An Economic Approach to Law : Two Types of Standards and Cost plus Fee Contract

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—Two Types of Standards and Cost plus Fee Contract—

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Abstract

A purpose of this paper is to analyze the relationship between the cost plus fee contract and the two types of the standards; i.e. the time standard for producing the plant and the cost standard for producing it.

In Watanabe and Maeda (2013) the relationship between the cost plus fee contract and one type of the standard; i.e. the cost standard**,** has been analyzed using the generalized efficiency wages hypothesis where not only the efficiency of the workers but also the effective utilization of raw material will be increased with the increase in the wage rate. In this paper, as in Watanabe and Maeda (2013), we will use the generalized efficiency wages hypothesis**.**

Following main results have been derived; (ⅰ) the increase in the gain, G ,which accrues if the operation of the plant can be started before the standard time will increase the wage rate, (ⅱ) with respect to the cost standard, the increase in the sharing rate, μ , for the firm which produces the plant will decrease the wage rate, (ⅲ) with respect to the time standard, the increase in the sharing rate, α , for that firm will increase the wage rate, (ⅳ) the increase in the expected value of the price, $E[p]$, of the material will increase the wage rate, (ⅴ) the positive effect of the increase in G on the wage rate will be made stronger when the sharing rate, α , with respect to the time standard is increased, (ⅵ) on the other hand, the positive effect of the increase in G on the wage rate will be made weaker when the sharing rate, μ , with respect to the cost standard is increased. In addition to the above results, (ⅶ) the wage rate in the case where two types of standards are considered will be higher than that in the case where only one standard, i.e. cost standard is considered.

If the wage rate is increased the efforts for seeking lower material price may be increased. Even in this case the same result with respect to the elasticity of the efficiency with respect to the wage rate can be obtained.

Keywords: Cost plus Fee Contract, Standard Time, Standard Cost, Generalized Efficiency Wages

1. Introduction

A purpose of this paper is to analyze the relationship between the cost plus fee contract [See Yamada and Sano (2009) for the simple but excellent explanation of the cost plus fee contract] and the two types of the standards; i.e. the time standard for producing the plant and the cost standard for producing it.

In Watanabe and Maeda (2013) the relationship between the cost plus fee contract and the standard of cost has been analyzed using the generalized efficiency wages hypothesis where not only the efficiency of the workers but also the effective utilization of raw material will be increased with the increase in the wage rate.

In the next section, we will analyze the relationship between the cost plus fee contract and the two-types of the standards. In this paper, as in Watanabe and Maeda (2013), we will use the generalized efficiency wages hypothesis instead of the ordinal efficiency wages hypothesis [See Solow 1979][1].

In section 3, the effect of the change in the time standard for producing the plant on the wage rate will be examined. Other effects on the wage rate will also be analyzed.

Following main results have been derived; (ⅰ) the increase in the gain, G, which accrues if the operation of the plant can be started before the standard time will increase the wage rate from (15), (ⅱ) with respect to the cost standard, the increase in the sharing rate, μ, for the firm which produces the plant will decrease the wage rate from (16), (ⅲ) with respect to the time standard, the increase in the sharing rate, α, for that firm will increase the wage rate from (17), (ⅳ) the increase in the expected value of the price, $E[p]$, of the material will increase the wage rate from (18), (ⅴ) the positive effect of the increase in G on the wage rate will be made stronger when the sharing rate, α, with respect to the time standard is increased from (19), (ⅵ) on the other hand, the positive effect of the increase in G on the wage rate will be made weaker when the sharing rate, μ, with respect to the cost standard is increased from (20). In addition to the above results, (ⅶ)the wage rate in the case where two types of standards are considered will be higher than that in the case where only one standard, i.e. cost standard is considered. If the wage rate is increased the efforts for seeking lower material price may be increased. Even in this case the same result with respect to the elasticity of the efficiency with respect to the wage rate can be obtained.

In the last section concluding remarks will be given.

2. Simple Model of Two Types of Standards

Using the similar notation to Watanabe and Maeda (2003), we denote the profit, π , in the following manner.

$$\pi = F - \mu(C - Z) - \alpha(t - T))G, \quad (1)$$

where F is the given fee for producing the plant, the scale of which is also given from the contract , C is the real cost, $Z(\equiv Z(Q))$ is the given standard cost for producing the plant, $\mu(>0)$ is the sharing rate for the firm which produces the plant, t is the real time for producing it, $T(\equiv T(Q))$ is the given standard time, G is the given gain which accrues if the operation of the plant can be started before the planed standard T ; *i.e.* if $t<T$, on the other hand if $t>T$, the loss will accrue , and $\alpha(>0)$ is the sharing rate of the gain or the loss for the firm which produces the plant.

Real cost is denoted by the following equation (2).

$$C = wL + pm, \quad (2)$$

where w is the wage rate, L is the amount of labor employment, p is the price of the material, m is the amount of used material.

As the scale of the plant, Q, is determined from the contract, the required amount of the labor can be determined if the efficiency of the labor, e , is determined. However, the efficiency of the labor, in turn, will depend on the wage rate in the following manner;

$$e = e(w),$$
where $de(w)/dw > 0.$

Hence, the amount of the labor employment is denoted by the following equation (3).

$$L = L(Q, e(w)). \quad (3)$$

On the other hand, the expected value of the material price, $E[p]$, is denoted by the following equation (4).

$$E[p] = \int_{\lambda}^{\vartheta} pf(p)dp, \quad (4)$$

where $f(p)$ is the probability density function $\lambda \leqq p \leqq \theta$, and the expected value of the price is

assumed to be given.

Further in the generalized efficiency wages model, not only the efficiency of the workers but also the effective utilization of raw material will be increased when the wage rate is increased.

Since the scale of the plant, Q, is determined from the contract, the required amount of the material will also be determined if the degree of the effective utilization of raw material , h , is determined. On the other hand, the degree of the effective utilization of raw material , h ,will also depend on the wage rate in the following manner.

$$h = h(w),$$
where $dh(w)/dw > 0$.

Hence, m , is denoted by the following equation (5).

$$m = m(Q, h(w)). \tag{5}$$

In the same way, the real time , t , for producing the plant is denoted by the following equation (6).

$$t = t(Q, g(w)). \tag{6}$$

where $dg(w)/dw > 0$ and $g(w)$ denotes the time efficiency for producing the given Q.
Hence, from (1), (2), (3), (4), (5) and (6) the expected profit, $E[\pi]$, is denoted by the following equation (7).

$$\begin{aligned} E[\pi] = F - \mu(wL(Q, e(w)) + m(Q, h(w))E[p] - z) \\ - \alpha(t(Q, g(w)) - z)G. \end{aligned} \tag{7}$$

Maximizing the equation (7) with respect to w yields the following first order condition (8).

$$\begin{aligned} dE[\pi]/dw = &-\mu(L(Q, e(w)) + w\ \partial L/\partial e(w)\, de(w)/dw \\ &+ \partial m/\partial h(w)\, dh(w)/dw E[p]) \\ &- \alpha(\partial t/\partial g\ dg(w)/dw)G \\ = &\ 0. \end{aligned} \tag{8}$$

Second order condition is assumed to be satisfied.

To make the analysis simple the functions, $L = L(Q, e(w))$, $m = m(Q, h(w))$, $t = t(Q, g(w))$ are specified in the following manner; $L = L_s(Q)/e(w)$, $m = m_s(Q)/h(w)$, $t = T(Q)/g(w)$, where $L_s(Q)$, and $m_s(Q)$ and $T(Q)$ are ordinarily required level for producing Q which is given

from the contract.

From the first order condition (8), the following result (9) can straightforwardly obtained.

$$1-\eta_w^{e(w)}=\beta\eta_w^{h(w)} + (\alpha/\mu)\,\gamma\eta_w^{g(w)} \tag{9}$$

where $\beta \equiv m(Q, e(w))\,E[p]/wL(Q, h(w)) > 0,$

and $\gamma \equiv t\,(Q, g(w))\,G/wL(Q, h(w)) > 0.$

Therefore from (9),

$$1 > \eta_w^{e(w)}, \tag{10}$$

where $\beta\eta_w^{h(w)} + (\alpha/\mu)\,\gamma\eta_w^{g(w)} > 0,$ as $\beta > 0$ and $\eta_w^{h(w)} > 0,$

and

$(\alpha/\mu)\,\gamma\eta_w^{g(w)} > 0.$

Hence, from (10) the elasticity of the efficiency of the workers with respect to the wage rate becomes less than 1, though according to the ordinal efficiency wages hypothesis, as is well known, the elasticity is equal to 1.

If the elasticity of the efficiency of the labor with respect to the wage rate is the decreasing function of the wage rate, then the wage rate in this generalized efficiency wages model with two types of the standards will be higher than that in the ordinal efficiency wages model where the elasticity will be equal to 1.

3. Effects of Time Standard on Wage Rate

In this section the effect of the change in time standard for producing the plant on the wage rate will be examined. Other effects on the wage rate will also be examined.

To get the optimal value from the first order condition (8), the functions are specified in the following manner;

$$e = e_0(w-v)^{\frac{1}{2}}, \tag{11}$$

$$h = h_0(w-v)^{\frac{1}{2}}, \text{ and} \tag{12}$$

$$g = g_0 (w - v)^{\frac{1}{2}}, \tag{13}$$

where v is the minimum wage rate.

The optimal value of the wage rate, w, can be obtained from (8), (11), (12) and (13) in the following manner.

$$\begin{aligned} w^* = {} & 2v + E[p] m_s e_0 / (L_s h_0) \\ & + (\alpha / \mu) T e_0 G / (L_s g_0). \end{aligned} \tag{14}$$

Therefore, the following results can be obtained straightforwardly.

$$\partial w^* / \partial G > 0, \tag{15}$$

$$\partial w^* / \partial \mu < 0, \tag{16}$$

$$\partial w^* / \partial \alpha > 0, \tag{17}$$

$$\partial w^* / \partial E[p] > 0. \tag{18}$$

$$\partial^2 w^* / \partial G \partial \alpha > 0, \tag{19}$$

$$\partial^2 w^* / \partial G \partial \mu < 0. \tag{20}$$

From (14), the value of the wage rate at $\alpha = 0$ is less than that at $\alpha > 0$. Hence, we get the additional; result that the wage rate in the case where two types of standards are considered will be higher than that in the case where only one standard, i.e., cost standard is considered.

Hence, we get the following results; (ⅰ) the increase in the gain, G, which accrues if the operation of the plant can be started before the standard time will increase the wage rate from (15), (ⅱ) with respect to the cost standard, the increase in the sharing rate, μ, for the firm which produces the plant will decrease the wage rate from (16), (ⅲ) with respect to the time standard, the increase in the sharing rate, α, for that firm will increase the wage rate from (17), (ⅳ) the increase in the expected value of the price, $E[p]$, of the material will increase the wage rate from (18), (ⅴ) the positive effect of the increase in G on the wage rate will be made stronger when the sharing rate, α, with respect to the time standard is increased from (19), (ⅵ) on the other hand, the positive effect of the increase in G on the wage rate will be made weaker when the sharing rate, μ, with respect to the cost standard is increased from (20).

In addition to the above results, (vii) the wage rate in the case where two types of standards are considered will be higher than that in the case where only one standard, i.e. cost standard is considered.

4. Expected Value of Material Price and Wage Rate

In the preceding sections it is presumed that the expected value of the price, $E[p]$, of the material will not be affected by the wage rate. However, in general, if the wage rate is increased the efforts for seeking lower material price may be increased.

Then, the expected value of the price, $E[p]$, of the material will be the decreasing function of the wage rate. Hence, $f(p)$, λ and θ in the equation (4) can be modified such that $f(p, w)$, $\lambda(w)$ and $\theta(w)$.

In the same way, equation (8) can be modified in the following manner.

$$\begin{aligned} dE[\pi]/dw = &-\mu(L(Q, e(w)) + w\ \partial L/\partial e(w)\, de(w)/dw \\ &+\partial m/\partial h(w)\, dh(w)/dw E[p] \\ &+ m(Q, h(w))\, dE[p] - dw) \\ &-\alpha(\partial t/\partial g\ dg(w)/dw)G \\ &= 0. \end{aligned} \tag{21}$$

In the same way, equation (9) can be modified in the following manner.

$$\begin{aligned} 1 - \eta_w^{e(w)} = &\beta(\eta_w^{h(w)} + \eta_w^{j(w)}) \\ &+ (\alpha/\mu)\gamma\eta_w^{g(w)}, \end{aligned} \tag{22}$$

where $\beta \equiv m(Q, e(w))E[p]/wL(Q, h(w)) > 0$,

$\gamma \equiv t\ (Q, g(w))G/wL(Q, h(w)) > 0$, and

$\eta_w^{j(w)}$ is the elasticity of the efficiency of the expected material price with respect to the wage rate, $E[p] = E_s/j(w)$, where E_s is the standard expected material price and $j(w)$ is the efficiency of the expected material price.

From (22), the same result as (10) can be obtained straightforwardly. Hence in this generalized case the elasticity of the efficiency of the workers with respect to the wage rate becomes less than 1. Therefore, if the elasticity of the efficiency of the labor with respect to the wage rate is the decreasing function of the wage rate, then the wage rate in this case will be higher than that in the ordinal

efficiency wages model.

5. Concluding Remarks

A purpose of this paper is to analyze the relationship between the cost plus fee contract and the two types of the standards; i.e. the time standard for producing the plant and the cost standard for producing it.

In Watanabe and Maeda (2013) the relationship between the cost plus fee contract and one type of the standard; i.e. the cost standard, has been analyzed using the generalized efficiency wages hypothesis where not only the efficiency of the workers but also the effective utilization of raw material will be increased with the increase in the wage rate. In this paper, as in Watanabe and Maeda (2013), we used the generalized efficiency wages hypothesis**.**

Following main results have been derived; (ⅰ) the increase in the gain, G, which accrues if the operation of the plant can be started before the standard time will increase the wage rate from (15), (ⅱ) with respect to the cost standard, the increase in the sharing rate, μ, for the firm which produces the plant will decrease the wage rate from (16), (ⅲ) with respect to the time standard, the increase in the sharing rate, α, for that firm will increase the wage rate from (17), (ⅳ) the increase in the expected value of the price, $E[p]$, of the material will increase the wage rate from (18), (ⅴ) the positive effect of the increase in G on the wage rate will be made stronger when the sharing rate, α, with respect to the time standard is increased from (19), (ⅵ) on the other hand, the positive effect of the increase in G on the wage rate will be made weaker when the sharing rate, μ, with respect to the cost standard is increased from (20). In addition to the above results, (ⅶ) the wage rate in the case where two types of standards are considered will be higher than that in the case where only one standard, i.e. cost standard is considered.

If the wage rate is increased the efforts for seeking lower material price may be increased. Even in this case the same result with respect to the elasticity of the efficiency with respect to the wage rate can be obtained.

Notes

1 See Blanchard, O.J., and S. Fisher (1989), Laszlo (2004), Chang, Wen-Ya und Ching-Chong Lai (1996), Watanabe (1996a, 1996b), in addition to Solow(1979).

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