Rural Development Policy, Agricultural Producer Services and Wage Disparities in the Context of Developing Economies

Yuan Run [a], Yangshunzi Sun [a] and Dianshuang Wang [a*]

[a] School of Economics, Anhui University of Finance and Economics, China.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

In developing countries, due to the predominance of marginal and small farmers leads to agriculture practices on small and fragmented plots of land where access and usage to modern farm equipment and implements is hampered. Agricultural producer service sector that acts as an intermediate sector facilitates this process. We build three-sector general equilibrium models to delineate this process: parts of manufacturing goods are utilized by the service sector, the outputs of which are intermediate inputs that could substitute labor in agriculture. We explore the impact of labour market distortion mitigation and input subsidies on rural development policies on pay disparity using this framework. Growing subsidies result in widening wage inequality. Reduction of labor market distortion will raise wage rate of skilled labor, and its impact on wage rate of unskilled labor is ambiguous, depending on elasticity between skilled and unskilled labor. In order for the agricultural development policy to fall short of its broad objectives and may impact on agricultural output.

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Corresponding author: Email: wangds55@aufe.edu.cn, wangds07@126.com;

1. INTRODUCTION

It is widely accepted by development economics that traditional agricultural systems cannot generate high labor productivity and rapid productivity growth relies on advancement in agricultural technology, which is embodied in industry-supplied intermediate inputs. However, many farmers in developing countries cannot use these farm equipments and implements properly and or are not financially affordable. On the one hand, farmers are usually limited resources of land and with lack of access to capital. On the other hand, agriculture in developing countries operates on small-scale land and farmers are unable to exploit economies of scale[1].

To help smallholders benefit from modern agricultural equipment and implements and enhance agricultural productivity, subsidies have been implemented for purchasing of agricultural equipment and implements and innovative techno savvy arrangements have emerged in many developing countries. Agricultural equipment and implements subsidies aim to make inputs available to farmers at Government sponsored subsidies rate as a way of promoting adoption and popularization of smart agricultural practices. Recent years have a positive change, witnessed a resurgence and utilization of agricultural equipment subsidies, mainly in East Asian and Africa [2] . Meanwhile, agricultural producer service sector, as an intermediate sector to facilitate the utilization of modern Agricultural equipment and implements, has increased rapidly in developing countries with small-scale agriculture[3]. "Specifically, the firm in this sector, as the substitute for individual farmers' investment, provides services to smallholders. Thus, smallholders could use modern technology and inputs without paying the corresponding high sunk costs. Meanwhile, firms provide services to a large number of small plots and greatly lower their unit cost of operation" [1].

The purpose of this study is to investigate the impacts of rural public investment on wage inequality between skilled and unskilled labor with the existence of agricultural modernization in small-scale agriculture. Following Yang and Zhu [2], we define agricultural modernization as the introduction of non-agricultural intermediate inputs. And small-scale agriculture requires an intermediate sector, agricultural producer service sector, to facilitate this process.

This research makes a contribution to the existing body of research institutions, organizations that examines agricultural modernization and productivity in developing countries. Notably, the study aligns with the recent scholarly focus on small-scale agriculture, shedding light on the significance of the agricultural producer service sector as an intermediary element in this context. In particular, Li and Fu [3] develop a general equilibrium model. This model is designed to explore the repercussions of changes in remittance rates on the income of migrant workers and, consequently, on environmental pollution. Expanding on this trend, Wang and Li [4] extend the research by considering the role of purchasing services in influencing rural labor migration. Their work delves into the intricate relationship between agricultural producer services and rural labor dynamics. By assuming that the acquisition of services contributes to rural labor migration, Wang and Li [4] investigate the implications of capital market distortion and wage inequality. Importantly, this analysis is conducted within the framework of a small open economy assumption, enhancing the applicability of their findings to broader economic contexts. However, existing literature could not answer how rural development policy impacts on wage inequality.

In this study, a thorough three-sector general equilibrium model that incorporates the agricultural productive services sector. The primary objective is to evaluate how two significant interventions—reducing inefficiencies in the unskilled labor market and providing subsidies for purchases made by the agricultural productive services sector from the industrial sector—affect the wage gap. The products of the

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[1] *According to one report from FAO, about 95% of all farms in Asia are smaller than 5 ha. In China, 98% of farmers cultivate less than 2 ha. In India, 80% of farmers are smallholders.*
[2] *We do not have accurate statistics data for agricultural inputs subsidies. From one article in Statista, overall agricultural subsidies account for 3.1% of GDP in Philippines,2.9% in Indonesia and 1.6% in China (detail information could refer to https://www.statista.com/chart/24416/agricultural-subsidies/).*
[3] *Such services are mainly in machinery services form and are investigated by many scholars. For example, Bangladesh [5], Myanmar [6], Ethiopia [7]. This sector is called "New Agricultural Service Providers" in China.*

industrial sector are used in the agricultural productive services sector and the output of the agricultural services sector is used in agricultural production. The following are the primary conclusions. (1) Growing subsidies result in fewer firms in the agricultural producer services sector, lower output per company, higher wages for skilled workers, lower wages for unskilled workers, and a decline in output in the agricultural sector and an increase in the industrial sector. (2) Reducing the distortions in the unskilled labor market results in an increase in the number of firms within the agricultural producer services sector, a decrease in output per firm, an increase in skilled labor wages, an indeterminate effect on unskilled labor wages, and an increase in industrial and agricultural output. (3) The agricultural development policy falls short of its objectives and has a detrimental effect on agricultural output.

The map of this paper is organized as follows. Section 2 establishes a three-sector general equilibrium model. The comparative static analysis is conducted in section 3. Concluding remarks are provided in section 4.

2. THE MODEL

Consider a small open economy that composes of three sectors: an Urban Manufacturing Sector (UMS) and two Rural Sectors: Agricultural Sector (AS) and Agricultural Producer Service Sector (APS). Suggested that briefly write about these three and make it clear to the reader. The *APS* sector is upstream in the sense that it supplies varieties of differentiated intermediate goods to the agricultural sector in the rural area[4]. These goods include, for instance, agricultural machinery services, agricultural technical services, and supply service of agricultural means of production that embody the manufacturing output. The manufacturing sector (sector *M*) uses skilled labour S_M and unskilled labor L_M to produce an exportable good Y_M. Output of agricultural (Y_A) is generated through the use of unskilled labor L_A and a set of *n* of differentiated goods of *APS* sector sold within a

market structure characterized by Chamberlinian monopolistic competition[5].

Agricultural goods Y_A are produced under perfect competition with the constant returns to scale technology,

$$Y_A = \left[(1-\psi)L_A^{\frac{\rho-1}{\rho}} + \psi X^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, X = \left[\int_0^N x(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}$$

where L_A is unskilled labor input, X is the index of differentiated intermediate goods.

$\rho > 1$ is the elasticity of substitution between unskilled labor and agricultural producer service. The higher elasticity of substitution means the intermediate goods could substitute unskilled more easily. $\psi \in (0,1)$ is the distribution parameter and governs the weight of service in the production function . X is assumed to be of the CES type, and $x(i)$ denotes the amount of each service demanded by agricultural. N is the number of varieties, $\sigma > 1$ is a parameter and represents the elasticity of substitution among varieties. Commodity *A* is chosen as the numeraire. From the production function, the price equals to the unit cost for agricultural good,

$$1 = \left[(1-\psi)^\rho w_A^{1-\rho} + \psi^\rho P^{1-\rho} \right]^{\frac{1}{1-\rho}}, \qquad (1)$$

w_A is wage rate of unskilled labor, $P = \left[\int_0^N p(i)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$ is the price index of service intermediate goods X, $p(i)$ is the price of variety *i*. Given X, the agricultural sector generates the demand for each variety $x(i) = p(i)^{-\sigma} P^\sigma X$.

Production in the manufacturing sector takes place under constant returns to scale technology as follow: $Y_M = F^M(L_M , S_M)$ and F^M is linearly homogeneous and strictly concave. L_M and S_M are unskilled labor input and skilled labor input in the manufacturing sector, respectively. Given the assumption of perfectly competitive markets, the

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[4] *Murata [8] consider the agriculture is integral to the whole developed economy and the agricultural sector as well as manufacturing sector use such same intermediate goods. However, in the setting of our model, we analyze the developing economy and the use of intermediate good is still in its infancy, and the service in agricultural sector, which is mainly doing farm work, is vast different with the manufacturing sector.*

[5] *Although the capital and land are input factors during the manufacturing and agricultural production, respectively, we abstract from them for the following reason. In developing countries, these two factors are sluggish mobility between sectors, and we can treat two factors as specific factors. When two factors are introduced in the present model as specific factors, the main conclusions will not change.*

price-unit cost equality condition relating to the manufacturing sector is given by

$$p_M = a_{SM} w_S + a_{LM} w_M \qquad (2)$$

where p_M is the prices of commodity *M*. w_S and w_M are the wage rates of skilled and unskilled labor, respectively. a_{iM} (*i = S, L*) denotes the amount of factor *i* used to produce one unit of good *M*.

APS sector: Each variety is produced by a monopolistically competitive firm in the rural area. The presence Of internal economies of scale implies that each firm specializes in the production of a single variety. In this sector, every variety x_i is produced by the employment of manufacturing goods and skilled labor. Assume each firm employs θ manufacturing goods as the fixed cost, and skilled labor is the variable input, with the labor demand by each firm given by $S_i = vx(i)$, where v denotes the unit labor requirement. Total cost faced by each service firm is $TC(i) = \theta p_M (1-\alpha) + vx(i) w_S$, where *α* is the subsidy rate. Given the demand function and cost function of each variety, a firm sets the price to maximize its profit, which yields $p(i) = (\sigma/(\sigma-1)) v w_S$ .Here, the pricing rule is independent of the variety index *i*. Since p, θ, v and w_S are the same for all firms, each firm would also produce the same amount of output of services. The zero-profit entry condition would determine the number of firms, *N*, which implies

$$\frac{vxw_S}{\sigma-1} = \theta p_M (1-\alpha) \qquad (3)$$

Unskilled labor market distortion that in effect raises the cost of reallocating unskilled labor between manufacturing and agricultural sector[6]. Following Restuccia et al. [9], we consider distortions in the labor market suppresses unskilled labor wages in agriculture, giving farmers an incentive to use unskilled labor more intensively. No-arbitrage condition in the unskilled labor market implies

$$\tau w_M = w_A, 0 < \tau < 1 \qquad (4)$$

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[6] *Generally, developing countries lack skilled labor. Therefore, we assume that skilled labor could move freely between the urban and agricultural sectors and no distortion in the skilled labor market.*

This equilibrium condition means unskilled labor in the agriculture receives *τ* percentage of the wage rate of his counterpart in the manufacture. *τ* measures the distortions. When the parameter increases, degree of distortion reduces, and when *τ*=1, the distortion vanishes.

APS goods market-clearing condition can be demonstrated by

$$\psi^\rho Y_A P^{-\rho} = \sum_{i=1}^{N} x(i) \qquad (5)$$

The left hand of (5) is the demand for APS outputs, and the right is supply.

The market-clearing conditions of the skilled labour and unskilled labour could be shown as follows:

$$(1-\psi)^\rho w_A^\rho Y_A + a_{LM} Y_M = L \qquad (6)$$

$$Nxv + a_{SM} Y_M = S \qquad (7)$$

where *L* and *S* represent the endowment of unskilled labor and skilled labor, respectively.

So far, the theoretical model thus consists of seven equations, from (1) to (7). Seven endogenous variables are determined: w_A, w_M, w_S, Y_A, Y_M, *N*, and *x*.

3. COMPARATIVE STATIC ANALYSIS

Since the *APS* sector provides intermediate inputs to the agriculture, we begin with analysis of this sector. A firm in *APS* sector sets its price according to $p = (\sigma/(\sigma-1)) v w_S$, thus $P = pN^{1/(1-\sigma)}$ .Due to all firms produce equal amount of output *x*, $X = xN^{\sigma/(\sigma-1)}$. Since $\sigma > 1$, a rise in the number of services, *N*, reduces the price index and raises the sector output, even if each firm keeps its price and output the same. As the value of σ goes to infinite, the influence of *N* on *P* and *X* disappears. The reason is that, *X* becomes the simple sum of the quantities of services and varieties become perfect substitutes for each other. On the other hand. as the value of σ declines towards 1, the importance of diversity becomes more significant. Considering the *APS* sector stills in its initial stage, firms in this sector supply different services with little substitution. In

the following, we assume the value of σ is not large than two. Given the above relations, we can obtain $\hat{p} = \hat{w}_S$, $\hat{P} = \hat{p} + \frac{1}{1-\sigma}\hat{N}$, $\hat{X} = \hat{x} + \frac{\sigma}{\sigma-1}\hat{N}$, where a hat denotes the percentage change of the variable. A rise in skilled wage rate increases each variety price and price index.

3.1 Impacts of an Increase in Subsidy

Considering the case that the government implements policy to subsidize the purchase of manufacture-supplied intermediate equipment and implements in the *APS* sector. First, we analyze the relation between the wage rate of skilled labor and unskilled labor in manufacture and agriculture, which can be obtained by totally differentiating the zero-profit condition in (1), (2) and (4):

$$\theta_{SM}\hat{w}_S + \theta_{LM}\hat{w}_A = \theta_{LM}\hat{\tau} \qquad (8)$$

$$\theta_{LA}\hat{w}_A + \theta_{XA}\hat{w}_S = \theta_{XA}\frac{1}{\sigma-1}\hat{N} \qquad (9)$$

where $\theta_{SM} = a_{SM}w_S / p_M$ and $\theta_{LM} = a_{LM}w_M / p_M$ represent the cost share of skilled labour and unskilled labour in sector *M*. θ_{LA} and θ_{XA} represent the cost share of unskilled labour and *APS* inputs in sector *A*.

From (8) and (9),

$$\hat{w}_A = -\Psi\theta_{XA}\hat{\tau} + \Phi\theta_{SM}\hat{N} \qquad (10)$$

$$\hat{w}_S = \Psi\theta_{LA}\hat{\tau} - \Phi\theta_{LM}\hat{N} \qquad (11)$$

where $\Psi = \theta_{LM}/(\theta_{LA} - \theta_{LM}) > 0$, $\Phi = \theta_{XA}/\big((\theta_{LA} - \theta_{LM})(\sigma-1)\big) > 0$ by the fact that the cost share of unskilled labor is larger than that in the manufacturing in developing country. Thus, an increase in subsidy affect wage rate through its impact on the number of variety.

The effect of an increase in subsidy could be obtained by differentiating (3) and

$$\hat{x} + \hat{w}_S = -\frac{\alpha}{1-\alpha}\hat{\alpha} \qquad (12)$$

Clearly, the zero profit makes each firm reduces its output and demand for skilled labor, which further has a negative effect on wage rate of skilled labor.

Totally differentiating (5), (6) and (7) and substituting (10), (11), and (12),

$$\begin{pmatrix} A_1 & -1 & 0 \\ A_2 & \lambda_{LA} & \lambda_{LM} \\ A_4 & 0 & \lambda_{SM} \end{pmatrix}\begin{pmatrix} \hat{N} \\ \hat{Y}_A \\ \hat{Y}_M \end{pmatrix} = \begin{pmatrix} \alpha/(1-\alpha)\hat{\alpha} - (\rho-1)\Psi\theta_{LA}\hat{\tau} \\ A_3\hat{\tau} \\ \lambda_{SX}\alpha/(1-\alpha)\hat{\alpha} + A_5\hat{\tau} \end{pmatrix} \quad (13)$$

where $\lambda_{LM} = a_{LM}Y_M/L$ and $\lambda_{SM} = a_{SM}Y_M/S$ denote the share of unskilled labour and skilled labour in sector *M*, $\lambda_{LA} = (1-\psi)^\rho w_A^\rho Y_A / L$ denotes the share of unskilled labour used in sector *A*, $\lambda_{SX} = Nxv / S$ represents the share of skilled labour used in *APS* sector. $A_1 = 1 - \rho/(\sigma-1) - (\rho-1)\Phi\theta_{LM} < 0$,

$$A_2 = -\lambda_{LM}S_{LS}\Phi - \lambda_{LA}\rho\Phi\theta_{SM} < 0 \quad ,$$
$$A_3 = -\lambda_{LM}S_{LS} - \Psi\lambda_{LM}S_{LS} - \lambda_{LA}\rho\Psi\theta_{XA} < 0$$
,

$$A_4 = \lambda_{SX} + \lambda_{SM}S_{SL}\Phi + \Phi\theta_{LM}\lambda_{SX} > 0 \quad ,$$
$$A_5 = \lambda_{SM}S_{SL}(1+\Psi) + \Psi\theta_{LA}\lambda_{SX} > 0 \quad .$$ In

addition, $S_{LS} = \frac{\partial a_{LM}}{\partial w_S}\frac{w_S}{a_{LM}} > 0$ is the partial elasticity of substitution between unskilled labor and skilled labor in sector *M*, $S_{SL} = \frac{\partial a_{SM}}{\partial w_M}\frac{w_M}{a_{SM}} > 0$ is the partial elasticity of substitution between skilled labor and unskilled labor in sector *M*.

Denote the value of determinant of the coefficient matrix of equation (13) as Δ , and we have

$$\Delta = A_1\lambda_{LA}\lambda_{SM} + A_3\lambda_{SM} - A_4\lambda_{LM} < 0$$

By Cramer's rule,

$$\frac{\hat{N}}{\hat{\alpha}} = \frac{\alpha}{1-\alpha}\frac{\lambda_{LA}\lambda_{SM} - \lambda_{LM}\lambda_{SX}}{\Delta}$$

$$\frac{\hat{Y}_A}{\hat{\alpha}} = \frac{\alpha}{1-\alpha} \frac{A_4\lambda_{LM} - A_2\lambda_{SM} - \lambda_{LM}\lambda_{SX}A_1}{\Delta} < 0$$

$$\frac{\hat{Y}_M}{\hat{\alpha}} = \frac{\alpha}{1-\alpha} \frac{A_1\lambda_{SX}\lambda_{LA} + A_2\lambda_{SX} - \lambda_{LA}A_4}{\Delta} > 0$$

The sign of $\hat{N}/\hat{\alpha}$ depends on the sign of $\lambda_{LA}\lambda_{SM} - \lambda_{LM}\lambda_{SX}$. In developing countries, the share of skilled labor in urban is larger than that in rural and the relationship of unskilled labor is opposite. By incorporating this reality, we hold $\lambda_{LA}\lambda_{SM} > \lambda_{LM}\lambda_{SX}$ in this model. And $\hat{N}/\hat{\alpha} < 0$. From (10),(11) and(12), $\hat{w}_A/\hat{\alpha} < 0$, $\hat{w}_S/\hat{\alpha} > 0$, $\hat{x}/\hat{\alpha} < 0$.

We use Lemma 1 to summarize impacts of an increase in subsidy.

Lemma 1: Strengthening policy that subsidizes the purchase of manufacture-supplied intermediate inputs in the *APS* sector will reduce agricultural output and the number of varieties in *APS* sector.

These results are contrary to intuition because the subsidy reduces fixed cost of firm in the *APS* sector and should attract more firms to enter. The economic explanation of the Lemma 1 is as follows. An increase in subsidy will reduce the fixed cost to buy manufacture-supplied intermediate inputs in the *APS* sector and raise the number of variety. With more varieties, each firm reduce its output and the demand for skilled labor. Demand for skilled labor faces two conflicting results: expansion of variety raises the demand and contraction in output reduces it. In the model, the latter effect dominates the change and *APS* sector reduces its demand for skilled labor. Skilled labor moves into the manufacturing sector and raises the marginal productivity of unskilled labor. Unskilled also moves from agriculture to manufacture, which expands the manufacture sector. Outflow of unskilled labor reduces the demand for intermediate inputs from

APS sector, which bring to the reduction of varieties at last. Since agricultural sector faces less unskilled labor and *X*, output of goods *A* decreases.

The policy aims to reduces the fixed cost of a firm in APS sector, but ignores the indirect effect of this policy. When a firm faces less fixed cost, its equilibrium output also reduces and reduces the demand for skilled labor. Thus, the reason for failing to achieve the expected result is the mobility of skilled labor out of rural area, which further induces the outflow of unskilled labor in agriculture.

Next, we investigate its impact on wage rate of skilled labor and unskilled labor and wage inequality, which are described by Propositions 1.

Propositions 1: Strengthening policy that subsidizes the purchase of manufacture-supplied intermediate inputs in the *APS* sector will raise skilled wage rate and reduce unskilled wage rate, and expand wage rate between skilled and unskilled wage inequality.

From the Lemma 1, an increase in subsidy contracts agriculture and reduces its demand for unskilled labor. Since the agriculture sector is labor-intensive, contraction of agriculture sector releases more unskilled labor that reduces its wage rate. However, an increase in subsidy expands the manufacture sector, which is skilled-intensive compared with two rural sectors, and raises its demand for skilled labor. Thus, an increase in subsidy raises wage rate of skilled labor correspondingly. Once we get its impact on skilled and unskilled wage rate, we can obtain an increase in subsidy expands wage equality.

3.2 Impacts of Reduction of Labor Market Distortion

In the setting, reduction of labor market distortion means a rise in *τ*. Solving (13) with respect to the change of *τ*,

$$\frac{\hat{N}}{\hat{\tau}} = \frac{(\lambda_{LA}\lambda_{SM} - \lambda_{LM}\lambda_{SX})\Psi\theta_{LA} - \rho\Psi\lambda_{LA}\lambda_{SM} - \lambda_{LM}\lambda_{SM}(1+\Psi)(S_{LS} + S_{SL})}{\Delta} < 0$$

$$\frac{\hat{Y}_A}{\hat{\tau}} = \frac{1}{\Delta}\left\{ \begin{array}{l} \rho\Psi\lambda_{SM}\lambda_{LA}\theta_{XA}\left[\left(\frac{\rho}{\sigma-1}-1\right)+(\rho-1)\Phi\theta_{LM}\right] + \rho\Psi\theta_{LA}\lambda_{LM}\lambda_{SX}\left(\frac{2-\sigma}{\sigma-1}\right) \\ +\left(\frac{\rho}{\sigma-1}-1\right)(1+\Psi)\lambda_{LM}\lambda_{SM}(S_{SL}+S_{LS}) + \rho(\rho-1)\Psi\Phi\lambda_{LA}\lambda_{SM}\theta_{XA}\theta_{LM} \end{array} \right\}$$

$$\frac{\hat{Y}_M}{\hat{\tau}} = \frac{1}{\Delta}\left[\left(1-\frac{1}{\sigma-1}\right)\lambda_{SX}\lambda_{LA}\rho\Psi - \rho\Phi\lambda_{LA}\lambda_{SM}S_{SL} + \lambda_{LA}\lambda_{SM}S_{SL}(1+\Psi)\left(1-\frac{\rho}{\sigma-1}\right)\right] > 0$$

We use Lemma 2 to summarize the above results.

Lemma 2: Reduction of labor market distortion will reduce the number of variety in *APS* sector and raise the output of manufacturing. Under the assumption the value of σ is not larger than two, an improvement of labor market reduces agricultural output.

Improvement of distortion in labor market accelerates the mobility of unskilled labor because of higher wage rate in the manufacturing sector. With more unskilled labor input, the manufacture expands. The movement of unskilled labor brings two effects: raising demand for skilled labor in the manufacture and increasing demand for output of *APS* sector. From $X = xN^{\sigma/(\sigma-1)}$, two solutions for increasing demand:(1) by raising each firm's output; (2) by developing new varieties and expanding the number of variety. Since skilled labor flows into the manufacturing, the second approach is feasible. However, the expansion of X limits by the decrease of unskilled labor in the agriculture and the agricultural output decreases.

Next, we investigate the impact of reduction of labor market distortion on wage rate. From (10) and (11), the degree of distortion could affect the wage rate through two channels: the direct effect evaluated at a constant number of variety and the indirect effect. The direct effect of decrease the degree of distortion raises the mobility of unskilled from rural to urban region, and increases the demand for skilled labor in the manufacture. Wage rate of skilled labor rises correspondingly. Thus, *APS* sector faces higher price and reduces its output. With the constant number of variety, agriculture sector reduces its demand for unskilled labor and also decreases wage rate of unskilled labor. The indirect effect is generated through the change of the number of variety. More varieties will raise marginal productivity of unskilled labor in the agriculture and increase its wage rate. However, more varieties will bring skilled labor to flow from manufacture into *APS* sector which reduces its wage. Combining two effects and substituting $\hat{N}/\hat{\tau}$ into (10) and (11),

$$\frac{\hat{w}_S}{\hat{\tau}} = \frac{\Psi}{\Delta}\left[\theta_{LA}(\lambda_{LA}\lambda_{SM}-\lambda_{LM}\lambda_{SX}) - \frac{\rho\lambda_{LA}\lambda_{SM}}{\sigma-1}\right] > 0$$

$$\frac{\hat{w}_A}{\hat{\tau}} = \frac{1}{\Delta}\left[\Psi\frac{2-\sigma}{\sigma-1}\theta_{XA}(\lambda_{LA}\lambda_{SM}-\lambda_{LM}\lambda_{SX}) - \lambda_{LM}\lambda_{SM}\Phi(S_{SL}+S_{LS})\right]$$

and

$$\frac{\hat{w}_S-\hat{w}_A}{\hat{\tau}} = \frac{1}{\Delta}\left[\Psi\lambda_{LA}\lambda_{SM}\left(1-\frac{\theta_{XA}+\rho}{\sigma-1}\right) - \Psi\lambda_{LM}\lambda_{SX}\left(1-\frac{\theta_{XA}}{\sigma-1}\right) + \lambda_{LM}\lambda_{SM}\Phi(S_{SL}+S_{LS})\right]$$

The above results are summarized as Proposition 2 and 3.

Proposition 2: Reduction of labor market distortion will raise wage rate of skilled labor, and its impact on wage rate of unskilled labor is ambiguous, depending the sum of two elasticity of substitution, S_{SL} and S_{LS}. If the sum of S_{SL} and S_{LS} is large enough, a raise in τ also increases wage rate of unskilled labor, while is the sum of two elasticity is relatively small, a raise in τ reduces wage rate of unskilled labor.

From the Lemma 2, improvement of labor market expands the manufacturing and raises the demand for skilled labor and its wage rate. However, its impact on wage rate of unskilled labor in agriculture is indeterminate, depending on the substitution between skilled labor and unskilled labor in manufacture. If S_{LS} is large enough, reduction of labor market distortion raises w_S that further induces a significant increase of a_{LM}. An augmented a_{LM} as well as Y_M add the demand for unskilled labor, thus wax the unskilled wage rate. If S_{SL} is large enough, the rise in skilled wage rate makes the wage of unskilled labor in the manufacture to increase in a large magnitude, which also raises the demand for unskilled

labor and increases w_M and w_A. If both of S_{SL} and S_{LS} is relatively small, the opposite case occurs and decreases wage rate of unskilled labor.

From the **Proposition 2**, we get

Proposition 3: The impact of a change of τ on wage inequality also determines by the sum of two elasticity. If the sum is large enough, the wage inequality will narrow down as a result of a raise in τ. While if the sum is relatively small and an increase in τ expands wage inequality.

A raise in τ waxes skilled wage rate and if the sum of S_{SL} and S_{LS} is large enough, it also increases unskilled wage rate. Thus, the wage inequality is indeterminate. If the increament of unskilled wage rate is larger than that of skilled labor, which requires the threshold of sum of S_{SL} and S_{LS} is larger than that in the Proposition 2, the wage inequality narrows down. If the threshold of sum of S_{SL} and S_{LS} is smaller than that in the Proposition 2, wage inequality expands. Note, at this case, unskilled wage may increase or decrease because of the larger threshold.

4. CONCLUSION

Enhancing traditional agricultural productivity heavily depends on introducing modern agricultural equipment and implements. However, due to small-scale operation, smallholders face numerous problems in utilizing modern agricultural equipment and implements directly. The study highlights agricultural producer service sector that acts as an intermediate sector in facilitating the use of agricultural equipment and implements. We build a two-layer vertical production structure in three-sector general equilibrium models to delineate this process: parts of manufacturing goods are utilized by the service sector, the outputs of which are intermediate inputs that could substitute labor in agricultural production.

In this study, the sector of agricultural productive services is included in a full three-sector general equilibrium model. The main focus is to evaluate the impact of two important interventions on the wage gap: lowering inefficiencies in the unskilled labor market and providing subsidies for the agricultural productive services sector to acquire goods from the industrial sector. The products of the industrial sector are used in the agricultural productive services sector and the output of the agricultural services sector is used in agricultural production. The following are the primary conclusions:

The following are the key conclusions is highlights by the research study are as below. (1) Growing subsidies result in fewer firms in the agricultural producer services sector, lower output per company, higher salaries for skilled workers, lower wages for unskilled workers, and a fall in output in the agricultural sector and an increase in the industrial sector. (2) The number of firms in the agricultural producer services sector rises when the distortions in the unskilled labor market are reduced; output per firm falls; skilled labor wages rise; the impact on unskilled labor wages is uncertain; and industrial and agricultural output rises. (3) The policy for agricultural development fails to achieve its goals and negatively impacts the productivity of agriculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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