

Original Research Article

Factor market distortions, agricultural producer service and agricultural productivity

Abstract: Small-scale agriculture prevails in developing countries and adds difficulties for the agricultural sector to use modern inputs from the urban region. In practice, raising division among rural area and the development of agricultural producer service sector could solve this problem without transferring the right to management of rural land. This paper employs the general equilibrium approach to investigate how the mitigation of labor and capital distortion influences rural development and agricultural productivity with the existence of the agricultural producer service sector. In the model, the capital could not move into agricultural production directly, instead, capital enters into the agricultural producer service sector and indirectly serves the agricultural production. Our model shows that the mitigation of labor market promotes rural labor migration as well the capital mobility from urban to rural, and expands agricultural output and raises agricultural productivity. However, a reduction of capital market distortion fails to achieve its goal and reduces agricultural output and productivity.

Keywords: Factor market distortion; Factor mobility; Agricultural producer service; Agricultural productivity.

1.Introduction

Enhancing agricultural productivity is one crucial aspect to promote structural transformation and alleviate poverty in developing economies. Insights from economic development literature are that traditional agricultural systems cannot generate high labor productivity and rapid productivity growth relies on advancement in science-based technology, which is often embodied in industry-supplied intermediate inputs (e.g. chemical fertilizers, seed varieties, and agricultural machinery). Nevertheless, developing countries face difficulties to employ such modern intermediate inputs. Restuccia et al.(2008) consider two barriers. The first is a direct barrier, the high price of modern inputs. The second is an indirect barrier associated with labor market distortion that encourages farmers to substitute cheap labor for other inputs¹.Restuccia et al.(2008) conclude that removing these two barriers could achieve substantial improvements in agricultural and aggregate productivity in developing countries.

However,barriers to transforming traditional agriculture are still pervasive in developing countries, and one obvious obstruction is the massive small-scale agricultural production, which is largely ignored by literature. There are three main reasons for the importance of the topic. First, small-scale production adds the difficulties to the use of modern inputs. On the one hand, smallholders cannot purchase modern inputs (such as machines) due to the high cost and poverty of farmers. On the other hand, after smallholders buy such inputs, they face a high average cost because of small-scale production. Second, small-scale production restricts rural labor migration. Since this type of production mainly depends on family members during the production process, even if family members find jobs in the urban, they have to return to rural regions and do farm work occasionally, especially during the harvest season, which significantly affects their urban employment. Third, capital input is hard to be accessed by each small farmer. Small-scale agriculture faces risks of multiple dimensions, for example, market price variations, weather variations,

¹ Murata(2002) analyzes the development process of industrialization. He concludes the transition from the low development trap to industrialization is accompanied by a significant rise in the wage rate and by a rapid decline in the price index of industrial inputs. His conclusions are similar to Restuccia et. al(2008).

disease risks, natural disasters, poor quality inputs that lead to low productivity, and declining soil quality. High levels of risk reduce the incentives for financial institutions to service each smallholder, making it hard for farmers to access credit.

In practice, the development of the agricultural producer service sector (*APS* sector for short) could solve these problems without transferring the right to management of rural land. Specifically, the *APS* sector, as a substitute for individual farmers' investment, provides services to smallholders; thus, they could use modern inputs without paying the corresponding sunk costs. Meanwhile, firms in the *APS* sector could provide services to large customers and greatly lower their unit cost of operation. Many developing countries, with the advancement of technology, have developed a service sector that offers services to agriculture. Meanwhile, the development of *APS* sector also promotes factor mobility between rural and urban. First, farmers do not have to go back to the rural area when they find employment in the urban region. They could hire services from *APS* sector when they leave. When the government loosens restrictions on labor mobility, the development of *APS* sector releases labor from land and promotes labor migration. Second, progress in the *APS* sector facilitates the mobility of capital. Capital finds it hard to connect with the individual farmers; however, if some organizations or firms do an intermediate job and capital talks with a “representative”, which makes capital inflow into rural regions easier. Thus, some developing countries, for example, China and Vietnam, have identified the development of *APS* sector as a path to realizing agricultural modernization.²

The purpose of this study is to investigate the impacts of mitigation of factor market distortion on agricultural output and raises agricultural productivity with the existence of the agricultural producer service sector. Agricultural producer service sector that provides intermediate inputs to small-scale agriculture. Meanwhile, service could substitute rural unskilled labor and promote rural labor migration, leading to the reallocation of production factors among sectors. Considering mitigation of factor market distortion and development of agricultural producer service affect labor and capital allocation simultaneously, it is necessary to analyze how mitigation of factor

² Chinese government issued policies to promote the development of *APS* sector, detailed information (in Chinese) http://jjuban.moa.gov.cn/zwl/m/tzgg/tz/201708/t20170823_5791602.htm. More Vietnam recent agricultural policies could refer to http://ap.ffc.agnet.org/ap_db.php?id=908.

market distortion in the presence of agricultural producer service sector impacts the agricultural output and raises agricultural productivity.

The remainder of this paper is organized as follows. Section 2 provides a review of the literature. The model with the *APS* sector and factor market distortion is given in Section 3. In Section 4, we do a comparative static analysis and investigate the impacts of mitigation of factor market. Concluding remarks are provided in Section 5.

2. Literature Review

This research is related to three strands of the literature. The first strand documents factor market distortion in developing countries, especially market distortion of labor and capital. In this paper, we use the term "factor market distortion" in the sense of Ide and Takayama(1988,1990), that is, there exists a reward differential in the capital and labor market. Imperfect mobility of factors, subsidies, urban bias policies, and other forms of regulations prevent the factor reward from being equal within one economy. As for labor market distortion, for example, *hukou* registration in China. Households must receive official registration in order to legally reside in an urban area. Without this registration, access to urban amenities such as housing and education is limited and quite expensive. Concerning capital market, rural-urban capital market distortion manifests as a far higher interest rate of capital in the rural area than in the urban area due to the favor of the urban region, as stressed by Beladi et al(2019).

Market distortion and its effects are explored by many scholars from different perspectives. Early research considers this issue from an international trade perspective(Ide and Takayama,1988). Because this issue is more severe in developing countries than in developed countries, recent literature analyzes it in the context of developing countries with a dual economy(Parai and Beladi,1997;Beladi and Chau,2000; Chaudhuri,2003; Gu and Yabuuchi,2006;Gilbert and Oladi,2009; Choi and Yu,2010;Pi and Chen,2016; Beladi, et al,2019). Nevertheless, to the best of our knowledge, the impact of factor market distortion on agricultural productivity in the presence of the *APS* sector is largely ignored. Since factor market distortions hinder economic development and bring uneven development between rural and urban region, the government adopted policies to address this issue except for the

development of *APS* sector³. Therefore, it is worth analyzing the impacts of such policies on agricultural region, especially with the existence of the *APS* sector.

This research contributes to the strand of the literature that studies rural development in developing economy. The promotion of factor mobility aims at rising agricultural productivity and the realization of agricultural modernization in developing countries. Scholars in development economics have broken through the traditional dual economy structure and considered that rural region has two distinctive sectors: traditional agriculture and modern agriculture. Different studies offer various insights to investigate the impacts of the development of modern agriculture (Chaudhuri,2007;Li and Xu,2016;Dong and Li, 2019). The above research assumes modern agriculture could employ capital directly while traditional agriculture only uses labor. However, such an investigation could not answer how traditional agriculture raises its productivity and how to transform it into modern agriculture. Since the majority of agriculture produces in a small-scale which makes it difficult to use capital or modern input directly, it is necessary to consider the development policies with the existence of *APS* sector.

The third strand of the literature that we contribute to is the branch that focuses on the agricultural producer service. In theoretical research, agricultural producer service recently has received attention from scholars. This paper focuses on the theoretical approach and establishes a general equilibrium model to conduct the analysis. The angle that is most closely related to this paper is Li and Fu (2020) and Wang and Li (2022). Li and Fu(2020) incorporated agricultural producer service sector into a three-sector general equilibrium model to study the effects of the changes of remittance rate in the migrant workers' income on environmental pollution. Under the settings of Li and Fu(2020), all remittances are used to purchase agricultural producer services products that complement labor in agricultural production. Thus, when purchasing more agricultural producer service, agricultural sector will enlarge its employment. However, this assumption is inconsistent with economic reality. To

³ Promotion of *APS* sector encourages factor mobility which affects the factor mobility mainly through the market mechanism. Apart from this approach, government could implement several policies to eliminate institutional factors. For example, on April 9, 2020, Chinese central government published policy guidelines on building effective factor markets. Substantial progress is expected in the areas of factor markets, and market access.

reflect the economic real data, the paper assumes service could substitute unskilled labor and , and purchasing services from agriculture will contribute to rural labor migration. Therefore, this study differentiates from Li and Fu(2020) by providing a new perspective to incorporate agricultural producer service sector into the general equilibrium model. Wang and Li(2022) incorporated agricultural producer service sector and investigate the impact of mitigation of capital market distortion on wage inequality between skilled and unskilled labor. However, Wang and Li(2022) ignored how mitigation of factor market distortion affects agricultural output and agricultural productivity.

In order to fill the current research gap, this paper builds a three-sector general equilibrium model and tries to analyze how the alleviation of labor and capital market influences capital and labor mobility and agricultural productivity in developing countries. In the model, the capital could not move into agricultural production directly, instead, capital could enter into the *APS* sector and indirectly serve agricultural production. And *APS* sector is an upstream sector that supplies varieties of differentiated intermediate services, which could substitute rural labor. We find that mitigation of labor market promotes rural labor migration as well the capital mobility from urban to rural. Mitigation of labor market distortion expands the *APS* sector which contributes to the enlargement of agricultural output. With less labor and expansion of output, the mitigation of labor market distortion raises agricultural productivity. However, a reduction of capital market distortion fails to achieve its goal and the economy will not experience the mobility of capital. An improvement in capital market distortion reduces agricultural output and productivity.

3. The model

Consider a small open economy that composes of three sectors: an urban manufacturing sector and two rural sectors: agricultural sector and *APS* sector. The *APS* sector is upstream in the sense that it supplies varieties of differentiated intermediate inputs to the agricultural sector in the rural area⁴. These goods include,

⁴ Murata (2002) 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 input is still in its infancy, and the service in agricultural sector, which is mainly doing farm work, is vastly different from the manufacturing sector.

for instance, agricultural machinery services, agricultural technical services, supply service of agricultural means of production that embody the manufacturing output. The manufacturing sector (sector M) uses labor L_M and capital K_M to produce an exportable good Y_M . The output of agricultural (Y_A) is generated through the use of labor L_A and a set of n of differentiated goods of APS sector sold within a market structure characterized by Chamberlinian monopolistic competition⁵.

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 inputs.

$\rho > 1$ is the elasticity of substitution between labor and intermediate goods. $\psi \in (0, 1)$ is the distribution parameter and governs the weight of intermediate goods in the production function. X is assumed to be of the CES type, and $x(i)$ denotes the amount of each service demanded by agriculture. 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 the agricultural good,

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

w_A is wage rate of labor in the rural region, $P = \left[\int_0^N p(i)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$ 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

⁵ Although the land is input factors during the agricultural production, we abstract from it for the following reason. In developing countries, the land is sluggish mobility between sectors, and we can treat land as a specific factor. When the land factor is introduced in the present model as a specific factor, the main conclusions will not change.

scale technology as follow: $Y_M = F^M(L_M, K_M)$ and F^M is linearly homogeneous and strictly concave. Given the assumption of perfectly competitive markets, the price-unit cost equality condition relating to the manufacturing sector is given by

$$p_M = a_{KM} r_M + a_{LM} w_M \quad (2)$$

where p_M is the relative prices of commodity M . r_M and w_M are the interest rate and wage rates of labor in the urban region, respectively. a_{iM} ($i = K, L$) 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. In this sector, every variety x_i is produced by the employment of capital and labor. Assume each firm employs θ amounts of capital as the fixed cost, and labor is the variable input, with the labor demand by each firm given by $v x(i)$, where v denotes the unit labor requirement. Total cost faced by each service firm is $TC(i) = \theta r_A + v x(i) w_A$, where r_A is the interest rate in the rural region. The presence of internal economies of scale implies that each firm specializes in the production of a single variety. Given the demand function and cost function of each variety, a firm sets the price to maximize its profit, which yields $p(i) = (\sigma / (\sigma - 1)) v w_A$. Here, the pricing rule is independent of the variety index i . Since p, θ, v and w_A 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

$$\frac{v x w_A}{\sigma - 1} = \theta r_A \quad (3)$$

Labor market distortion that in effect raises the cost of reallocating labor between urban and rural region. Following Restuccia et al(2008), we consider distortion in the labor market suppresses labor wage in the agriculture, giving farmers an incentive to use labor more intensively. No-arbitrage condition in the labor market implies

$$\alpha w_M = w_A, 0 < \alpha \leq 1 \quad (4)$$

This equilibrium condition means labor in the agriculture receives α percentage of the wage rate of his counterpart in the manufacture⁶. α measures the distortion in labor market. When the parameter increases, degree of distortion reduces, and when $\alpha=1$, the distortion vanishes.

Capital market distortion expresses that capital would not move to the rural sector in spite of a higher interest rate in that sector. Following the setting in Beladi et al (2019), we characterize the rural-urban capital market distortion as:

$$\tau r_A = r_M, 0 < \tau < 1 \quad (5)$$

The parameter τ measures the degree of distortion in the capital market. The greater of τ is, the higher degree of distortion. And when $\tau=1$, no distortion exists in the capital market.

APS goods market-clearing condition can be demonstrated by

$$\psi^\rho Y_A P^{-\rho} = \sum_{i=1}^N x(i) \quad (6)$$

The left hand of (6) is the derived demand for *APS* outputs, and the right is supply.

The market-clearing conditions of the labor and capital could be shown as follows:

$$(1-\psi)^\rho w_A^{-\rho} Y_A + N\theta v + a_{LM} Y_M = L \quad (7)$$

$$N\theta + a_{KM} Y_M = K \quad (8)$$

where L and K represent the endowment of labor and capital, respectively. The first term in (6) is the demand for labor in the agriculture.

So far, the theoretical model thus consists of eight equations, from (1) to (8). The above framework could be employed to analyze the impacts of mitigation of distortion in the presence of *APS* sector on output and agricultural productivity.

4. Comparative static analysis

⁶ The setting is Lewis type of underemployment (surplus labor), and underemployment of labour occurs in the low-wage agricultural sector.

Since the *APS* sector provides intermediate inputs to the agriculture, we begin with analysis of this sector. Each firm in *APS* sector sets its price according to $p = (\sigma/(\sigma - 1))vw_A$, thus $P = pN^{1/(1-\sigma)}$. Similarly, each firm produces equal amount of output x , $X = xN^{\sigma/(\sigma-1)}$. Since $\sigma > 1$, expansion of the number of varieties, N , reduces the price index P and raises X , 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 further obtain $\hat{p} = \hat{w}_A$,

$\hat{P} = \hat{p} + \frac{1}{1-\sigma} \hat{N}$, $\hat{X} = \hat{x} + \frac{\sigma}{\sigma-1} \hat{N}$, where a hat denotes the percentage change of the variable.

Totally differentiating from (1) to (5), we get following results $\hat{r}_M = -\frac{\theta_{LM}}{\theta_{KM}} \hat{w}_M$,

$\hat{w}_A = \frac{1}{\sigma-1} \hat{N}$, $\hat{r}_A = \hat{x} + \hat{w}_A$, $\hat{w}_A = \hat{\alpha} + \hat{w}_M$, $\hat{r}_A + \hat{\tau} = \hat{r}_M$. By using these relationships, we

further get $\hat{x} = -\frac{1}{\theta_{KM}(\sigma-1)} \hat{N} + \frac{\theta_{LM}}{\theta_{KM}} \hat{\alpha} - \hat{\tau}$. Totally differentiating (6) to (8),

$$\begin{pmatrix} 1 - \frac{1}{(\sigma-1)\theta_{KM}} & -1 & 0 \\ \lambda_{KX} + \frac{\lambda_{KM} S_{KL}}{(\sigma-1)\theta_{KM}} & 0 & \lambda_{KM} \\ A & \lambda_{LA} & \lambda_{LM} \end{pmatrix} \begin{pmatrix} \hat{N} \\ \hat{Y}_A \\ \hat{Y}_M \end{pmatrix} = \begin{pmatrix} -\frac{\theta_{LM}}{\theta_{KM}} \hat{\alpha} + \hat{\tau} \\ \frac{\lambda_{KM} S_{KL}}{\theta_{KM}} \hat{\alpha} \\ -\left(\frac{\lambda_{LM} S_{LK}}{\theta_{KM}} + \frac{\lambda_{LX} \theta_{LM}}{\theta_{KM}} \right) \hat{\alpha} + \lambda_{LX} \hat{\tau} \end{pmatrix} \quad (9)$$

where $\lambda_{LM} = a_{LM}Y_M/L$ and $\lambda_{KM} = a_{KM}Y_M/K$ denote the share of labor and capital in sector M , $\lambda_{LA} = (1-\psi)^\rho w_A^{-\rho} Y_A / L$ ($\lambda_{LX} = Nxv / L$) denotes the share of labor used in sector A (*APS*) sector, $\lambda_{KX} = N\theta / K$ represents the share of capital used in the *APS* sector, i.e the share of capital locates in the rural region.

$A = \lambda_{LX} - \rho\lambda_{LA}/(\sigma-1) - \lambda_{LM}S_{LK}/(\theta_{KM}(\sigma-1)) - \lambda_{LX}/(\theta_{KM}(\sigma-1)) > 0$. In addition,

$S_{LK} = \frac{\partial a_{LM}}{\partial r_M} \frac{r_M}{a_{LM}} > 0$ is the partial elasticity of substitution between labor and capital in

sector M , $S_{KL} = \frac{\partial a_{KM}}{\partial w_M} \frac{w_M}{a_{KM}} > 0$ is the partial elasticity of substitution between capital and

labor in sector M .

Denote the value of determinant of the coefficient matrix of equation (9) as Δ , and we have

$$\Delta = - \left[1 - \frac{1}{(\sigma-1)\theta_{KM}} \right] \lambda_{LA}\lambda_{KM} + \left[\lambda_{LM}\lambda_{KX} + \frac{\lambda_{LM}\lambda_{KM}S_{KL}}{(\sigma-1)\theta_{KM}} - A\lambda_{KM} \right] > 0$$

4.1 Impacts of improvement of labor market distortion

Solving (9) by Cramer's rule regarding to $\hat{\alpha}$,

$$\frac{\hat{N}}{\hat{\alpha}} = - \frac{\lambda_{KM}(\sigma-1)[\lambda_{LM}(S_{KL} + S_{LK}) + \theta_{LM}(\lambda_{LA} + \lambda_{LX})]}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma-1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma-1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})} > 0$$

$$\frac{\hat{Y}_A}{\hat{\alpha}} = \frac{(\sigma-1)[\lambda_{KM}\lambda_{LM}(S_{KL} + S_{LK}) + \theta_{LM}\lambda_{KX}\lambda_{LX}] + \rho\theta_{LM}\lambda_{LM}\lambda_{LA}}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma-1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma-1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})} > 0$$

and

$$\Delta \frac{\hat{Y}_M}{\hat{\alpha}} = \frac{\lambda_{KM}S_{KL}[(\lambda_{LA} + \lambda_{LX})(2-\sigma) + \rho\lambda_{LA}]}{\theta_{KM}(\sigma-1)} - \frac{\lambda_{KX}(\lambda_{LM}S_{LK} + \theta_{LM}\lambda_{LX} + \lambda_{LA}\theta_{LM})}{\theta_{KM}}$$

By utilizing the above results, we further obtain: $\frac{\hat{w}_A}{\hat{\alpha}} > 0$, $\frac{\hat{w}_M}{\hat{\alpha}} < 0$, $\frac{\hat{r}_M}{\hat{\alpha}} > 0$, $\frac{\hat{r}_A}{\hat{\alpha}} > 0$,

and

$$\frac{\hat{x}}{\hat{\alpha}} = \frac{1}{\theta_{KM}} \left(\theta_{LM} - \frac{1}{\sigma-1} \frac{\hat{N}}{\hat{\alpha}} \right)$$

$$= \frac{\theta_{LM}(\sigma-1)[\lambda_{KX}\lambda_{LM} - \lambda_{KM}(\lambda_{LA} + \lambda_{LX})] + \lambda_{KM}[\rho\theta_{LM}\lambda_{LA} - \lambda_{LM}(S_{KL} + S_{LK})]}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma-1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma-1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})}$$

A raise in α implies the improvement of labor market distortion, raising wage rate in rural region and decreasing wage rate in the urban region and narrowing down

income wage inequality between urban and rural area. Faced with the mitigation in the labor market, rural labor migrates into the urban region for the sake of a high wage rate. Since capital is relative expensive, manufacturing sector uses more labor to substitute capital and raises its demand for labor at the same time. Note, the output of manufacturing sector is still indeterminate because of the imperfect mobility of capital.

The large-scale outflow of labor pushes the demand for the service from *APS* sector. The expansion of X has two channels: adding the number of variety or raising the output of each variety. Since rural area experiences an outflow of labor and the manufacture releases capital, adding the number of variety is a prior choice. Thus, the derived demand for service raises the demand for capital in the rural area and N increases.

The output of manufacture and each variety depend on the elasticity of substitution between service and labor in the agricultural production, ρ . If the elasticity is large, which means a unit of X could replace numerous units of labor; at this case, rural remaining labor moves into the *APS* sector instead of staying in the agriculture, and the output of each variety rises. If the ρ is slightly larger than 1, we obtain the opposite result on the output of each variety. Meanwhile, the value of ρ also affects the amount of capital mobility from urban to rural region. From the above discussion, expansion of X first relies on the development of new varieties and capital moves from urban into rural region. Then, ρ determines the remaining rural labor between agricultural sector and the *APS* sector. When the ρ is large enough, an increase in α raises N as well as x , the expansion of X reckons on less capital from the manufacture. In this situation, with the inflow of labor, the manufacturing output rises. Nevertheless, if the ρ is slightly larger than 1, the expansion of X depends heavily on the capital from the manufacture and a relatively large amount of capital mobiles into the rural area, which contracts manufacturing output.

Last, we consider the agricultural output and agricultural productivity. An outflow of surplus labor harms little on agricultural production and its negative effect offsets by raising the demand for services. Meanwhile, the supplement of capital is realized by the released capital from the manufacture. With more provision of intermediate goods from the *APS* sector, agricultural output and agricultural productivity augment.

Summarizing the above discussion, we obtain Propositions 1 and 2.

Propositions 1: Mitigation of labor market distortion promotes rural labor migration as well the capital mobility from urban to rural. If the elasticity of substitution in the agricultural production, ρ , is large enough, improvement of labor market raises the manufacturing output.

Propositions 2: Mitigation of labor market distortion expands the *APS* sector which contributes to the enlargement of agricultural output. With less labor and expansion of output, mitigation of labor market distortion raises agricultural productivity.

4.2 Impacts of alleviation of capital market distortion

Solving (9) by Cramer's rule regarding to $\hat{\tau}$,

$$\frac{\hat{N}}{\hat{\tau}} = -\frac{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})(\sigma - 1)\theta_{KM}}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma - 1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma - 1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})} < 0$$

$$\frac{\hat{Y}_A}{\hat{\tau}} = -\frac{\lambda_{KX}\lambda_{LM}(\sigma - 1)\theta_{KM} + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK}) + \rho\lambda_{LA}\lambda_{KM}\theta_{KM}}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma - 1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma - 1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})} < 0$$

and

$$\frac{\hat{Y}_M}{\hat{\tau}} = \frac{(\lambda_{LA} + \lambda_{LX})[\lambda_{KX}(\sigma - 1)\theta_{KM} + \lambda_{KM}S_{KL}]}{\lambda_{KM}(\lambda_{LA} + \lambda_{LX})[1 - (\sigma - 1)\theta_{KM}] + \theta_{KM}[\lambda_{KX}\lambda_{LM}(\sigma - 1) + \rho\lambda_{LA}\lambda_{KM}] + \lambda_{LM}\lambda_{KM}(S_{KL} + S_{LK})} > 0$$

Similar to the process of 3.1, we further obtain: $\hat{w}_A/\hat{\tau} < 0$, $\hat{w}_M/\hat{\tau} < 0$, $\hat{x}/\hat{\tau} < 0$,

$$\hat{r}_M/\hat{\tau} > 0, \hat{r}_A/\hat{\tau} < 0.$$

These results seem counter-intuitive since an increase in τ (i.e., alleviation of capital market distortion) should benefit *APS* sector and promote the agriculture sector. Such intuitive results are valid if we only consider the supply-side of *APS* sector; however, if we incorporate the demand-side of *APS* sector, we may obtain the opposite results in the presence of factor market distortion.

A raise in τ results in the reallocation of capital towards rural region, growing the interest rate in the urban area and bring down the interest rate in the rural area. Combined with the zero-profit condition in the manufacture, wage rate in this sector decreases. Faced with these results, manufacturing sector uses more labor to substitute capital and raises its demand for labor. Raising demand for labor has two effects: substitution effect between labor and capital that reduces demand for capital and output effect that augments the demand for capital. However, the substitution effect impedes by the limited labor movement, which is heavily hampered by the imperfect labor market. Thus, the amounts of migration as well as capital are limit. Note here, the reason for little mobility of capital comes from the obstruction movement of labor that makes the substitution difficult

Because the substitution effect is weak, a raise in τ fails to achieve the goal of the reallocation of capital towards rural region, and on the contrary, the output effect dominates the change and the manufacture raises its demand for capital and expands its output. Meanwhile, little labor outflow hinders the substitution between service and labor and generates limited derived demand for the intermediate inputs, since wage of rural labor is relatively cheap. Thus, capital moves from rural area into urban region instead. An outflow of capital first reduces the number of varieties in the *APS* sector, and then cuts down wage rate of labor in rural region. Confronted with cheaper labor factor, the agriculture further lowers its demand for the intermediate goods and each firm's output declines. With fewer number of variety and each firm's output, intermediate goods X drops that go down agricultural output. Regarding to agricultural productivity, with little labor migration and contraction of agricultural output, we can further get the agricultural productivity cuts down as a result of the reduction of capital market distortion.

Compared with the section of 3.1, the crucial difference between mitigation distortion of labor and capital market lies on the distinct impacts on labor migration. The alleviation of capital market distortion aims provision capital to rural area; however, due to the labor market distortion, substitution between labor and capital in the manufacture could not bring into effect. This generates two results: capital cannot exude from the manufacture and leave little room for intermediate inputs in agricultural production. Nevertheless, the reduction in labor market distortion pushes the labor migration which lowers wage rate in the manufacturing sector. Substitution occurs in

the manufacture, which releases capital from manufacturing production, and generates heavy demand for intermediate goods in the agriculture. Therefore, the alleviation of labor market raises the supply and demand for intermediate goods simultaneously, promoting labor and capital mobility between urban and rural.

The above discussions are summarized as Proposition 3 and 4.

Proposition 3: Reduction of capital market distortion will not achieve its goal and the economy will not experience the mobility of capital towards rural area.

Propositions 4: Mitigation of capital market distortion raises manufacturing output and shrinks agricultural output. Regarding to agricultural productivity, improvement in capital market distortion reduces it.

5. Conclusion

Small-scale agriculture prevails in developing countries, especially in [Asia](#) and sub-Saharan Africa. Due to small-scale production, capital from urban region cannot enter into agricultural production directly. To solve this problem, rural region divides another sector, agricultural producer service sector, which acts as a bridge to connect individual farmers in some way and promotes labor division in agricultural production.

In this paper, we have employed a general-equilibrium model augmented by the *APS* sector to analyze the effects of alleviation of labor and capital market on outputs and agricultural productivity. In the model, capital could imperfectly mobile between manufacturing sector and *APS* sector. Agricultural sector utilizes the output of *APS* sector and labor as intermediate goods. Moreover, labor market distortion makes rural labor receive fewer rewards than its counterpart in the urban region. The main conclusion is that the improvement of labor market promotes rural labor migration as well the capital mobility from urban to rural. Mitigation of labor market distortion expands the *APS* sector which contributes to the enlargement of agricultural output. With less amount of labor and expansion of its output, the mitigation of labor market

distortion raises agricultural productivity. However, a reduction of capital market distortion will not achieve its goal and the economy will not experience the mobility of capital toward rural area. And an improvement in capital market distortion reduces agricultural productivity.

Further research possibly extends the analysis in the following two respects. Firstly, describing the dynamic development process of APS sector. With the large surplus labor in agriculture, the demand for intermediate goods is little. When massive labor migration and the increasing rural wage rate occur, the demand for intermediate inputs rises. Meanwhile, an outflow of labor pushes forward the manufacturing sector and substitutes capital in manufacturing production, which cuts down the cost of intermediate goods and raises the supply. With demand and supply growth, the APS sector develops which impulses a new round of labor migration. This interdependence between rural and urban can generate a virtuous circle and APS sector becomes larger and larger. A static general equilibrium model, offering insights to understand the development process, cannot describe the whole dynamic process. Secondly, the model can incorporate the vertical relationship between manufacturing sector and APS sector. The development of APS sector relies on advancements in science-based technology and modern inputs from the manufacturing sector. Extension of the model could assume the APS sector purchases manufacturing outputs and uses the intermediate inputs as a fixed cost.

References

- Beladi, H. and Chau, N.H.,2000, Endogenous factor market distortion, risk aversion, and international trade under input uncertainty. *Canadian Journal of Economics*, 33, 523-539.
- Beladi,H.,Chao, C.C., Ee,M.S.,Yu,E.S.H.,2019,Capital market distortion, firm entry and wage inequality,*China Economic Review*,56,101312.
- Choi, J.Y. and Yu, E.S.H.,2010, Imperfect Capital Mobility: A General Approach to the Two-Sector Harris Todaro Model. *Review of International Economics*,18, 81-94.

- Chaudhuri,S., 2003, How and how far to liberalize a developing economy with informal sector and factor market distortions, *The Journal of International Trade & Economic Development*, 12(4),403-428.
- Chaudhuri,S., 2007,Foreign capital, welfare and urban unemployment in the presence of agricultural dualism, *Japan and the World Economy*,19,149-165.
- Dong,Z., and Li, X., 2019, Rural dual economics, subsidy policy and the income inequality between skilled and unskilled workers, *Asia-Pacific Journal of Accounting & Economics*, 26(5), 609-621.
- Gilbert,J., Oladi,R., 2009,Capital specificity, imperfect labor mobility and growth in developing economies, *International Review of Economics & Finance*,18(1),113-122.
- Gu, W., and Yabuuchi, S.,2006, Imperfect labor mobility and unemployment in a dual economy. *Review of International Economics*, 14, 698-708.
- Ide,T. and Takayama, A.,1988,Marshallian stability and long-run equilibrium and the pattern of specialization under factor-market distortions in the pure theory of international trade, *Economics Letters*, 27,265-270.
- Ide,T. and Takayama, A.,1990, Marshallian stability and long-run equilibrium in the theory of international trade with factor market distortions and variable returns to scale, *Economics Letters*,33(2),101-108.
- Li,X. and Fu, H.,2020,Migrant Remittance, Agricultural Producer Services, and Environmental Pollution”, *Asia-Pacific Journal of Accounting & Economics*, [doi:10.1080/16081625.2020.1808797](https://doi.org/10.1080/16081625.2020.1808797).
- Li,X. , Xu,Y. ,2016, Unemployment, Wage Inequality and International Factor Movement in the Presence of Agricultural Dualism, *Review of Development Economics* ,20(2),415-425.
- Murata, Y.,2002, Rural-urban interdependence and industrialization, *Journal of Development Economics* , 68(1), 1-34.
- Parai,A.K. and Beladi,H.,1997, Imperfect Labor Mobility and Unemployment in LDCs, *Southern Economic Journal*, 64(1),180-190.

Pi, J., and Chen, X.,2016, The impacts of capital market distortion on wage inequality, urban unemployment, and welfare in developing countries. *International Review of Economics and Finance*, 42, 103-115.

Reinert, K.,1998, Rural non-farm development: a trade-theoretic view, *The Journal of International Trade & Economic Development*, 7(4),425-437.

Restuccia, D., Yang, D.T.and Zhu, X.,2008,Agriculture and aggregate productivity: A quantitative cross-country analysis, *Journal of Monetary Economics*, 55(2), 234-250.

Wang,D. and Li,X.,2022, Capital market distortion, agricultural producer service and wage inequality in the small-scale agriculture, *Annals of Regional Science*, <https://doi.org/10.1007/s00168-022-01141-x>

UNDER PEER REVIEW