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Managerial Delegation and Wage Inequality

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This paper analyzes how managerial delegation affects skilled-unskilled wage inequality. In the basic model with full employment, we find that an increase (resp., a decrease) in the strength of the profit incentive in managerial delegation will decrease (resp., increase) skilled-unskilled wage inequality. In the extended model with unemployment, we find that a stronger strength of the profit incentive in managerial delegation will narrow down (resp., widen) skilled-unskilled wage inequality if the substitution elasticity between unskilled labor and capital is small enough (resp., sufficiently large). Our conclusions also hold under different risk aversion utility functions.

Key Words: Managerial delegation; Skilled-unskilled wage inequality; General equilibrium approach.
JEL Classification Numbers: D21, J31, L21.

1. INTRODUCTION

Rising skilled-unskilled wage inequality is an important phenomenon around the world. The factors that influence skilled-unskilled wage inequality are deeply explored from different perspectives. For example, many studies link wage inequality to trade, globalization, and outsourcing (Feenstra and Hanson, 1996; Verhoogen, 2008; Attanasio et al., 2004). However, with the great development of the literature in this direction, more and more studies try to find the micro foundation for skilled-unskilled wage inequality, especially in the form of industrial organization. For instance, Anwar (2009) analyzes the role of downsizing in impacting skilled-unskilled wage inequality. Pi and Zhang (2018a) and Chao et al. (2018) analyze how a merger between firms affects skilled-unskilled wage inequality. Pi and Zhao (2020) analyze how corporate social responsibility generates an effect on skilled-unskilled wage inequality. However, the existing literature

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usually treats firms as profit-maximizing entities, which may not be realistic in the modern business environment. With the separation of ownership and management, various incentive arrangements emerge. Among them, managerial delegation is very important and plays a strategic role in the market equilibrium. It is therefore necessary to understand how managerial delegation influences skilled-unskilled wage inequality.

Managerial delegation refers to the design of an incentive payment scheme to the manager to deal with oligopolistic rivalry in the market (Das, 1997). There are many studies investigating managerial delegation from different angles. Since Vickers (1985), Fershtman and Judd (1987), and Sklivas (1987) make their original contributions to the use of managerial delegation, many researchers have paid attention to the role of managerial delegation. For example, Das (1997) examines how managerial delegation influences trade policy. Meccheri and Fanti (2014) explore how managerial delegation interacts with wage decisions made by a labor union. Poyago-Theotoky and Yong (2019) analyze how managerial delegation generates an effect on emissions taxation. Grobovšek (2020) investigates how managerial delegation affects aggregate productivity. Although Lee (2021a, 2021b) partially mentions the relationship between managerial delegation and wage inequality, wage inequality in his sense is between occupations, across firms, and between sectors, not between skilled and unskilled labor in this paper's sense. In general, the existing literature ignores to analyze how managerial delegation impacts skilled-unskilled wage inequality.

The aim of this paper is to bridge the research gap between the literature on skilled-unskilled wage inequality and that on managerial delegation. In order to do so, this paper builds the general equilibrium models with full employment and unemployment to investigate how managerial delegation affects skilled-unskilled wage inequality. For the basic model with full employment, the finding is that an increase (resp., a decrease) in the strength of the profit incentive in managerial delegation will decrease (resp., increase) skilled-unskilled wage inequality. For the extended model with unemployment, the finding is that a stronger strength of the profit incentive in managerial delegation will narrow down (resp., widen) skilled-unskilled wage inequality if the substitution elasticity between unskilled labor and capital is small enough (resp., sufficiently large). Our conclusions also hold under different risk aversion utility functions. To the best of our knowledge, this paper is the first one to comprehensively investigate the impact of managerial delegation on skilled-unskilled wage inequality.

The rest of this paper is organized as follows. Section 2 provides the basic model with full employment. Section 3 gives the extended model with unemployment. Section 4 adopts two different forms of utility functions. Section 5 makes some concluding remarks.

2. BASIC MODEL

We consider a full employment developing economy consisting of two sectors, a rural sector and an urban sector. The reason why we exclude the developed economy in this paper is that the model we construct is based on the Harris-Todaro framework (see Harris and Todaro, 1970), which focuses on migration from the rural area to the urban area that is usually regarded as a typical characteristic of the developing economy. The rural sector is in a perfectly competitive market and produces the homogenous agricultural good Y, while the firms in the urban sector are under Cournot competition and produce the homogenous manufacturing good X. Without loss of generality, the price of the agricultural good Y is normalized to unity, and the price of the manufacturing good X is denoted as p. Following Konishi et al. (1990), Chao and Yu (1997), Beladi and Chao (2006), Pi and Yin (2016), and Pi and Zhang (2018b), we use a quasi-linear function $U(X, Y) = v(X) + Y$ to represent consumers' utility in our model, where the agricultural good Y is taken as a numeraire. The budget constraint is given by $I = p(X) + Y$, where I is the total income. Moreover, according to Singh and Vives (1984) and Ghosh et al. (2015), $v(X) = aX - \frac{1}{2}X^2$. Therefore, the inverse demand function of the manufacturing good X is $p = a - X$, where a is a large enough constant that represents the market scale. The inverse demand function reveals a simplified linear relationship between the output level and the price.

The rural sector employs rural unskilled labor L_{UY} and land T as production factors, bearing a unit cost of $g(w_U, \tau)$, where w_U represents the wage rate of unskilled labor and τ represents the rent rate of land. Since the rural sector operates under perfect competition, the zero-profit condition yields:

$$g(w_U, \tau) = 1. \tag{1}$$

The urban sector adopts identical technology with the fixed cost and the marginal cost, and utilizes skilled labor, unskilled labor, and capital as production factors. According to Beladi and Chao (2006) and Chao et al. (2016), the fixed cost is denoted as $F(w_S, r)$, which is comprised of the wage rate of skilled labor and the interest rate of capital. The fixed cost can be occupied by administrative teams that provide managerial services. The variable cost is denoted as $m(w_U, r)$, consisting of the wage rate of unskilled labor and the interest rate of capital. In particular, w_S is the wage rate of skilled labor, w_U is the wage rate of unskilled labor, and r is the interest rate. Thus, the cost function of the firms in the urban sector is $C_i(w_S, w_U, r, X_i) = F(w_S, r) + m(w_U, r)X_i$, where $i = 0, 1$. Here, $i = 0$ represents the firm with managerial delegation, and $i = 1$ represents the firm without managerial delegation.

The agency problem arises when the firm tends to hire a professional manager to make decisions. Normally, the manager's objective is not to maximize the firm's profit, but to maximize the payoff of his own, which leads to the principal-agent problem. To address the problem, the board of the firm will sign a contract with the manager, linking the manager's payoff to the market performance of the firm. The designed contract that regulates the manager's behavior is called managerial delegation. Without loss of generality, we assume that there are two representative firms in the urban sector, namely firm 0 and firm 1. Firm 0 represents the firm that adopts managerial delegation, while firm 1 represents the firm that does not adopt managerial delegation. According to Vickers (1985), Fershtman and Judd (1987), and Sklivas (1987), an FJSV contract is applied in managerial delegation, in which the manager decides on the output level when his payoff is a linear combination of the profit and the sales of the firm. Therefore, the objective function of firm 0 is $\varphi_0 = \beta\pi_0 + (1-\beta)X_0$, where the parameter $\beta \in (0,1)$ can be interpreted as the strength of the profit incentive in managerial delegation. Correspondingly, $1-\beta$ can be regarded as the strength of the sales incentive. The profit of firm 0 is $\pi_0 = p(X)X_0 - C_0(w_S, w_U, r, X_0)$. The objective function of firm 1 is given by $\varphi_1 = \pi_1 = p(X)X_1 - C_1(w_s, w_U, r, X_1)$. Therefore, the first-order conditions of the firms with and without managerial delegation are respectively given by:

$$p(X) - X_0 + \frac{1-\beta}{\beta} = m(w_U, r), \tag{2}$$

$$p(X) - X_1 = m(w_U, r), \tag{3}$$

where the left-hand sides represent marginal benefits and the right-hand sides represent marginal costs.

Following Shepard's lemma, the demands for factors can be derived from cost functions. Hence, the factor market clearing conditions for skilled labor, unskilled labor, capital, and land are given by:

$$2F_w(w_S, r) = \overline{L}_S, \tag{4}$$

$$m_w(w_U, r)X + g_w(w_U, \tau)Y = \overline{L}_U, \tag{5}$$

$$m_r(w_U, r)X + 2F_r(w_S, r) = \overline{K}, \tag{6}$$

$$g_\tau(w_U, \tau)Y = \overline{T}, \tag{7}$$

where the left-hand sides represent the demands for factors, and the right-hand sides represent exogenous factor endowments.

So far, we have constructed the economic system. There are seven equations (i.e., Equations (1)-(7)) determining seven endogenous variables, namely $w_S, w_U, r, \tau, X_0, X_1$, and Y. β is the policy variable indicating the strength of the profit incentive in managerial delegation. Other variables are parameters.

For the rural sector, totally differentiating Equation (1), we obtain:

$$-\theta_{UY}\hat{w}_U - \theta_{TY}\hat{\tau} = 0, \tag{8}$$

where the notation "$\hat{}$" over a variable denotes the relative change of this variable (e.g., $\hat{w}_U = \frac{dw_U}{w_U}$). $\theta_{iY}(i = U, T)$ represents the cost share of factor i in the production of product Y. This implies that the wage rate of unskilled labor changes inversely with the rent rate of land. For instance, if the wage rate of unskilled labor rises, the demand for unskilled labor in the rural sector will decline. As a result, the land's marginal productivity also declines, leading to a decline in the rent rate of land due to the complementary relationship between the two input factors.

For the urban sector, totally differentiating Equations (2) and (3), we obtain:

$$-2\alpha_0\hat{X}_0 - \alpha_1\hat{X}_1 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = \frac{p^{-1}}{\beta}\hat{\beta}, \tag{9}$$

$$-2\alpha_1\hat{X}_1 - \alpha_0\hat{X}_0 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = 0, \tag{10}$$

where $\alpha_i = \frac{X_i}{p}$ $(i = 0, 1)$ denotes the ratio of the output level to the price of product X, θ_i $(i = S, U, K)$ represents the distributive share of factor i in the variable cost (with a superscript m) or in the fixed cost (with a superscript F) (e.g., $\theta_U^m = \frac{w_U m_w(w_U,r)}{m(w_U,r)}$), and $b = \frac{m(w_U,r)}{p}$ represents the ratio of the variable cost and the price and varies inversely with the gross margin.

In the factor markets, totally differentiating Equations (4)-(7), we obtain:

$$-\theta_K^F\sigma^F(\hat{w}_S - \hat{r}) = 0, \tag{11}$$

$$\lambda_{U1}\hat{X}_1 + \lambda_{U0}\hat{X}_0 + \lambda_{UY}\hat{Y} - \lambda_{UX}\theta_K^m\sigma^m(\hat{w}_U - \hat{r}) - \lambda_{UY}\theta_{TY}\sigma^g(\hat{w}_U - \hat{\tau}) = 0, \tag{12}$$

$$\lambda_{K1}^m\hat{X}_1 + \lambda_{K0}^m\hat{X}_0 + \lambda_{KX}^m\theta_U^m\sigma^m(\hat{w}_U - \hat{r}) + \lambda_{KX}^F\theta_S^F\sigma^F(\hat{w}_S - \hat{r}) = 0, \tag{13}$$

$$\theta_{UY}\sigma^g(\hat{w}_U - \hat{\tau}) + \hat{Y} = 0, \tag{14}$$

where λ_{ij} $(i = S, U, K; j = 0, 1, X, Y)$ denotes the allocative share of factor i occupied by firm j or product j, and the superscript also means the variable cost (denoted as m) or the fixed cost (denoted as F) (e.g., $\lambda_{UX} = (L_{U0} + L_{U1})/\overline{L}_U$). Moreover, σ^i $(i = m, F, g)$ is the substitution elasticity of the factors entering into the cost of type i (e.g, $\sigma^m = \frac{m_{rw}m}{m_r m_w}$ is the substitution elasticity between unskilled labor and capital in the variable cost).

Substituting Equation (8) into Equations (12) and (14), we rewrite Equations (9)-(14) in the matrix form:

$$\begin{pmatrix} 0 & -b\theta_U^m & -b\theta_K^m & -2\alpha_0 & -\alpha_1 & 0 \\ 0 & -b\theta_U^m & -b\theta_K^m & -\alpha_0 & -2\alpha_1 & 0 \\ -\theta_K^F\sigma^F & 0 & \theta_K^F\sigma^F & 0 & 0 & 0 \\ \lambda_{KX}^F\theta_S^F\sigma^F & \lambda_{KX}^m\theta_U^m\sigma^m & -\lambda_{KX}^F\theta_S^F\sigma^F - \lambda_{KX}^m\theta_U^m\sigma^m & \lambda_{K0}^m & \lambda_{K1}^m & 0 \\ 0 & -\lambda_{UX}\theta_K^m\sigma^m - \lambda_{UY}\sigma^g & \lambda_{UX}\theta_K^m\sigma^m & \lambda_{U0} & \lambda_{U1} & \lambda_{UY} \\ 0 & \frac{\theta_{UY}\sigma^g}{\theta_{TY}} & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \hat{w}_S \\ \hat{w}_U \\ \hat{r} \\ \hat{X}_0 \\ \hat{X}_1 \\ \hat{Y} \end{pmatrix} = \begin{pmatrix} \frac{1}{\beta p} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \beta. \tag{15}$$

Denote the determinant of the coefficient matrix of Equation (15) as Δ_1, and we have:

$$\Delta_1 = \frac{\alpha_1\theta_K^F\sigma^F(\theta_U^m\lambda_{KX}^m(2b\theta_{TY}\lambda_{U0} + 3\alpha_0\lambda_{UY}\sigma^g)\sigma^m + 2b\theta_K^m\lambda_{K0}^m(\lambda_{UY}\sigma^g + \theta_{TY}\lambda_{UX}\sigma^m))}{\theta_{TY}} > 0.$$

With the help of Equation (15), Lemmas 1 and 2 are established to describe how the strength of the profit incentive in managerial delegation affects the wage rates of skilled and unskilled labor, respectively.

LEMMA 1. *In an economy with full employment, the higher the strength of the profit incentive in managerial delegation, the lower the wage rate of skilled labor in the urban sector.*

Proof. Using Cramer's rule to solve Equation (15), we obtain:

$$\frac{\hat{w}_S}{\hat{\beta}} = -\frac{\alpha_1\theta_K^F\sigma^F(\lambda_{K0}^m\lambda_{UY}\sigma^g + \theta_{TY}\lambda_{KX}^m\lambda_{U0}\sigma^m)}{p\beta\theta_{TY}\Delta_1} < 0.$$

∎

The economic explanation of Lemma 1 is as follows. According to Equation (11), the wage rate of skilled labor is directly proportional to the interest rate due to the substitution effect within the fixed cost. Meanwhile, the interest rate can be affected by the demand for capital in both the fixed cost and the variable cost. When the strength of the profit incentive decreases, the manager will boost the production to maximize his payoff. Therefore, capital needed in actual production rises, which leads to an increase in the interest rate. When capital becomes more expensive, firms tend to replace capital in the fixed cost with relatively cheaper skilled labor, which drives up the demand for skilled labor and thus increases the wage rate of skilled labor in the end.

LEMMA 2. *In an economy with full employment, the wage rate of unskilled labor decreases when the strength of the profit incentive in managerial delegation is increased.*

Proof. Using Cramer's rule to solve Equation (15), we obtain:

$$\frac{\hat{w}_U}{\hat{\beta}} = -\frac{\alpha_1 \theta_K^F \lambda_{KX}^m \lambda_{U0} \sigma^F \sigma^m}{p\beta\Delta_1} < 0.$$

∎

The economic explanation of Lemma 2 is similar to that of Lemma 1. The wage rate of unskilled labor is affected by the nature of the unskilled labor market. When the profit incentive is weakened and the sales incentive is strengthened, the manager will raise the output level as Lemma 1 points out. As a result, more unskilled labor is needed in actual production, which directly increases the wage rate of unskilled labor.

On the basis of Lemmas 1 and 2, we obtain Proposition 1.

PROPOSITION 1. *In an economy with full employment, skilled-unskilled wage inequality is expanded (resp., narrowed down) when the strength of the profit incentive in managerial delegation is weakened (resp., strengthened).*

Proof. Combining Lemmas 1 and 2, we have:

$$\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} = -\frac{\alpha_1 \theta_K^F \lambda_{K0}^m \lambda_{UY} \sigma^F \sigma^g}{p\beta\theta_{TY}\Delta_1} < 0.$$

∎

Lemmas 1 and 2 show that the wage rates of skilled labor and unskilled labor vary in the same direction as the strength of the profit incentive in managerial delegation changes. However, there is a difference in the scale of change. When the strength of the profit incentive is enhanced, the wage rate of skilled labor decreases more severely, and therefore skilled-unskilled wage inequality is narrowed down. When production is contracted due to an increase in the strength of the profit incentive, the variable cost incurred in actual production is reduced immediately, where capital and unskilled labor involved in the variable cost shrink at the same rate. The decrease in the demand for unskilled labor directly pushes down the wage rate of unskilled labor, while the decrease in the demand for capital first pushes down the interest rate and then passes on the effect to the skilled labor market, as stated in Lemmas 1 and 2. However, since the urban sector is capital intensive, the decrease of the interest rate is more severe than that of the unskilled wage rate. Therefore, the decrease of the skilled wage rate triggered by the decrease of the interest rate is also more severe than that of the unskilled wage rate. As a result, skilled-unskilled wage inequality is narrowed down. Moreover, skilled-unskilled wage inequality is reduced at a diminishing marginal rate as the strength of the profit incentive is increased.

3. EXTENDED MODEL

The basic model considers the full-employment scenario. However, the exogenous minimum wage restriction is common in many developing countries, by which the government attempts to protect unskilled labor in the urban sector. Therefore, in the extended model, we replace the previous unskilled wage rate in the urban sector with an exogenous wage rate $\overline{w}_U$ that is higher than the unskilled wage rate in the rural sector.

One crucial problem is that the minimum wage restriction brings about unemployment in the urban sector, for it leads to the oversupply of unskilled labor. For unskilled labor, he can choose to work either in the urban sector with a rigid and stable payoff or in the rural sector with a flexible payoff. Migration between the two sectors reaches an equilibrium when the expected payoff in the urban sector equals the payoff in the rural sector, which can be expressed by:

$$\frac{\overline{w}_U}{1+\mu} = w_U, \tag{16}$$

where $\mu = \frac{L_{\text{unemployed}}}{L_{\text{employed}}}$ represents the Harris-Todaro unemployment rate (Harris and Todaro, 1970).

Accordingly, the profit-maximization conditions in the urban sector and market-clearing conditions in the factor markets (i.e., Equations (2), (3), (5), and (6)) are replaced by the following equations:

$$p(X) - X_0 + \frac{1-\beta}{\beta} = m(\overline{w}_U, r), \tag{17}$$

$$p(X) - X_1 = m(\overline{w}_U, r), \tag{18}$$

$$(1+\mu)m_w(\overline{w}_U, r)X + g_w(w_U, \tau)Y = \overline{L}_U, \tag{19}$$

$$m_r(\overline{w}_U, r)X + 2F_r(w_S, r) = \overline{K}. \tag{20}$$

So far, the extended model with the exogenous minimum wage in the urban sector has been constructed. Equations (1), (4), (7), (16)-(20) determine eight endogenous variables, namely $w_S, w_U, r, \tau, \mu, X_0, X_1$, and Y. Still, β is the policy variable indicating the strength of the profit incentive in managerial delegation. Other variables are parameters.

After constructing the new economic system, we conduct the comparative static analysis. Differentiating the above equations, we have:

$$\hat{w}_U + \frac{\mu}{1+\mu}\hat{\mu} = 0, \tag{21}$$

$$-2\alpha_0\hat{X}_0 - \alpha_1\hat{X}_1 - b\theta_K^m\hat{r} = \frac{1}{\beta p}\hat{\beta}, \tag{22}$$

$$-2\alpha_1\hat{X}_1 - \alpha_0\hat{X}_0 - b\theta_K^m\hat{r} = 0, \tag{23}$$

$$\lambda_{U1}\hat{X}_1 + \lambda_{U0}\hat{X}_0 + \frac{\lambda_{UY}}{1+\mu}\hat{Y} + \lambda_{UX}\frac{\mu}{1+\mu}\hat{\mu} + \lambda_{UX}\theta_K^m\sigma^m\hat{r} - \frac{\lambda_{UY}}{1+\mu}\theta_{TY}\sigma^g(\hat{w}_U - \hat{\tau}) = 0, \tag{24}$$

$$\lambda_{K1}^m\hat{X}_1 + \lambda_{K0}^m\hat{X}_0 - \lambda_{KX}^m\theta_U^m\sigma^m\hat{r} + \lambda_{KX}^F\theta_S^F\sigma^F(\hat{w}_S - \hat{r}) = 0. \tag{25}$$

From Equation (21), we can find that the wage rate of unskilled labor in the rural sector changes inversely with the unemployment rate in the urban sector. When the unemployment rate is higher, the migrant is less possible to find a job in the urban sector and therefore the expected payoff is lowered, which drives him back to the rural sector. Consequently, an increase in the supply of unskilled labor decreases the wage rate in the rural sector.

Substituting Equations (8) and (21) into Equation (24), we rewrite the new economic system in the following matrix form:

$$\begin{pmatrix} 0 & 0 & -b\theta_K^m & -2\alpha_0 & -\alpha_0 & 0 \\ 0 & 0 & -b\theta_K^m & -\alpha_0 & -2\alpha_1 & 0 \\ -\theta_K^F\sigma^F & 0 & \theta_K^F\sigma^F & 0 & 0 & 0 \\ \lambda_{KX}^F\theta_S^F\sigma^F & 0 & -\lambda_{KX}^F\theta_S^F\sigma^F - \lambda_{KX}^m\theta_U^m\sigma^m & \lambda_{K0}^m & \lambda_{K1}^m & 0 \\ 0 & -\lambda_{UX} - \frac{\lambda_{UY}\sigma^g}{1+\mu} & \lambda_{UX}\theta_K^m\sigma^m & \lambda_{U0} & \lambda_{U1} & \frac{\lambda_{UY}}{1+\mu} \\ 0 & \frac{\theta_{UY}\sigma^g}{\theta_{TY}} & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \hat{w}_S \\ \hat{w}_U \\ \hat{r} \\ \hat{X}_0 \\ \hat{X}_1 \\ \hat{Y} \end{pmatrix} = \begin{pmatrix} \frac{1}{\beta p} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \hat{\beta}, \tag{26}$$

Denote the determinant of the coefficient matrix of Equation (26) as Δ_2, and we have:

$$\Delta_2 = \frac{\alpha_1\theta_K^F\sigma^F((1+\mu)\theta_{TY}\lambda_{UX} + \lambda_{UY}\sigma^g)(2b\theta_K^m\lambda_{K0}^m + 3\alpha_0\theta_U^m\lambda_{KX}^m\sigma^m)}{(1+\mu)\theta_{TY}} > 0.$$

With the help of Equation (26), we establish Lemmas 3 and 4 to describe how the strength of the profit incentive in managerial delegation impacts the wage rates of skilled and unskilled labor, respectively.

LEMMA 3. *In an economy with unemployment, the wage rate of skilled labor increases when the strength of the profit incentive in managerial delegation is decreased.*

Proof. Using Cramer's rule to solve Equation (26), we obtain:

$$\frac{\hat{w}_S}{\hat{\beta}} = -\frac{\alpha_1 \theta_K^F \lambda_{K0}^m \sigma^F ((1+\mu)\theta_{TY}\lambda_{UX} + \lambda_{UY}\sigma^g)}{p\beta(1+\mu)\theta_{TY}\Delta_2} < 0.$$

∎

This result is similar to Lemma 1. The reason is that the minimum wage restriction only intervenes the unskilled labor market, and the skill labor market follows the same change as Lemma 1 shows, where a weaker profit incentive raises the output level and leads to an increase in the interest rate. Therefore, more skilled labor is needed to replace relatively costlier capital in the fixed cost. Consequently, the wage rate of skilled labor increases.

LEMMA 4. *In an economy with unemployment, the wage rate of unskilled labor in the rural sector increases when the strength of the profit incentive in managerial delegation is weakened.*

Proof. Using Cramer's rule to solve Equation (26), we obtain:

$$\frac{\hat{w}_U}{\hat{\beta}} = -\frac{\alpha_1 \theta_K^F \lambda_{KX}^m \lambda_{U0} \sigma^F \sigma^m}{p\beta\Delta_2} < 0.$$

∎

Although this result is similar to that in Lemma 2, the economic explanation is different. Under the minimum wage restriction, the unskilled labor market is divided into two separate markets, an urban one and a rural one. Therefore, the transfer equilibrium of unskilled labor between the rural area and the urban area should be considered. Since the wage rate of unskilled labor in the urban sector is fixed, we focus on the change of the unskilled wage rate in the rural sector. When the profit incentive is weakened, more unskilled labor will be employed in the urban sector to carry out more production, reducing unemployment in the urban sector. Therefore, the expected payoff of working in the urban sector increases, attracting more unskilled labor to migrate from the rural sector to the urban sector. The reduction of unskilled labor in the rural sector shifts the supply curve to the left, which raises the wage rate of unskilled labor in the rural area.

From Lemmas 3 and 4, we obtain Proposition 2.

PROPOSITION 2. *In an economy with unemployment, a stronger strength of the profit incentive in managerial delegation in the urban sector will narrow down (resp., widen) skilled-unskilled wage inequality if the substitution* *elasticity between unskilled labor and capital is small enough (resp., sufficiently large).*

Proof. Combining Lemmas 3 and 4, we have:

$$\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} = -\frac{\alpha_1 \theta_K^F \sigma^F (\lambda_{K0}^m \lambda_{UY} \sigma^g + (1+\mu)\theta_{TY} \lambda_{KX}^m \lambda_{U0}(1-\sigma^m))}{p\beta(1+\mu)\theta_{TY}\Delta_2}.$$

Thus, if $\sigma^m < 1 + \frac{\lambda_{K0}^m \lambda_{UY} \sigma^g}{(1+\mu)\theta_{TY}\lambda_{KX}^m \lambda_{U0}}$, then $\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} < 0$; and if $\sigma^m > 1 + \frac{\lambda_{K0}^m \lambda_{UY} \sigma^g}{(1+\mu)\theta_{TY}\lambda_{KX}^m \lambda_{U0}}$, then $\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} > 0$. ∎

Given a stronger strength of the profit incentive in managerial delegation, the wage rates of skilled and unskilled labor decrease, as described in Lemmas 3 and 4. However, the substitution effect in the variable cost may intensify the decrease of the unskilled wage rate. Since the interest rate decreases more severely than the unskilled wage rate, firms in the urban sector will replace unskilled labor with relatively cheaper capital, which worsens unemployment and thus makes more unskilled workers choose to migrate back to the rural area. The oversupply of unskilled labor further pushes down the wage rate of unskilled labor. Normally, this substitution effect only mitigates the effect of the capital intensity, instead of offsetting it. However, when the substitution elasticity is sufficiently large, the substitution effect will be dominant, making the wage rate of unskilled labor decrease more severely than the wage rage of skilled labor, and therefore expanding skilled-unskilled wage inequality. In sum, the change of skilled-unskilled wage inequality is dependent on the scale of the substitution elasticity between unskilled labor and capital in the variable cost, and there are two change directions.

4. RISK AVERSION UTILITY FUNCTIONS[1]

In this section, we consider two separate utility functions different from that in the basic model. The first one is for a risk aversion consumer, taking the form of $v(X) = -\frac{1}{\alpha}\exp(-\alpha X)$, where α represents the constant absolute risk aversion and is sufficiently small. In this case, the inverse demand function is $p(X) = e^{-\alpha X}$. After differentiating the first-order

[1]This section is added according to the insightful suggestion of an anonymous referee. Preference-driven wage inequality can refer to Pi and Huang (2022).

conditions for the firms with and without managerial delegation, we have:

$$-\alpha(2-\alpha X_0)X_0\hat{X}_0 - \alpha(1-\alpha X_0)X_0\hat{X}_1 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = \frac{p^{-1}}{\beta}\hat{\beta}, \quad (27)$$

$$-\alpha(2-\alpha X_1)X_1\hat{X}_1 - \alpha(1-\alpha X_1)X_0\hat{X}_0 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = 0. \quad (28)$$

Replacing the first two rows of Equation (15) with Equations (27) and (28), we can describe the new economic system as:

$$\begin{pmatrix} 0 & -b\theta_U^m & -b\theta_K^m & -\alpha(2-\alpha X_0)X_0 & -\alpha(1-\alpha X_0)X_1 & 0 \\ 0 & -b\theta_U^m & -b\theta_K^m & -\alpha(1-\alpha X_1)X_0 & -\alpha(2-\alpha X_1)X_1 & 0 \\ -\theta_K^F\sigma^F & 0 & \theta_K^F\sigma^F & 0 & 0 & 0 \\ \lambda_{KX}^F\theta_S^F\sigma^F & \lambda_{KX}^m\theta_U^m\sigma^m & -\lambda_{KX}^F\theta_S^F\sigma^F - \lambda_{KX}^m\theta_U^m\sigma^m & \lambda_{K0}^m & \lambda_{K1}^m & 0 \\ 0 & -\lambda_{UX}\theta_K^m\sigma^m - \lambda_{UY}\sigma^g & \lambda_{UX}\theta_K^m\sigma^m & \lambda_{U0} & \lambda_{U1} & \lambda_{UY} \\ 0 & \frac{\theta_{UY}\sigma^g}{\theta_{TY}} & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \hat{w}_S \\ \hat{w}_U \\ \hat{r} \\ \hat{X}_0 \\ \hat{X}_1 \\ \hat{Y} \end{pmatrix}$$

$$= \begin{pmatrix} \frac{1}{\beta p} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \beta, \quad (29)$$

Denote the determinant of the coefficient matrix of Equation (29) as Δ_3, and we have:

$$\Delta_3 = \frac{\alpha X_1\theta_K^F\sigma^F}{\theta_{TY}} 2b(\theta_K^m\lambda_{K0}^m\lambda_{UY}\sigma^g + \theta_{TY}\lambda_{KX}^m\lambda_{U0}\sigma^m) + \theta_U^m\lambda_{KX}^m\lambda_{UY}\sigma^g\sigma^m\alpha X_0(3-\alpha X) > 0.$$

We can interpret how managerial delegation affects skilled-unskilled wage inequality under a negative exponential functional form of utility through the establishment of Lemmas 5 and 6.

LEMMA 5. *Under a negative exponential functional form of utility function, the higher the strength of the profit incentive in managerial delegation, the lower the wage rate of skilled labor in the urban sector.*

Proof. Using Cramer's rule to solve Equation (29), we obtain:

$$\frac{\hat{w}_S}{\hat{\beta}} = -\frac{\alpha\theta_K^F\sigma^F((X_1 + (X_1 - X_0)(1-\alpha X_1)\theta_{UY})\lambda_{K0}^m\lambda_{UY}\sigma^g + \theta_{TY}(X_1\theta_K^m + X_0\theta_U^m)\lambda_{KX}^m\lambda_{U1}\sigma^m)}{p\beta\theta_{TY}\Delta_3} < 0.$$

∎

LEMMA 6. *Under a negative exponential functional form of utility function, the higher the strength of the profit incentive in managerial delegation, the lower the wage rate of unskilled labor in the urban sector.*

Proof. Using Cramer's rule to solve Equation (29), we obtain:

$$\frac{\hat{w}_U}{\hat{\beta}} = -\frac{\alpha X_1 \theta_K^F \lambda_{KX}^m \lambda_{U0} \sigma^F \sigma^m}{p\beta\Delta_3} < 0.$$

∎

According to Lemmas 5 and 6, we have Proposition 3.

PROPOSITION 3. *Under a negative exponential functional form of utility function, a stronger (resp., weaker) strength of the profit incentive in managerial delegation in the urban sector will narrow down (resp., widen) skilled-unskilled wage inequality.*

Proof. Combining the proofs of Lemmas 5 and 6, we have:

$$\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} = -\frac{\alpha X_1 \theta_K^F \lambda_{K0}^m \lambda_{UY} \sigma^F \sigma^g}{p\beta\theta_{TY}\Delta_3} < 0.$$

∎

Now we turn to another risk aversion utility function that is constant in relative risk aversion. The utility function takes a power functional form of $v(X) = \frac{X^{1-\gamma}}{1-\gamma}$, where γ is the constant of relative risk aversion. Therefore, the new inverse demand function is $p(X) = X^{-\gamma}$. After differentiating the new first-order conditions for the firms with and without managerial delegation, we obtain:

$$(\gamma(\gamma+1)\rho_0 - 2\gamma)\rho_0\hat{X}_0 + (\gamma(\gamma+1)\rho_0 - \gamma)\rho_1\hat{X}_1 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = \frac{p^{-1}}{\beta}\hat{\beta}, \tag{30}$$

$$(\gamma(\gamma+1)\rho_1 - \gamma)\rho_0\hat{X}_0 + (\gamma(\gamma+1)\rho_1 - 2\gamma)\rho_1\hat{X}_1 - b(\theta_U^m\hat{w}_U + \theta_K^m\hat{r}) = 0, \tag{31}$$

where $\rho_i = \frac{X_i}{X}$ $(i = 1, 2)$.

The new economic system is changed to:

$$\begin{pmatrix} 0 & -b\theta_U^m & -b\theta_K^m & (\gamma(\gamma+1)\rho_0 - 2\gamma)\rho_0 & (\gamma(\gamma+1)\rho_0 - \gamma)\rho_1 & 0 \\ 0 & -b\theta_U^m & -b\theta_K^m & (\gamma(\gamma+1)\rho_1 - \gamma)\rho_0 & (\gamma(\gamma+1)\rho_1 - 2\gamma)\rho_1 & 0 \\ -\theta_K^F\sigma^F & 0 & \theta_K^F\sigma^F & 0 & 0 & 0 \\ \lambda_{KX}^F\theta_S^F\sigma^F & \lambda_{KX}^m\theta_U^m\sigma^m & -\lambda_{KX}^F\theta_S^F\sigma^F - \lambda_{KX}^m\theta_U^m\sigma^m & \lambda_{K0}^m & \lambda_{K1}^m & 0 \\ 0 & -\lambda_{UX}\theta_K^m\sigma^m - \lambda_{UY}\sigma^g & \lambda_{UX}\theta_K^m\sigma^m & \lambda_{U0} & \lambda_{U1} & \lambda_{UY} \\ 0 & \frac{\theta_{UY}\sigma^g}{\theta_{TY}} & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \hat{w}_S \\ \hat{w}_U \\ \hat{r} \\ \hat{X}_0 \\ \hat{X}_1 \\ \hat{Y} \end{pmatrix}$$

$$= \begin{pmatrix} \frac{1}{\beta p} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \beta. \tag{32}$$

Denote the determinant of the coefficient matrix of Equation (32) as Δ_4, and we have:

$$\Delta_4 = \frac{\gamma\theta_K^F\rho_0\sigma^F(2b\theta_K^m\lambda_{K1}^m\lambda_{UY}\sigma^g + \lambda_{KX}^m(2b\theta_{TY}\lambda_{U1} + (2-\gamma)\gamma\theta_U^m\lambda_{UY}\rho_1\sigma^g)\sigma^m)}{\theta_{TY}} > 0.$$

We can establish Lemmas 7 and 8 to understand what managerial delegation generates an effect on skilled-unskilled wage inequality under a power functional form of utility function.

LEMMA 7. *Under a power functional form of utility function, the higher the strength of the profit incentive in managerial delegation, the lower the wage rate of skilled labor in the urban sector.*

Proof. Using Cramer's rule to solve Equation (32), we obtain:

$$\frac{\hat{w}_S}{\hat{\beta}} = -\frac{\gamma\theta_{KF}\lambda_{K1}^m\rho_0\sigma^F(\lambda_{UY}\sigma^g + \theta_{TY}\lambda_{UX}\sigma^m)}{p\beta\theta_{TY}\Delta_4} < 0$$

∎

LEMMA 8. *Under a power functional form of utility function, the higher the strength of the profit incentive in managerial delegation, the lower the wage rate of skilled labor in the urban sector.*

Proof. Using Cramer's rule to solve Equation (32), we obtain:

$$\frac{\hat{w}_U}{\hat{\beta}} = -\frac{\gamma\theta_K^F\lambda_{KX}^m\lambda_{U1}\rho_0\sigma^F\sigma^m}{p\beta\Delta_4} < 0.$$

∎

Based on Lemmas 7 and 8, we obtain Proposition 4.

PROPOSITION 4. *Under a power functional form of utility function, the result in Proposition 3 still holds.*

Proof. Combining the proofs of Lemmas 7 and 8, we obtain:

$$\frac{\hat{w}_S - \hat{w}_U}{\hat{\beta}} = -\frac{\gamma\theta_K^F\lambda_{K1}^m\lambda_{UY}\rho_0\sigma^F\sigma^g}{p\beta\theta_{TY}\Delta_4} < 0.$$

∎

The results derived from risk aversion utility functions are similar to those of the basic model, no matter it is constant absolute or relative risk aversion. First, a stronger profit incentive in managerial delegation will always lead to a lower skilled wage rate. Second, a stronger profit incentive in managerial delegation will always lead to a lower unskilled wage rate. Although both the skilled wage rate and the unskilled wage rate decline when the profit incentive is strengthened, skilled-unskilled wage inequality is always narrowed down. Due to the diminishing marginal utility, we can always predict that a higher output level causes a lower price, no matter what functional form of demand functions. Therefore, a weakened profit incentive will result in more outputs and hence more demands for capital and unskilled labor in actual production. Accordingly, the interest rate and the wage rate of unskilled labor will rise. As for the fixed cost, cost-minimizing firms will replace capital with relatively cheaper skilled labor, which pushes up the demand for skilled labor and the skilled wage rate. Nevertheless, because the urban sector is capital intensive in production, it makes sense that the change of the interest rate is more severe than that of the unskilled wage rate, and hence the rising demand for skilled labor triggered by the increasing interest rate will dominate the rising demand for unskilled labor. Therefore, skilled-unskilled wage inequality will be widened when the profit incentive in managerial delegation is weakened, which follows the same logic as the basic model. The results derived from risk aversion utility functions also confirm that our conclusions are robust.

5. CONCLUDING REMARKS

This paper examines the impact of managerial delegation on skilled-unskilled wage inequality. In the basic model with full employment, we find that a rise (resp., fall) in the strength of the profit incentive in managerial delegation will narrow down (resp., expand) skilled-unskilled wage inequality. In the extended model with unemployment, we find that a rise in the strength of the profit incentive in managerial delegation will decrease (resp., increase) skilled-unskilled wage inequality if the substitution elasticity between unskilled labor and capital is sufficiently small (resp., large). Our conclusions also hold under different risk aversion utility functions.

In the future research, this paper can be extended in the following directions. First, in addition to the FJSV contract, other forms of managerial delegation can be explored. Second, in addition to full employment and unemployment, other features of the skilled labor market and the unskilled labor market can be investigated.

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