Imperfect Factor Mobility, Agricultural Producer Service and Agricultural Development in Developing Economy

Abstract

Agriculture in developing countries operates on small-scale land that hinders the utilization of modern inputs. The agricultural producer service sector which acts as an intermediate sector facilitates this process. We build a three-sector general equilibrium model to investigate the relationship between imperfect factor mobility and agricultural development by incorporating the agricultural producer service sector. Results show that a rise in capital mobility expands the agricultural sector and promotes agricultural productivity, while an increase in labour mobility cuts down the output of the agricultural sector and its productivity.

Keywords: Agricultural Producer Service, Imperfect Factor Mobility, Agricultural Development.

1.INTRODUCTION

Developing economies face one permanent characteristic: dual economy structure. A dual economy refers to a structural economic framework characterized by the coexistence of two distinct sectors with different levels of development and productivity. This duality manifests as a stark contrast between a modern and industrially advanced urban alongside a traditional and backwards rural or agricultural sector. Thus, raising agricultural productivity and realizing agricultural modernization is viewed as an efficient way to end this duality.

Meanwhile, ineffective allocation of resources contributes to the low productivity of agriculture. In one influential work, Restuccia et. al. (2008) argue that certain distortions in factor markets may severely dampen the incentives of farmers to adopt modern inputs and raise agricultural productivity. Scholars use the term imperfect factor mobility to describe this issue (Casas,1984). Imperfect factor mobility characterizes the restrictions and challenges associated with the movement of production factors such as labour and capital, within a given economic system. These resources face impediments that hinder their smooth and efficient allocation across different sectors or regions. These barriers can be rooted in various factors, including institutional regulations, geographic constraints, and structural limitations. Recognizing and addressing these imperfections in factor mobility is essential for

formulating targeted policies that can unleash the latent potential of these economies, ultimately contributing to sustainable development and economic advancement.

In addition to the aspect of imperfect factor mobility, small-scale agriculture prevails in developing countries, which also results in low agricultural productivity and hinders rural development (Sarah et al., 2016). Therefore, small-scale agriculture encounters difficulties in utilizing modern advanced intermediate inputs directly. To overcome these challenges, the outsourcing of various stages of agricultural production and the procurement of services from the agricultural producer service sector are considered effective strategies to expedite the integration of non-agricultural inputs (Yang et al., 2013; Zhang et al., 2017; Belton et al., 2021).

The purpose of this study is to investigate the impacts of imperfect factor mobility on rural development with the existence of agricultural modernization in a small-scale agriculture-developing economy. Following Li and Fu (2022) and Li and Fu (2023), we view the agricultural producer service sector as an intermediate sector to facilitate the introduction of non-agricultural intermediate inputs. When the developing economy faces the improvement of factor mobility, how does this change affect rural development? We try to bridge this gap and analyze the impacts of an increase in factor (e.g. capital and labour) mobility on rural development with the existence of agricultural producer services.

2.LITERATURE REVIEW

This research is closely related to two strands of the literature. The first strand documents imperfect factor mobility and its impact on economic activities. Choi and Yu (2010) analyzed the implications of imperfect mobile capital among sectors in the context of the two-sector general equilibrium model. Results show that under partially mobile capital,labour growth (capital accumulation) may destabilize sectoral capital movement and lower the welfare of a small country if the agricultural rental rate is lower (higher) than the manufacturing rental rate. Agnès and Hippolyte (2021) considered this issue from the perspective of tax competition. The conclusions show that the mobility of one factor affects the taxation of both factors and that the "race-to-the-bottom" narrative (with burden shifting) applies essentially to capital-exporting countries. Erhan et al.(2022) formulated a multi-sector dynamic model featuring capital and labour adjustment costs and explored how different investment frictions affect the patterns of responses of labour markets to tariff cuts. Results indicate that capital adjustment can create long-run responses of real wages

that are larger than the short-run responses. Nevertheless, the impact generated byimperfect factor mobility in the presence of the agricultural producer service sector on rural development in developing countries is largely ignored. When investigating the relationship between factor mobility and rural development, scholars leave agricultural producer service aside and neglect to discuss this aspect. In reality, along with factor mobility, the factor rewards will change correspondingly and further affect intermediate inputs in agriculture, exerting a neglectable impact on rural development. Thus, it is necessary to analyze howimperfect factor mobility in the presence of the agricultural producer service sector influences rural development.

This research contributes to the literature focusing on rural development or agricultural production in developing countries. A widely held consensus among scholars is that sustainable advancements in the productivity of traditional agriculture hinge on the integration of technology developed in urban sectors. While prior studies addressing the introduction of intermediate inputs in traditional agriculture predominantly examined large-scale farming, assuming direct utilization after a straightforward transformation (Yang and Zhu, 2013; Donovan, 2021), recent scholarship has increasingly turned its attention to small-scale agriculture. Notably, researchers such as Li and Fu (2022) have incorporated the agricultural producer service sector into a three-sector general equilibrium model to examine the impact of the remittance rate of migrant workers' income on environmental pollution. Furthermore, Li and Fu (2023) explored the effects of government subsidies (price, interest, and wage) on the agricultural producer service on agricultural pollution and other economic indicators, employing a comprehensive three-sector general equilibrium model. Within the frameworks proposed by Li and Fu (2022) and Li and Fu (2023), it becomes evident that intermediate inputs, agricultural producer services, and unskilled labour are complementary components influencing agricultural dynamics. However, the above-mentioned papers neglect to consider the aspect of imperfect factor mobility.

This paper plans to analyze the impacts of an increase in factor (e.g. capital and labour) mobility on rural development with the existence of agricultural producer services. We build a three-sector general equilibrium model to investigate the relationship between imperfect factor mobility and agricultural development by incorporating the agricultural producer service sector. Results show that a rise in capital mobility expands the agricultural sector and promotes agricultural productivity,

while an increase in labour mobility cuts down the output of the agricultural sector and its productivity.

3. MODEL

Consider a small open economy with two traded goods(manufacturing *Y* and agriculture *Z*) and one intermediate input *X* (varieties of agricultural producer services(APS)). Good *Y* is produced in the urban region, while good *Z* and input *X* are produced in the rural area. *Y* is produced by using labour and capital, while Z is produced by labour and input *X*.The production functions are

$$Y = L_Y^{\alpha} K_Y^{1-\alpha}$$

$$Z = L_Z^{\beta} X^{1-\beta}$$

where two functions satisfy neoclassical properties (i.e., strict quasi-concavity and linear homogeneity). The employment of labour in *Y* (*Z*) is L_Y (L_Z), while the use of capital(input) in *the Y* (*Z*) sector is K_Y (X).

Use x_i to express the output of firm *i* in the APS sector, *n* is the number of firms in that market,

$$X = \left[\sum_{i=1}^{n} x_i^{\delta} \right]^{\frac{1}{\delta}}$$

where δ is a parameter to be interpreted shortly and $0 < \delta < 1$.

The APS sector uses labour and capital for production. Capital is assumed to enter as a fixed input, with the given capital input requirement of each producer equal γ to. Labour is a variable input, with the labour demand by each service firm given $L_i = \beta x_i$, wh β ich denotes the unit labour requirement.The total cost faced by each service firm is $TC_i = \gamma r + \beta x_i w$, where *w*and *r*, respectively, are the wage rate of labour and price of capital in the rural area. Here, we impose two assumptions about APS. First, assume the market structure within services is one of Chamberlinian monopolistic competition. In this framework, the price elasticity of demand for a single service would be $1/(1-\delta)$. Second, we consider a symmetric way in APS firms $x_i = x_j = x$. Therefore, $X = n^{1/\delta} x$ we can rewrite the production function of the

agricultural sector as follow $Z = n^{\frac{1-\delta}{\delta}} L_Z^{\beta} x^{1-\beta}$ s: From this production function, a rise in the number of firms in the APS sector increases the output of the agricultural sector, even if agriculture keeps its inputs the same. Such external economies were captured by $(1-\delta)/\delta$ the model. In addition, as the value δ goes to 1, the output of firms in the APS becomes perfect substitutes for each other, only the total output of APS matters. On the other hand, as the δ declines towards 0, the importance of the firm's number becomes more important.

Use *p* to denote the price of services, and the equality of marginal cost to marginal revenue implies that

$$\delta p = \beta w \quad (1)$$

Concerning two final goods and taking*Z*as numeraire, in equilibrium, we have

$$A\bar{w}^{\alpha} r_Y^{1-\alpha} = q \quad (2)$$

and

$$Bw^{\beta} p^{1-\beta} n^{-\frac{(1-\beta)(1-\delta)}{\delta}} = 1 \quad (3)$$

where *q* is the relative price of good $\bar{w}$ s Y. is the wage rate of labour in the manufacturingsector, which is downward rigid due to the protection of labour unions. r_Y is the interest rates of capital in the urban sector. $A = 1/[\alpha^{\alpha}(1-\alpha)^{1-\alpha}] > 0$ and $B = 1/[\beta^{\beta}(1-\beta)^{1-\beta}] > 0$ are parameters. The productivity of the agricultural sector is linked to the quantity of varieties of APS. An increase in the quantity of varieties reduces the unit cost of agricultural production. The labour of demand for two sectors are $L_Y = \alpha q A \bar{w}^{\alpha-1} r_Y^{1-\alpha} Y$ and $L_Z = \beta B w^{\beta-1} p^{1-\beta} n^{-\frac{(1-\beta)(1-\delta)}{\delta}} Z$. Capital demand in the urban sector is $K_Y = (1-\alpha) A q \bar{w}^{\alpha} r_Y^{-\alpha} Y$.

Assume labour and capital markets are characterized by the existence of some inertia. The equilibrium condition of the labour market is specified using Gilbert and Oladi's (2009) setting, hence:

$$w + \rho = \frac{L_Y}{L_Y + L_U} \bar{w} \quad (4)$$

where ρ is the cost of migration, L_U is unemployment in the urban sector, and $L_Y/(L_Y + L_U)$ is the probability of employment in the urban region. A decrease ρ

means an increase in labour mobility. As for the capital market, we follow Casas(1984) and stipulate the mobility function of capital as:

$$K_Y/(n\gamma) = k(r_Y/r)^{\varepsilon} \quad (5)$$

where ε is the elasticity of capital mobility, which is assumed to be constant. $\varepsilon = 0$ means capital is completely immobile and $\varepsilon = \infty$ indicates capital is perfect mobility. The right-hand side of (8) measures the impact of intersectoral rent differential on the mobility of capital.Regarding the rent differentials of urban and rural regions, we assume the rural rent is larger than that of urban[1].

The market clearing condition for services is

$$(1-\beta)Bw^{\beta}p^{-\beta}n^{-\frac{(1-\beta)(1-\delta)}{\delta}}Z = nx \quad (6)$$

Factor markets clearing conditions are:

$$L_Y + L_Z + nx\beta + L_U = L \quad (7)$$

and

$$K_Y + n\gamma = K \quad (8)$$

where *L*and *K* denote the economy's endowment of labour and capital, respectively.
In the long run, zero profit from service condition

$$px(1-\delta) = r\gamma \quad (9)$$

So far, the theoretical model has been established. Nine endogenous variables, w r_Y r n p Y Z L_U and x, are determined by equation (1)–(9), ε and ρ policy variables. Other variables are exogenous. To set the following analysis, it is necessary to conduct the ensuing comparative static analysis.

4. COMPARATIVE STATIC ANALYSIS

The impacts of an increase in capital and labour mobility on the number of varieties, agricultural output and productivity, and unemployment can be conducted by differentiating equilibrium conditions (1)-(9) with respect to ε ρ. The impacts of a rise in capital and labour mobility on the quantity and output of varieties, agricultural output is as follows:

$$\hat{n} = \frac{1}{\Delta}\left[-\varepsilon(\lambda_{LZ} + \lambda_{LX})\log\frac{r_Y}{r}\hat{\varepsilon} + \frac{\lambda_{LU}\lambda_{\rho}^{e}}{\lambda}\hat{\rho}\right] \quad (10)$$

[1] Some discussion on intersectoral rent differentials refers to Choi and Yu(2010).

$$\hat{x}=\frac{1}{\Delta}\left\{\varepsilon\left[\lambda_{LZ}+\lambda_{LX}-\frac{(\lambda_{LY}+\lambda_{LU})\lambda_{KX}}{\lambda_{KY}}-\frac{\lambda_{LU}\lambda_{w}^{e}}{\lambda}\frac{(1-\beta)(1-\delta)}{\delta}\right]\log\frac{r_{Y}}{r}\hat{\varepsilon}-\frac{\lambda_{LU}\lambda_{\rho}^{e}}{\lambda}\left[\varepsilon\frac{(1-\beta)(1-\delta)}{\delta}-\frac{1}{\lambda_{KY}}\right]\hat{\rho}\right\} \quad (11)$$

$$\hat{Z}=\frac{1}{\Delta}\left[-\varepsilon\left[\lambda_{KX}\frac{\lambda_{LY}+\lambda_{LU}}{\lambda_{KY}}+\left(\lambda_{LX}+\lambda_{LZ}+\frac{\lambda_{LU}\lambda_{w}^{e}}{\lambda}\right)\frac{(1-\beta)(1-\delta)}{\delta}\right]\log\frac{r_{Y}}{r}\hat{\varepsilon}+\frac{\lambda_{LU}\lambda_{\rho}^{e}}{\lambda}(\varepsilon+\frac{1}{\lambda_{KY}})\hat{\rho}\right] \quad (12)$$

$$\Delta=\frac{\lambda_{LZ}+\lambda_{LX}}{\lambda_{KY}}+\varepsilon\left[\lambda_{LZ}+\lambda_{LX}-\frac{(\lambda_{LY}+\lambda_{LU})\lambda_{KX}}{\lambda_{KY}}-\left(\lambda_{LZ}+\lambda_{LX}+\frac{\lambda_{LU}\lambda_{w}^{e}}{\lambda}\right)\frac{(1-\beta)(1-\delta)}{\delta}\right] \quad (13)$$

where λ_{ij} (i=L,K; j=X,Y,Z)is the allocated shareof factor i in the jth sector. λ is the unemployment rate in the urban region. $\lambda_{\rho}^{e}=\rho/(\rho+w)$ $\lambda_{w}^{e}=w/(\rho+w)$ The sign Δ is ambiguous. In the case that capital is completely immobile $\Delta>0$. By making use of dynamic stability conditions, we obtain $\Delta>0$ as long as the equilibrium is stable. In addition, to make the ensuing discussion tractable, we assume that per capita capital in the urban regionis larger than that of the rural region. Under this assumption $\lambda_{KY}/(\lambda_{LY}+\lambda_{LU})>\lambda_{KX}/(\lambda_{LZ}+\lambda_{LX})$.

4.1 Capital Mobility and Agricultural Productivity

From (10) and (11), we obtain $\hat{n}/\hat{\varepsilon}>0$ and the sign of $\hat{x}/\hat{\varepsilon}$ is ambiguous. Suppose that δ^{*} is the solution $\hat{x}/\hat{\varepsilon}=0$. If $\delta>\delta^{*}$, then $\hat{x}/\hat{\varepsilon}<0$; and if $\delta<\delta^{*}$, then $\hat{x}/\hat{\varepsilon}>0$. We summarized the results by Lemma 1

Lemma 1*A rise in capital mobility increases varieties in the APS sector; however, its impact on a single service output depends on the size of external economies. If the size is relatively large(small), an increase in capital mobility expands (contracts) a single service output.*

A rise in capital mobility increases the capital availableand reduces the interest rate in the rural area. With the decreased interest rate, the APS sector faces a lower fixed cost, which grows varieties in this sector. A larger quantity of capital and varieties raises the marginal product of labour in the APS and agricultural sector and attracts labour to move out of urban regions. Its impact on a single service output is related to the magnitude of external economies. If the size of external economies is relatively large,

an increase in varieties has a relatively large impact on agricultural output and raises the (derived) demand for APS correspondingly. In this case, a rise in capital mobilitycontributes to the expansion of a single service output. In contrast, if the size is relatively small, a growth of varieties has relatively little influence on the agricultural output and (derived) demand of APS accordingly. With the growth of quantity in the APS sector, a rise in capital mobility reduces a single service output.

The change in capital mobility furtheraffects agricultural output and productivity through the APS sector.From (12), we get its impact on agricultural output and summarize it in **Proposition 1**.

Proposition 1*A rise in capital mobility expands the agricultural sector and promotes agricultural productivity.*

A rise in capital mobility promotes capital as well as labour transfer from urban to rural areas and grows the number of APS available. From the results, the intermediate input *X* also increases as a result of a larger mobility of capital. Therefore, a larger movement of capital raises the inputs of agriculture and its output. Meanwhile, the expansion of agriculture also raises the demand for labour and intermediate input, which leads to an increase in the wage rate and price of intermediate input. Under the setting, changes in two-factor reward are the same. If no external economies, agricultural productivity remains the same. However, a rise in capital mobility grows the number of APS available and amplifies such external economies. Thus, a rise in capital mobility promotes agricultural productivity through the expansion of external economies.

4.2 Labor Mobility and Agricultural Productivity

Raising labour mobility means a decrease in migration cost,namely,a reduction of ρ.From (10) and (11), we obtain $\hat{n}/\hat{\rho} > 0$ and the sign of $\hat{x}/\hat{\rho}$ is ambiguous. Suppose that δ^{**} is the solution $\hat{x}/\hat{\rho} = 0$. If $\delta > \delta^{**}$, then $\hat{x}/\hat{\rho} > 0$; and if $\delta < \delta^{**}$, then $\hat{x}/\hat{\varepsilon} < 0$. We summarized the results by Lemma 2.

Lemma 2*A rise in labour mobility decreases varieties in the APS sector; its impact on a single service output depends on the size of external economies. If the size is*

relatively large(small), an increase in capital mobility expands (contracts) a single service output.

A rise in labour mobility means a drop in migration costs and promotes labour mobility between rural and urban regions. The manufacturing sector raises the demand for labour and capital. Due to the rigid wages in the manufacturing sector, not all migrants can be employed in this sector and urban unemployment rises. In the rural area, the agricultural sector employs less labour and correspondingly reduces its demands for APS. Thus, the rewards of two inputs are reduced.Facing a lower demand and output price, the number of firms decreases. Its impact on a single service output depends on the change in wage rate. When the external economies aresmall, a drop in varieties affects the marginal product of labour insignificantly, and the reduction of wage rate is mainly decided by a decline in demand. Thus, a single service firm responds in the same way and reduces its output. If the external economies are relatively large, a reduction of varieties decreases wages on a large scale. In this case, a single service faces a much lower variable cost, which encourages it to expand the output.
The impact of an increase in labour mobility on agricultural output can be obtained from (12) and summarised in **Proposition 2**.

Proposition 2*An increase in labour mobility cuts down the output of the agricultural sector and its productivity.*

An increase in labour mobility transfers labour from rural to urban and reduces employment in the agricultural sector. From Lemma 2, an increase in labour mobility reduces the number of varieties in the APS sector, but the impact on the total output, *nx*, is ambiguous. However, the contribution of APS to the agricultural sector also includes the external economies, *X*. After incorporating the external economies, the agricultural sector faces a lower *X* in production and its output reduces. As discussed in Proposition 1, agricultural productivity is decided by the number of APS. An increase in labour mobility decreases the number of APS and reduces its productivity correspondingly.

5. CONCLUSION

Enhancing traditional agricultural productivity heavily depends on introducing modern non-agricultural inputs. However, due to small-scale operations, smallholders face numerous difficulties in utilizing modern inputs directly. The study highlights the agricultural producer service sector that acts as an intermediate sector in facilitating the use of non-agricultural inputs. We build a three-sector general equilibrium model to investigate the relationship between imperfect factor mobility and agricultural development by incorporating the agricultural producer service sector. Results show that a rise in capital mobility expands the agricultural sector and promotes agricultural productivity, while an increase in labour mobility cuts down the output of the agricultural sector and its productivity.

Future studies can extend our analysis in the following respects. Firstly, foreign investment is one type of liberalization policy and plays an important role in economic development, we can consider the impact of imperfect factor mobility by incorporating this aspect. Secondly, improvements in factor mobility promote labor migration which further leads to structural transformation. With the existence of the agricultural producer service sector, we can analyze how imperfect factor mobility influences structural transformation in small-scale agriculture. Thirdly, the factor of mobility also contributes to labour mobility and further impacts labour rewards and wage inequality. Hence, we should consider this point in future research.

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