon}} - \frac{1}{2} cM^2\). Concerning the derivative of the indirect profit in terms of profit sharing we have (see Appendix C)

\[
\pi^*_c = \frac{wL}{\tau} \left(-\frac{dw}{d\tau} \frac{\tau}{w} + \frac{d\bar{\epsilon}}{d\tau} \frac{\tau}{\bar{\epsilon}}\right) = \frac{wL}{\tau} (\phi^* - \frac{dw}{d\tau} \frac{\tau}{w})
\]

so that the optimal committed profit sharing in the presence of strategic outsourcing is
\[
\tau^e = \frac{\alpha}{1-\alpha} \left( \phi^e - \frac{d\tau}{d\tau^e} \right)
\left[ 1 + \frac{\alpha}{1-\alpha} \left( \phi^e - \frac{d\tau}{d\tau^e} \right) + \frac{M}{(1-\alpha)\bar{e}L} \left( 1 - \frac{\alpha}{2} \frac{c\bar{e}M}{\bar{e}} \right) \right],
\]

(17)

where the effort elasticity in terms of profit sharing is \( \phi^e = \frac{d\bar{e}}{d\tau^e} = \frac{\gamma}{1+\gamma(\eta_w-1)} > 0 \)

and from equation (13b) \( \frac{d\tau}{d\tau^e} = \frac{A_x}{A} = \frac{\phi^e}{1-\frac{A_w}{A}} \) as \( \phi < 1 \) (see equation (B5) in Appendix B). This is an implicit form for profit sharing because both employee effort and labor demand will depend on profit sharing in a non-linear way and both numerator and denominator depend on outsourcing.

Comparative statics of (17) in terms of outsourcing and wage formation is ambiguous on committed profit sharing related to wage formation. If the first-order condition for committed profit sharing works correctly, then

\[ \pi^* = \frac{wL}{\tau^e} \left( \frac{d\tau}{d\tau^e} + \frac{\bar{e}}{\tau} \right) = \frac{wL}{\tau^e} \left( \phi - \frac{d\tau}{d\tau^e} \right) \]

so that in this case according to

\[-\pi^* + (1-\tau^e)\pi^* = 0 \]

profit sharing is positive so that \( 0 < \tau^e < 1 \) holds.

By differentiating the indirect profit \( \pi^* = \frac{1-\alpha}{\alpha} \frac{w}{\bar{e}} \frac{\alpha}{\bar{e}^{1-\alpha}} + \frac{wM}{\bar{e}} - \frac{1}{2} cM^2 \) in terms of outsourcing \( M \) gives (see Appendix C)

\[ \pi^*_M = \frac{w}{\bar{e}} - cM - L(1-\phi) \frac{d\tau}{d\tau^e} = 0 \]

(18)

where \( 1-\phi = 1 - \frac{d\bar{e}}{d\bar{e}} \frac{w}{\bar{e}} = \frac{1-2\gamma}{1-\gamma+\gamma\eta_w} \geq 0 \) as \( \gamma \leq \frac{1}{2} \) and \( \frac{d\tau}{d\tau^e} = \frac{A_x}{A} \frac{w}{A} < 0 \) as
Flexible outsourcing, which is determined after wage setting, is determined by $\pi^*_M = \frac{w}{e} - cM = 0$. According to (18) strategic outsourcing is higher than flexible outsourcing if the wage elasticity of effort $\phi$ is smaller than one.\footnote{In the absence of outsourcing Koskela and Stenbacka (2006) have also studied the differences between committed profit sharing and flexible profit sharing, which is decided after wage formation. They have shown that the optimal profit share under commitment is higher than under flexibility because through a profit share commitment the firms can induce wage moderation.}

We can now summarize these findings as.

\textbf{Proposition 3:} For individual effort provision, the firm will optimally implement a committed profit sharing scheme and strategic outsourcing is higher than flexible outsourcing when wage elasticity of effort is smaller than one.

Koskela and König (2009) have analyzed committed profit sharing in the case of labour union determination of wage and effort and by showing a constant effort level will result so that in this case firm’s optimal choice of profit sharing is zero. The difference between both approaches is that now the firm will induce higher productivity with the implementation of profit sharing, while this does not happen in Koskela and König (2009). Therefore the firm will not lose due to profit sharing. This result shows that the time structure with individual effort determination will generate an alternative compensation scheme with profit sharing, while in the presence of union effort determination such a scheme would optimally not be implemented.

Finally, we can analyze both committed profit sharing and strategic outsourcing for the special case $\gamma = 1/2$ so that in this case as we have already mentioned the elasticity of effort in terms of wage is one, i.e. $\phi = 1$. In this case, the strategic outsourcing (18) can be expressed as
\[ \pi_m^{*} \bigg|_{y=1/2 \land \phi = 1} = \frac{w}{\epsilon} - cM = 0 \]  

(19)

which is similar as in the case of flexible outsourcing when the elasticity of effort in terms of wage is only one, \( \phi = 1 \).

Concerning the optimal committed profit sharing in the presence of strategic outsourcing equation (17) can be simplified by using

\[ (\phi^* - \frac{dw}{d\tau} \frac{\tau}{w}) \bigg|_{y=1/2} = \frac{1}{1+\eta_w} - \frac{1}{2} \left( \frac{dL}{d\tau} - 1 \right) = \frac{1}{1+\eta_w} - \frac{1}{2} (\frac{\alpha + \frac{M}{\epsilon L}}{2 - \alpha + \frac{M}{\epsilon L}} - 1) > 0 \]  

(20)

where the effort elasticity in terms of profit sharing is

\[ \phi^* \bigg|_{y=1/2} = \frac{d\epsilon}{d\tau} \frac{\tau}{\epsilon} = \frac{1}{1+\eta_w} > 0, \]

where \( \eta_w = \frac{1}{1-\alpha}(1 + \frac{M}{\epsilon L}) > 1 \) and the labor elasticity in terms of profit sharing is

\[ \frac{dL}{d\tau} \bigg|_{y=1/2} = \frac{\alpha + \frac{M}{\epsilon L}}{2 - \alpha + \frac{M}{\epsilon L}} < 1. \]

By using (19) and (20) equation (17) in this case, \( \phi = 1 \Leftrightarrow \gamma = 1/2 \), can be expressed as

\[ \tau^* \bigg|_{y=1/2} = \frac{\alpha}{1-\alpha} \left( \frac{2(1-\alpha)}{2 - \alpha + \frac{M}{\epsilon L}} \right) \]

\[ = \left[ 1 + \left( \frac{2\alpha}{2 - \alpha + \frac{M}{\epsilon L}} \right) + \frac{(2 - \alpha) M}{2(1-\alpha) \epsilon L} \right]^{\frac{2\alpha}{2 + \alpha + (\frac{2 - \alpha}{2(1-\alpha)}) \frac{M}{\epsilon L} + (\frac{2 - \alpha}{2(1-\alpha)}) \left[ \frac{M}{\epsilon L} \right]^2}} \]
By using (21) the relationship between committed profit sharing and strategic outsourcing is negative, \( \frac{d\tau^c}{dM} \bigg|_{\beta=1, \gamma=1/2} < 0 \), because

\[
\frac{d}{dM} \left( \frac{M}{\bar{v}L} \right)_{\gamma=1/2} = \frac{(\bar{v}L - M\bar{v} \frac{dL}{dM})}{(\bar{v}L)^2} > 0
\]

so that outsourcing cost will have a positive effect on committed profit sharing, \( \frac{d\tau^c}{dc} \bigg|_{\beta=1, \gamma=1/2} > 0 \).

We can now summarize these findings as.

**Corollary 2:** For individual effort provision, when the elasticity of effort in terms of wage is only one, \( \phi = 1 \)

(a) optimal committed outsourcing is the same as in the case of flexible outsourcing and

(b) higher (lower) outsourcing due to lower (higher) outsourcing cost will have a negative (positive) effect of the firm committed profit sharing.

V. Conclusions

We have analyzed the following questions associated with strategic outsourcing and committed profit sharing under imperfect domestic labor market in the case when profit sharing affects effort. First, what is the relationship between wage formation, profit sharing and outsourcing under strategic outsourcing? Second, will the firm implement the strategic profit sharing scheme if homogenous workers decide individually about effort provision? Third, are the determinants of committed profit sharing decided before wage formation relative to flexible outsourcing decided after wage formation?
We have shown that profit income and wage have an individual effort-augmenting effect and thus increase productivity and wage elasticity of effort depends on the parameter of disutility of effort so that it can be smaller, equal to, or higher than one. Moreover, in the case of wage elasticity of effort being smaller than one, higher wage and higher outsourcing will increase the total wage elasticity of labor demand, while higher profit sharing will decrease the total wage elasticity of labor demand. In the presence of strategic outsourcing when the wage elasticity of effort is smaller than one, higher outsourcing decreases wage formation, whereas higher profit sharing will have an ambiguous effect on wage formation and when profit sharing elasticity of labor demand is smaller than one. When the wage elasticity of effort is one, higher outsourcing decreases wage formation, whereas higher profit sharing will have a negative effect on wage formation when profit sharing elasticity of labor demand is smaller than one. For individual effort provision, the firm optimally implements a committed profit sharing scheme and strategic outsourcing is higher than flexible outsourcing when wage elasticity of effort is smaller than one.

Finally when the elasticity of effort in terms of wage is only one optimal committed outsourcing is the same as in the case of flexible outsourcing and higher (lower) outsourcing due to lower (higher) outsourcing cost will have a negative (positive) effect of the firm committed profit sharing.

In our analysis we have focused on configurations where labor unions are organized by the representative industry. An interesting topic for future research would be to embed our approach within a framework, where wages are determined through negotiations between labor unions and firms. Even though such an extension might seem obvious at first thought, it would add tremendously to the analytical complexity of the analysis.

Appendix A: Calculations of the total and direct own wage elasticities in terms of wage, outsourcing cost and profit sharing

In our framework, the base wage $w$ affects labor demand in two different ways and thus we can separate the elasticity in an direct labor demand effect and an indirect
labor demand effect via effort as follows: \( \eta = -\frac{\partial L w}{\partial w} L - \frac{\partial L \bar{e}}{\partial \bar{e}} L \cdot \frac{w \, d\bar{e}}{d w} \). These effects can be expressed as \( \frac{\partial L w}{\partial w} = \eta_w, \ \frac{\partial L \bar{e}}{\partial \bar{e}} L = \eta_e - 1 \) and \( \frac{d\bar{e}}{d w} = \phi \), so that we can rewrite the total wage elasticity by using the wage elasticity of effort as follows

\[
\eta = -\frac{dL w}{dw L} = \eta_w(1 - \phi) + \phi = \frac{\gamma - (1 - \gamma)\eta_w}{1 - \gamma + \gamma \eta_w}.
\] (A1)

which is a negative function of wage elasticity of effort \( \phi = \frac{d\bar{e}}{d w} \). The special assumption \( \gamma = 1/2 \) gives \( \eta = 1 \). The total wage elasticity can be presented in terms of direct wage elasticity as

\[
\frac{\partial \eta}{\partial \eta_w} = \frac{1 - 2\gamma}{(1 - \gamma + \gamma \eta_w)^2} > 0 \quad \text{as} \quad \gamma < \frac{1}{2},
\] (A2)

so that there is the positive relationship between the total wage elasticity and the direct own wage elasticity in the case \( \gamma < 1/2 \).

As given outsourcing the effect of wage rate on the direct own wage elasticity (using equation (4a)) can be expressed as

\[
\frac{d\eta_{\text{w}}}{dw} = \frac{1}{1 - \alpha} \left( -M \frac{d \bar{e}(L)}{dw} \right) \left( \frac{\bar{e} L}{\bar{e} L} \right)^2 = \frac{M^*}{(1 - \alpha)\bar{e} L w} (1 - \phi)\eta_w > 0 \quad \text{as} \quad \phi < 1.
\] (A3)

Thus under the assumption that the wage elasticity of effort is smaller than one, higher wage will increase the direct own wage elasticity so that in this case it will also increase the total wage elasticity of labor demand according to equation (A2).

The effect of outsourcing on the direct own wage elasticity (using equation (4a)) can be expressed as

\[
\frac{d\eta_{\text{w}}}{dM} = \frac{1}{1 - \alpha} \left( \bar{e} L - M \frac{d \bar{e}(L)}{dM} \right) \left( \frac{\bar{e} L}{\bar{e} L} \right)^2 = \frac{1^*}{(1 - \alpha)\bar{e} L} (1 + \frac{M^*}{\bar{e} L}) = \frac{\eta_w}{\bar{e} L} > 0.
\] (A4)

Higher outsourcing will increase the direct own wage elasticity and in the case of \( \gamma < 1/2 \) so that in this case it will also increase the total wage elasticity of labor demand (15).\(^{17}\)

Finally, as given outsourcing the effect of profit sharing on the direct own wage elasticity (using equation (4a)) can be expressed as

\(^{17}\) This lies in conformity with empirics, see e.g. Hasan et al. (2007) and Slaughter (2001).
\[
\frac{d\eta_w}{d\tau} = \frac{1}{1-\alpha} \left( -M \frac{d(\bar{\varepsilon}L)}{d\tau} \right) = -\frac{M^*}{(1-\alpha)\bar{\varepsilon}L} \frac{1}{\tau} \frac{1}{1-\alpha} (1+\frac{M^*}{\bar{\varepsilon}L})\phi < 0. \tag{A5}
\]

According to this higher profit sharing will decrease the direct own wage elasticity.\(^{18}\) Therefore, in terms of total wage elasticity of labor demand when wage elasticity of effort being smaller than one, \(\phi < 1\), higher wage and higher outsourcing will increase the total wage elasticity of labor demand \(\frac{d\eta}{dw} > 0\), \(\frac{d\eta}{dM} > 0\), while higher profit sharing will decrease the total wage elasticity of labor demand \(\frac{d\eta}{d\tau} < 0\) QED.

**Appendix B: Derivations of the relationships between outsourcing, profit sharing and wage formation**

We find that the effect of wage on the mark-up can be expressed by using

\[A = (\gamma + (1-\gamma)\eta_w)/X, \quad \text{where} \quad X = (\eta_w - 1)(1-2\gamma + \frac{\tau\gamma^2}{L}) + \tau(1-2\gamma + \frac{\gamma}{L}), \quad \text{as} \]

\[A_w = X^{-2} \left[ X(1-\gamma)\frac{d\eta_w}{dw} - (\gamma + (1-\gamma)\eta_w)\frac{dX}{dw} \right] \] so that we have

\[A_w^w = \frac{w X(1-\gamma)\frac{d\eta_w}{dw} - (\gamma + (1-\gamma)\eta_w)\frac{dX}{dw}}{X(\gamma + (1-\gamma)\eta_w)} \tag{B1}\]

where \(\frac{d\eta_w}{dw} = \frac{M^*}{(1-\alpha)\bar{\varepsilon}L}(1-\phi)\eta_w \geq 0\) as \(\phi \leq 1\) and

\[\frac{dX}{dw} = (1-2\gamma + \frac{\tau\gamma^2}{L})\frac{d\eta_w}{dw} + (\eta_w - 1)\frac{\tau\gamma^2}{L}(-\frac{dL_w}{dw}L) + \frac{\gamma}{L}(-\frac{dL_w}{dw}L). \quad \text{Using} \]

\[\eta = -\frac{dL_w}{dw}L = \frac{\gamma + (1-\gamma)\eta_w}{1-\gamma + \gamma\eta_w}, \quad \text{we can rewrite the last part derivation of (B1) as} \]

\[\frac{dX}{dw} = (1-2\gamma + \frac{\tau\gamma^2}{L})\frac{d\eta_w}{dw} + \left[ \frac{\gamma + (1-\gamma)\eta_w}{1-\gamma + \gamma\eta_w} \right] ((\eta_w - 1)\frac{\tau\gamma^2}{L} + \frac{\gamma}{L}) > 0 \text{ as } \phi \leq 1 \tag{B2} \]

Using (B2) and \(\frac{d\eta_w}{dw} = \frac{M^*}{(1-\alpha)\bar{\varepsilon}L}(1-\phi)\eta_w \geq 0\) we can re-express (B1) as

\(^{18}\) Calculations of equations (A3)-(A5) are available upon request.
\[
\frac{A_w}{A} = Y^{-1} \left( \frac{d \eta_w}{dw} \left[ (1 - 2 \gamma)(\tau(1 - \gamma(1 - \frac{1}{L})) - 1) \right] - \frac{[\gamma + (1 - \gamma)\eta_w]^2}{1 - \gamma + \gamma \eta_w} \left( (\eta_w - 1)\gamma + 1 \right) \frac{\tau \gamma}{L} \right) < 0 \tag{B3}\]

under the sufficient, but not necessary, assumption \( \frac{d \eta_w}{dw} \geq 0 \) as the wage elasticity of effort does not exceed one, i.e. \( \phi \leq 1 \) and \( \tau(1 - \gamma(1 - \frac{1}{L})) \leq 1 \). In this case we have \( 1 - \frac{A_w}{A} > 0 \). The effect of profit sharing on the mark-up can be expressed by using

\[
\frac{A_w}{A} = Y^{-1} \left[ X(1 - \gamma) \frac{d \eta_w}{d \tau} - (\gamma + (1 - \gamma)\eta_w) \frac{dX}{d \tau} \right] \text{ so that we have } \frac{A_w}{A} = Y^{-1} \left[ X(1 - \gamma) \frac{d \eta_w}{d \tau} - (\gamma + (1 - \gamma)\eta_w) \frac{dX}{d \tau} \right] \tag{B4}\]

where

\[
\frac{d \eta_w}{d \tau} = -\frac{M^*}{(1 - \alpha)\bar{\sigma}L} \frac{1}{\tau} \left( 1 + \frac{M^*}{\bar{\sigma}L} \right) \theta^* = -\frac{M^*}{(1 - \alpha)\bar{\sigma}L} \eta_w \theta^* < 0 \quad \text{and} \quad \frac{dX}{d \tau} = (1 - 2 \gamma + \frac{\tau^*}{\bar{L}}) \frac{d \eta_w}{d \tau} - ((\eta_w - 1)\gamma + 1) \frac{\gamma \frac{d L}{d \tau}}{L} + 1 - 2 \gamma + ((\eta_w - 1)\gamma + 1) \frac{\gamma}{L},
\]

where

\[
\frac{d L}{d \tau} = \left( \frac{\alpha \gamma}{1 - \alpha} + \frac{1}{1 - \alpha} \frac{M^*}{\bar{\sigma}L} \right) \theta^* > 0, \quad \phi^* = \frac{d \bar{\sigma}}{d \tau} = \frac{\gamma}{1 + \gamma(\eta_w - 1)} > 0, \quad \text{so that this profit sharing total labor demand elasticity can be written as}
\]

\[
\frac{d L}{d \tau} = \left( \frac{\gamma(\alpha + \frac{M^*}{\bar{\sigma}L})}{(1 - \alpha)(\eta_w - 1)\gamma + 1} \right) > 0. \quad \text{Using these derivations (B4) can be written as}
\]

\[
\frac{A_w}{A} = Y^{-1} \left( \frac{d \eta_w}{d \tau} \left[ (1 - 2 \gamma)(\tau(1 - \gamma(1 - \frac{1}{L})) - 1) \right] \right. \left. \theta^* + (\gamma + (1 - \gamma)\eta_w) \left[ (\eta_w - 1)\gamma + 1 \right] \frac{\tau \gamma}{L} \left( \frac{d L}{d \tau} - \frac{1}{L} \right) - (1 - 2 \gamma) \right] \tag{B5}\]

where the first term is positive under the assumption \( \tau < \left[ 1 - \gamma(1 - \frac{1}{L}) \right]^{-1} \) and under our assumption that \( \gamma < 1/2 \). Concerning the second term and using

\[
\eta_w = \frac{1}{1 - \alpha} \left( 1 + \frac{M^*}{\bar{\sigma}L} \right), \quad \text{the elasticity of labor demand in terms of profit sharing is}
\]
\[
\frac{dL}{d\tau} = \frac{\gamma(\alpha + \frac{M^*}{\bar{e}L})}{(1-\alpha)(1-\gamma + \gamma \eta_w)} = \frac{\gamma \alpha + \gamma \frac{M}{\bar{e}L}}{1-\alpha + \gamma \alpha + \gamma \frac{M}{\bar{e}L}} < 1
\]
so that under this assumption the second term is negative so that under these assumptions the effect of profit sharing on wage formation is a priori ambiguous, \(\frac{dw}{d\tau} = ?\).

Finally, the effect of outsourcing on the mark-up can be expressed by using
\[
A_M = X^{-1} \left[ X(1-\gamma) \frac{d\eta_w}{dM} - (\gamma + (1-\gamma)\eta_w) \frac{dX}{dM} \right]
\]
so that we have
\[
\frac{A_M w}{A} = Y^{-1} w \left[ X(1-\gamma) \frac{d\eta_w}{dM} - (\gamma + (1-\gamma)\eta_w) \frac{dX}{dM} \right]
\]
(B6)

where
\[
\frac{d\eta_w}{dM} = \frac{1}{(1-\alpha)\bar{e}L} (1 + \frac{M^*}{\bar{e}L}) = \frac{\eta_w}{\bar{e}L} > 0
\]
and
\[
\frac{dX}{dM} = (1-2\gamma + \frac{\tau \gamma^2}{L}) \frac{d\eta_w}{dM} - \frac{(\eta_w-1)(\gamma + 1)\tau \gamma}{M} \frac{dL}{dM} \frac{M}{L}
\]
\[
(1-2\gamma + \frac{\tau \gamma^2}{L}) \frac{d\eta_w}{dM} + \frac{(\eta_w-1)(\gamma + 1)\tau \gamma}{\bar{e}L^2} > 0
\]

Using these derivations (B6) can be written as
\[
\frac{A_M w}{A} = Y^{-1} w \left[ \frac{d\eta_w}{dM} \left( (1-2\gamma)(\tau (1-\gamma(1-\frac{1}{L}))-1) \right) \right]
\]
(B7)

\[
- (\gamma + (1-\gamma)\eta_w)((\eta_w-1)(\gamma + 1)\frac{\tau \gamma}{\bar{e}L^2}) < 0
\]

under the sufficient, but no necessary assumption \( \tau \leq \left[ 1 - \gamma (1 - \frac{1}{L}) \right]^{-1} \) and under our assumption that \( \gamma \leq 1/2 \). QED.

Appendix C: Effects of profit sharing and outsourcing on indirect profit

Differentiating the profit \( \pi^* = \frac{1-\alpha}{\alpha} \frac{w^{-\frac{a}{1-a}}}{\bar{e}^{\frac{a}{1-a}}} + \frac{wM}{\bar{e}} - \frac{1}{2} cM^2 \) in terms of \( \tau \) gives as
\[
\pi^* = \left[-w^{-\frac{a}{1-a}} \frac{dw}{d\tau} + w^{-\frac{a}{1-a}} \frac{M}{\bar{e}} \frac{d\bar{e}}{d\tau} \frac{1}{\bar{e}} \right] + \frac{wM}{\bar{e}} \left[ \frac{dw}{d\tau} - \frac{d\bar{e}}{d\tau} \frac{1}{\bar{e}} \right].
\]
This can be expressed by using \( w^{-\frac{a}{1-a}} \frac{1}{\bar{e}^{\frac{a}{1-a}}} = L + \frac{M}{\bar{e}} \) as
\[ \pi^*_i = \frac{w}{\tau} \left( L + \frac{M}{\bar{e}} \right) \left( -\frac{d\tau}{d\tau \bar{w}} + \frac{d\bar{e}}{d\tau \bar{e}} \right) + \frac{wM}{\bar{e} \tau} \left( \frac{d\tau}{d\tau \bar{w}} - \frac{d\bar{e}}{d\tau \bar{e}} \right) = \frac{wL}{\tau} \left( \phi^* - \frac{d\tau}{d\tau \bar{w}} \right) \]  

By using (C1) and \( \pi^* = \frac{1}{\alpha} w^{\frac{-\alpha}{\alpha - 1}} \bar{e}^{\frac{1}{\alpha - 1}} + \frac{wM}{\bar{e}} - \frac{1}{2} cM^2 \) the first-order condition \(-\pi^* + (1 - \tau)\pi^*_i = 0\) can be written as equation (17). QED.

Appendix D: Optimal Outsourcing

The first-order condition in terms of outsourcing is

\[ \pi^*_M = \frac{w}{\bar{e}} - cM + \left[ \frac{M}{\bar{e}} - \frac{M}{\bar{e}} \frac{d\bar{e}}{d\bar{e}} \right] \frac{dw}{dM} + \left[ -\frac{1}{\bar{e}^{\alpha-1}} - \frac{1}{\bar{e}^{\alpha-1}} \frac{d\bar{e}}{d\bar{e}} \right] \frac{dw}{dM} = 0, \]  

(D1)

and by using \( \phi = \frac{d\bar{e}}{d\bar{e}} w = \frac{1}{1 - \gamma + \gamma \eta_w} \) and \( L + \frac{M}{\bar{e}} = \frac{w}{\bar{e}^{\alpha-1}} \) this can be rewrite as follows

\[ \pi^*_M = \frac{w}{\bar{e}} - cM + \left[ \frac{M}{\bar{e}} (1 - \phi) \right] \frac{dw}{dM} + \left[ -(L + \frac{M}{\bar{e}}) (1 - \phi) \right] \frac{dw}{dM} \]  

(D2)

QED.

References:


