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Rural Public Infrastructure and Agricultural Development under the "Manufacturing Supporting Agriculture" Policy in Developing Countries

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This paper systematically examines the repercussions of rural development facilitated by the implementation of the "manufacturing supporting agriculture" policy. The financial resources for public infrastructure development in rural areas are sourced exclusively from the manufacturing sector. The study deduces that an augmentation in the unit supporting fund correlates with a diminished urban unemployment ratio and the advancement of rural development. Moreover, if the impact of public infrastructure on agricultural output is substantial, the manufacturing sector need not necessarily experience a decline in output when the government enacts this policy. Additionally, the study determines that the optimal level of the unit supporting fund is greater (or smaller) compared to an open economy scenario when the influence of price changes on national income is positive (or negative).

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JEL: H4, J6, O2.

1. INTRODUCTION

During the process of industrialization, managing the intersectoral relationship between manufacturing and agriculture is of paramount importance, particularly in developing countries. In the initial phases of industrialization in these nations, policymakers drew lessons from successful developed countries, emphasizing the necessity of transferring a substantial surplus of agricultural labor as a prerequisite for initiating the industrialization process [1]. Consequently, the focus was predominantly on exploring how agriculture could contribute to manufacturing, while relatively overlooking the reciprocal contribution that manufacturing could make to agriculture. Governments tended to perceive agriculture as a subordinate sector, primarily tasked with providing a foundation for the industrialization process. Lipton [2] succinctly encapsulated policies favoring manufacturing over agriculture as ''urban bias.'' It is evident that prolonged implementation of urban-centric policies has adverse consequences on rural development, especially impacting the income of peasants. Yang [3] contends that the increase in rural-urban income disparity in China can be attributed to urban-biased policies, such as subsidies, investments, and credits, which impose higher inflationary taxes on rural earnings. Fesselmeyer and Le [4] argue that government investment policies and the manipulation of price incentives were pivotal factors contributing to the rural-urban gap in Vietnam during the 1990s, with government policies favoring urban dwellers at the expense of rural areas.

The implementation of pro-manufacturing policies has given rise to significant challenges in rural development. Recognizing the multifaceted contributions of agricultural growth—providing sustenance for the entire economy, reducing poverty, and mitigating regional disparities—many countries, especially those undergoing rapid industrialization, have shifted toward policies favoring agriculture. In the case of China, a noteworthy transformation occurred in the early 21st century, transitioning from "agriculture supporting manufacturing" to "manufacturing supporting agriculture." Since 2000, there has been a substantial increase in fiscal expenditure on agriculture and rural development. In 2000, the Chinese government allocated 123.15 billion yuan for these purposes, experiencing a sharp annualized growth of 21%, reaching 1738.05 billion yuan in 2015. The 13th Five-Year Plan, which outlined the government's social and economic policy from 2016 to 2020, emphasized industry supporting agriculture as a long-term guiding principle to establish a new pattern of integrated urban-rural development. Similarly, Vietnam adopted comparable policies to bolster agricultural development. In 2008, the ruling party approved Resolution 26/NQ-TW, considered a groundbreaking policy on agriculture and rural development. Subsequently, the government issued various policies supporting agricultural development, encompassing areas such as investment promotion (Decree No.210/2013/NQ-CP) and infrastructure development (Decree No.210/2013/NQ-CP). In essence, government-drafted policies and the allocation of fiscal funds constitute the primary mechanisms for supporting agricultural development. Given that revenue from agriculture constitutes only a fraction of the total fiscal income in rapidly industrializing developing countries, the funds allocated to support agriculture predominantly originate from urban regions. From this perspective, these pro-agriculture policies can be characterized as either "manufacturing supporting agriculture" or "urban supporting rural."

Existing literature often associates the provision of public infrastructure with urban areas or the manufacturing sector when examining the dual economy [5,6,7,8]. However, there is a notable gap in research regarding the impacts of providing rural public infrastructure. Moreover, the prevalent assumption in the literature is that financing for public infrastructure is executed through lump-sum taxes [9,10,11]. However, there is a dearth of studies addressing how the control of rural public infrastructure, financed solely from the urban region, affects the economy, especially under the "manufacturing supporting agriculture" policy.

The paper addresses a dual economy scenario marked by a high-wage urban area coexisting with a low-wage rural area. The wage differential induces rural-urban migration and urban unemployment, reflecting the characteristic

features of a Harris-Todaro economy (1970). Within the framework of the "manufacturing supporting agriculture" policy, the government allocates a specific fund sourced exclusively from the manufacturing sector to finance the provision of public infrastructure, with the aim of supporting rural development. Consequently, alterations in public input expenditures have repercussions on consumer income, influencing the demand for final goods. This, in turn, affects prices, factor rewards, unemployment, and overall social welfare. The central questions revolve around understanding how changes in the supporting fund impact the economy and determining the optimal level of providing public agricultural infrastructure under the "manufacturing supporting agriculture" policy. The paper aims to address these questions.

The remainder of the paper is organized as follows. We establish a general equilibrium model with public inputs provision in the agriculture in section 2. Section 3 makes comparative statics results. Combining the demand side of the economy, section 4 considers a change in unit supporting fund on the price of manufacturing good, public infrastructure, manufacturing and agricultural output and urban unemployment ratio, the welfare and optimal level of unit supporting fund are analyzed in section 5. Section 6 draws some concluding remarks.

2. THE MODEL

We consider a small and closed economy framework based on Harris and Todaro [12], incorporating public infrastructure in the agricultural sector, such as environment, R&D in agricultural technology. The production side of the economy consists of two private final sectors, manufacturing(X_1) and agriculture(X_2), and one public intermediate sector (X_R). Two primary factors, labor and capital, are employed to produce X_1 and X_R, which take place in the urban area. Labor and public infrastructure are used to produce X_2 in the rural area.

Before building up the theoretical model, we first clarify how to accommodate rural public infrastructure to the agricultural production function. In theoretical papers, public infrastructure is always regarded as a public intermediate input or a public good supplied by the public sector, just as suggested by Meade [13], Tawada and Okamoto [14], Tawada and Abe [15], and Abe [9]. The basic idea of agricultural production with accommodation of public infrastructure is derived from Meade [13]. Since agricultural production heavily relies on agricultural technology and natural environment, we treat the rural public infrastructure as the “creation of atmosphere” type, which means public infrastructure is fully available to every firm in the sector irrespective of the number of firms. As Tawada and Okamoto [14] and Tawada and Abe [15] argue, the impact exerted by the increased pure public infrastructure on the inputs is just like an improvement of the Hicks neutral technology. More detailed explanations for the setup of agricultural production function with the public infrastructure can be referred to Henderson [16].

The production functions for the private good are expressed as:

$$X_1 = F^1(L_1, K_1)$$

and

$$X_2 = g(X_R)F^2(L_2)$$

where L_i denotes the i th sector’s employment of labor, K_1 is the input of capital in the manufacturing, and X_R is the public infrastructure in the agriculture. F^1 is assumed to be linear homogeneous and quasi-concave in L_1 and K_1, while F^2 has the property that $F_L^2 = dF^2/dL > 0$ and $F_{LL}^2 = dF_L^2/L < 0$. Note that the output of agriculture depends on the labor factor as well as public infrastructure, and the positive impact of public infrastructure on the agricultural output can be captured by the elasticity:

$$e = (dg/g)/(dX_R/X_R) > 1$$

We assume that the agriculture enjoys the public infrastructure free of charge and regards the amount of the public infrastructure as given in the decision of production. The unit cost function of the agriculture is expressed as:

$$C^2(w, X_R) \equiv \tilde{C}^2(w)/g(X_R)$$

where w is the wage rate in the agriculture.

Consider the government appropriates t amount of fund out of unit manufacturing output to finance the provision of public infrastructure

(afterward we call *t* as "unit supporting fund"). Under the condition that the private markets are perfectly competitive, we could obtain the following

$$C^1(\bar{w}, r) = p - t \tag{1}$$

$$C^2(w, X_R) = 1 \tag{2}$$

where C^1 is unit cost function of the manufacturing. $\bar{w}$ is the wage rate of the manufacturing sector, which is downward rigid due to labor unions. *r* is the interest rates of capital. We normalize the price of the agricultural product as the unit, and *p* is the price of the manufacturing goods relative to that of agriculture goods.

The public infrastructure is produced by the labor and capital. Moreover, we assume that the cost of the production of the public infrastructure is minimized and the cost is financed by the government. Use $C^R(\bar{w}, r)$ denote the unit cost function of the public infrastructure[1], then the government's budget constraint is expressed as:

$$C^R(\bar{w}, r)X_R = tX_1 \tag{3}$$

Next, consider the equilibrium condition for the labor market. The Harris-Todaro allocation mechanism [12], recent studies refer to Beladi et al. [17], Wang et al. [18], Li et al. [19] between sectors can be shown as:

$$\bar{w} = (1+\lambda)w \tag{4}$$

where $\lambda = L_U/(L_1 + L_R)$ is the unemployment ratio and L_U and L_R are urban unemployment and employment in the public sector, respectively.

By the Shephard's lemma, the labor and capital demand in sector *i* are $L_i = C_w^i X_i$ and $K_i = C_r^i X_i (i = 1, 2, R)$,respectively, where the subscript in the unit cost function denotes the partial derivative. The market-clearing conditions of the labor and capital could be shown as follows:

$$(1+\lambda)(C_w^1 X_1 + C_w^R X_R) + C_w^2 X_2 = L \tag{5}$$

$$C_r^1 X_1 + C_r^R X_R = K \tag{6}$$

where *L* and *K* are the endowments of labor and capital.

The supply side of the economy can be described by (1) through (6). There are six equations encompassing six endogenous variables: *w*,*r*, λ ,X_1,X_2 and X_R, with policy variable *t* and a parameter $\bar{w}$. By treating the manufacturing goods price *p* as given, we can solve the endogenous variables. The price will be decided after we use the supply-side and demand-side conditions together.

3. EFFECTS OF A CHANGE IN THE UNIT SUPPORTING FUND

In this section, we conduct some comparative statics exercises. From the established supply side of the economy, any change in supporting agriculture fund for the provision of public infrastructure will affect the economic variables as well as income available for consumers, altering the demand side and the price thereby. This will further affect other economic variables. To gain insight, it is helpful to separate the total effect of a change in unit supporting fund into two partial effects: the direct effect with a constant price and the indirect price-induced effect. Therefore, for example, the effect of a change in supporting fund on *w* can be expressed as $w = w(t, p(t))$, and differentiating *w* with respect to *t*, yields

$$dw/dt = \partial w/\partial t + (\partial w/\partial p)(dp/dt)$$

The first term represents the direct effect of a change in the supporting fund upon the agricultural wage while keeping the price constant. The second term refers to the indirect effect on the agricultural wage due to a change in the price which is caused by a change in the supporting fund.

Use $\theta_{ij}(i = L, K; j = 1, R)$ to expresses the distributive share of factor *i* employed in sector *j*, $\theta_t = t/p$ to indicate the share of the manufacturing supporting agriculture in manufacturing sector; $\lambda_{ij}(i = L, K; j = 1, 2, R)$ to refers the allocative share of factor *i* in sector *j*. $\sigma_{ij}^h = C^h C_{ij}^h / C_i^h C_j^h \ (i, j = w, r; h = 1, R)$ represents the

[1] *In general, since the public sector is controlled by the government, the labor employed by the public sector is also protected by the urban minimum wage act [20].*

elasticity of substitution of factors in sector *h*. The notation " $\wedge$ "denotes the relative rate of the change of a variable.

Differentiating equation (1), (2) and (4) and get $\hat{r} = \hat{p}/\theta_{K1} - \hat{t}\,\theta_t/\theta_{K1}$, $\hat{w} = e\hat{X}_R$, and $\lambda\hat{\lambda} = -(1+\lambda)\hat{w}$,respectively. Substituting these results into the results of differentiating equation (3) and (6), and get

$$\hat{X}_1 = \Omega_1\hat{p} + \Omega_2\hat{t} \quad \text{,and} \quad \hat{X}_R = \Omega_3\hat{p} + \Omega_4\hat{t} \tag{7}$$

Where,

$$\Omega_1 = (\lambda_{KR}\theta_{KR} - S_K)/\theta_{K1} > 0\,,$$
$$\Omega_2 = (S_K - \lambda_{KR}\theta_{KR})\theta_t/\theta_{K1} - \lambda_{KR} < 0\,,$$
$$\Omega_3 = -(S_K + \lambda_{K1}\theta_{KR})/\theta_{K1}\,,$$
$$\Omega_4 = \lambda_{K1} + \theta_t\,(S_K + \lambda_{K1}\theta_{KR})/\theta_{K1}\,,$$
$$S_K = \sigma^1_{rr}\lambda_{K1}\theta_{K1} + \sigma^R_{rr}\lambda_{KR}\theta_{KR} < 0\,.$$

From equation (7), we have $\hat{X}_1/\hat{p} = \Omega_1 > 0$ and $\hat{X}_1/\hat{t} = \Omega_2 < 0$; however, the sign of $\hat{X}_R/\hat{p} = \Omega_3$ and $\hat{X}_R/\hat{t} = \Omega_4$ are ambiguous, depending on the sign of $S_K + \lambda_{K1}\theta_{KR}$. Note $\sigma^1_{rr}\lambda_{K1}\theta_{K1}$ and $\sigma^R_{rr}\lambda_{KR}\theta_{KR}$ are the elasticity of substitution of capital in the unit cost of manufacturing sector and public sector, respectively[2]. Thus, if the sum of elasticity of substitution of capital in the unit cost of manufacturing and public sector is large enough, and $S_K + \lambda_{K1}\theta_{KR} > 0$,we can get $\Omega_3 < 0$ and $\Omega_4 > 0$.

Differentiating equation (5), and substituting $\hat{X}_1 = \Omega_1\hat{p} + \Omega_2\hat{t}$,and $\hat{X}_R = \Omega_3\hat{p} + \Omega_4\hat{t}$,

$$\hat{X}_2 = -\frac{1}{\lambda_{L2}}\left\{(1+\lambda)\lambda_{L1}\Omega_1 + (1+\lambda)S_L/\theta_{K1} + \Omega_3[eS^2 + (1+\lambda)\lambda_{LR}]\right\}\hat{p}$$
$$-\frac{1}{\lambda_{L2}}\left\{(1+\lambda)\lambda_{L1}\Omega_2 - (1+\lambda)S_L\theta_t/\theta_{K1} + \Omega_4[eS^2 + (1+\lambda)\lambda_{LR}]\right\}\hat{t} \tag{8}$$

Where,

$$S_L = \sigma^1_{LK}\lambda_{L1}\theta_{K1} + \sigma^R_{LK}\lambda_{LR}\theta_{KR} > 0\,,$$
$$S^2 = S^2_L - (1+\lambda)(\lambda_{L1} + \lambda_{LR}) < 0\,,$$
$$S^2_L = \sigma^2_{ww}\lambda_{L2}\theta_{L2} < 0\,.\ \text{If}\ S_K + \lambda_{K1}\theta_{KR} > 0\,,$$
we have $\hat{X}_2/\hat{p} < 0$ and $\hat{X}_2/\hat{t} > 0$

Lemma 1 *An increase in the price of manufacturing shrinks public and agricultural output while expands them as a result of an increase in the unit supporting fund if the sum of elasticity of substitution of capital in the unit cost of manufacturing sector and public sector is large enough.*

A rise in *p* promotes the manufacturing production and this results in an increase in employment of capital in the manufacturing sector and interest rate of capital. The public sector faces higher interest rate and substitutes capital to labor for production. The change of the output of public sector is determined by the interaction between the decreased capital and the increased labor. If the elasticity of substitution of capital in the unit cost of manufacturing sector and public sector are large enough which means capital is less likely to substitute by labor, the public sector drops its output. Since the output of public sector has a positive effect on agricultural production, the shrinking of public sector reduces the agricultural production consequently. The result that a greater amount in *t* (similar to a decrease in price) expands the public sector can be interpreted similarly, except that an increase in *t* also contributes to total supporting fund (tX_1).

4. GOOD PRICE, PUBLIC INFRASTRUCTURE AND URBAN UNEMPLOYMENT RATIO

In this section, we finish the demand-side of the model, which can be expressed by an expenditure function:

$$E(p,u) = \min\left\{pC_1 + C_2, s.t\,U(C_1,C_2) = u\right\}$$

where is *U* quasi-concave utility function,C_1 and C_2 are consumption of manufacturing and agricultural goods, respectively. The economy's budget constraint is

$$E(p,u) = (p-t)X_1 + X_2 \tag{9}$$

Let us turn to the goods-market equilibrium condition. According to the Shephard's lemma, the demand for manufacturing good is expressed by $E_p(p,u) = \partial E/\partial p = C_1$. By virtue of the Walras law that one good market clearing means the other product market will be cleared up if there are only two final goods, we know that the

[2] *Similar denotations see Beladi and Chao [21].*

market-clearing condition can be demonstrated by:

$$E_p(p,u) = X_1 \tag{10}$$

Differentiating the equation (9) and (10) and substituting results in equation (7) and (8), we can get

$$\begin{pmatrix} \frac{\varepsilon_p - \Omega_1}{p} & \frac{1}{u\varepsilon_c} \\ \frac{1}{p\lambda_{L2}}\left[\Omega_4\Omega_5 - \lambda_{I2}\Omega_3\Omega_6 - \frac{\lambda_{I2}(1+\lambda)S_L}{\theta_{K1}}\right] & -\frac{m}{u} \end{pmatrix}\begin{pmatrix} dp \\ du \end{pmatrix} = \begin{pmatrix} \frac{\Omega_2}{t} \\ \frac{1}{t\lambda_{L2}}\left[\lambda_{I2}\Omega_4\Omega_6 - \Omega_2\Omega_5 - \frac{(1+\lambda)\lambda_{I2}S_L\theta_t}{\theta_{K1}}\right] \end{pmatrix} dt \tag{11}$$

where $m = uE_u/E > 0$, $E_u = \partial E/\partial u > 0$ is the inverse of marginal utility of income; $\lambda_{I1} = (p-t)X_1/E$ ($\lambda_{I2} = X_2/E$)is the share of manufacturing (agricultural)income; $\varepsilon_p = (\partial C_1/C_1)/(\partial p/p) < 0$ is the price elasticity of demand of manufacturing good, $\varepsilon_c = (\partial u/u)/(\partial C_1/C_1) > 0$ is the manufacturing good elasticity of utility. In addition,consider the economic fact that the unit capita income of urban is larger than that of rural, we have $\Omega_5 = \lambda_{I1}\lambda_{L2} - (1+\lambda)\lambda_{L1}\lambda_{I2} > 0$, $\Omega_6 = eS^2 + (1+\lambda)\lambda_{LR} < 0$.

Solving equation (11), the effect of unit supporting fund on the price of the manufacturing can be obtained as:

$$\frac{dp}{dt} = \frac{\lambda_{I2}\{(1+\lambda)S_L\theta_t - \theta_{K1}[\Omega_2(1+\lambda)\lambda_{L1} + \Omega_6\Omega_4]\}}{\Delta t u \varepsilon_c \lambda_{L2}\theta_{K1}} > 0$$

where

$$\Delta = -\frac{m\varepsilon_p}{up} + \frac{\lambda_{I2}[\Omega_1(1+\lambda)\lambda_{L1}\theta_{K1} + (1+\lambda)S_L + \Omega_6\Omega_3\theta_{K1}]}{up\varepsilon_c\lambda_{L2}\theta_{K1}} > 0 .$$

An increase in unit supporting fund, supplying more public infrastructure and agricultural good, always raises the relative price of the manufacturing good. From the result of dp/dt and results in the section 3, we can deduce the effects of unit supporting fund on the provision of public infrastructure and ratio of urban unemployment.

$$\frac{dX_R}{dt} = \frac{X_R}{t}\frac{(1+\lambda)\lambda_{I2}(\lambda_{K1}S_L - \lambda_{L1}S_K) - \Omega_4\theta_{K1}\varepsilon_c\lambda_{L2}m\varepsilon_p\lambda_{L2}}{\Delta p\theta_{K1}\varepsilon_c u}$$

and

$$\frac{d\lambda}{dt} = -\frac{(1+\lambda)e}{t}\frac{(1+\lambda)\lambda_{I2}(\lambda_{K1}S_L - \lambda_{L1}S_K) - \Omega_4\theta_{K1}\varepsilon_c\lambda_{L2}m\varepsilon_p\lambda_{L2}}{\Delta p\theta_{K1}\varepsilon_c u}$$

If $\Omega_4 > 0$, $dX_R/dt > 0$ and $d\lambda/dt < 0$ hold.

Proposition 1: *For the established model, an increase in unit supporting fund results in a lower urban unemployment ratio and a larger provision of public infrastructure if the sum of elasticity of substitution of capital in the unit cost of manufacturing sector and public sector is large enough.*

The rationale for the Proposition 1 is as follow. Ceteris paribus, an increase in unit supporting fund raises the output of public sector if the sum of elasticity of substitution of capital in the unit cost of manufacturing sector and public sector is large enough. The expansion of public sector requires the enlargement of employment and reduces urban unemployment. Meanwhile, a rise in the provision of public infrastructure raises the agricultural productivity and its wage, which discourages migration from rural to the urban and contributes to the drop of the urban unemployment ratio.

Next, we consider the effects of unit supporting fund on manufacturing and agricultural output,

$$\frac{dX_1}{dt} = \frac{X_1}{t}\frac{\lambda_{I2}\Omega_6 S_K - \lambda_{I2}(1+\lambda)S_L\lambda_{KR} - m\varepsilon_p\theta_{K1}\varepsilon_c\Omega_2\lambda_{L2}}{\Delta p\theta_{K1}\varepsilon_c mu\lambda_{L2}} \lessgtr 0$$

and

$$\frac{dX_2}{dt} = \frac{X_2}{t}\frac{(1+\lambda)\lambda_{I2}(S_L\lambda_{K1} - \lambda_{L1}S_K) - m\varepsilon_p\theta_{K1}\varepsilon_c\lambda_{L2}}{\Delta\theta_{K1}\varepsilon_c\lambda_{L2}u} > 0$$

An increase in unit supporting fund promotes agricultural output and rural development; however, its impact on manufacturing output is ambiguous. Generally, the shifting fund from the manufacturing to agriculture harms manufacturing sector and reduces its output. However, from the result concerning the impact of an increase in unit supporting fund on manufacturing output, the sector may not experience an output loss in the model if Ω_6 is large enough. Note that the absolute value of Ω_6 is mainly determined by the *e*, the production elasticity of the public infrastructure in the agricultural sector. If the public infrastructure affects the agriculture remarkably, the relative price of manufacturing rises greatly since more agricultural good is supplied in the market. Thus, the marginal productivity of labor and capital in the manufacturing may raise because its price increased by a larger magnitude than the growth

of unit supporting fund (i.e, $dp/dt-1>0$), and the manufacturing enlarges employment of factors and its production raises. Here, we need to point out that the simultaneous expansion of the manufacturing and public sector mainly relies on the enlargement of labor factor from unemployment since capital endowment is a constant.

From above results, we get Proposition 2.

Proposition 2: *For the established model, an increase in unit supporting fund promotes rural development without sacrificing the manufacturing sector if the impact of public infrastructure on agricultural output is large enough.*

5. SOCIAL WELFARE AND OPTIMAL LEVEL OF PUBLIC INFRASTRUCTURE

In this section, we examine the welfare effect of rural development. In the model, the change in welfare can be denoted by $dW = E_u du$. Solving equation (11), we can get

$$\frac{du}{dt} = \frac{(\theta_{K1}\varepsilon_p\Omega_4 + S_K)\lambda_{I2}\Omega_6 - \theta_{K1}\varepsilon_p\Omega_2\Omega_5 - (1+\lambda)S_L\lambda_{I2}(\lambda_{KR} + \theta_t\varepsilon_p)}{\Delta tp\lambda_{L2}\theta_{K1}}$$

Therefore,

$$\frac{dW}{dt} = E_u\frac{du}{dt} = \frac{E_u}{\Delta tp\lambda_{L2}\theta_{K1}}\left[(\theta_{K1}\varepsilon_p\Omega_4 + S_K)\lambda_{I2}\Omega_6 - \theta_{K1}\varepsilon_p\Omega_2\Omega_5 - (1+\lambda)S_L\lambda_{I2}(\lambda_{KR} + \theta_t\varepsilon_p)\right]\begin{matrix}<\\=\\>\end{matrix}0 \quad (12)$$

When rural development through the government provision of public infrastructure, a higher unit supporting fund can reduce welfare once the financing aspect is taken into consideration in general. However, if the positive effect produced by the growth of agricultural output, mainly depending on the impact of public infrastructure on agricultural production, is larger than the cost of public infrastructure, the total income and welfare may increase. The optimal unit supporting fund can be obtained by setting (12) equals to zero, and substituting previous results in the section 3, we get

$$\lambda_{I1}\frac{\hat{X}_1}{\hat{t}} + \lambda_{I2}\frac{\hat{X}_2}{\hat{t}} = \frac{\Omega_2}{\Omega_1 - \varepsilon_p}\left(\lambda_{I1}\frac{\hat{X}_1}{\hat{p}} + \lambda_{I2}\frac{\hat{X}_2}{\hat{p}}\right) \quad (13)$$

which implicitly determines the optimal level of unit supporting fund. When we consider the open economy that manufacturing and agricultural sector produce traded goods, the economy is a price taker and the relative price of the manufacturing sector is constant world price. Thus, from equation (13), the optimal level of unit supporting fund is expressed as

$$\lambda_{I1}\frac{\hat{X}_1}{\hat{t}} + \lambda_{I2}\frac{\hat{X}_2}{\hat{t}} = 0 \quad (14)$$

which means that on the optimal level, the magnitude of the impact of unit supporting fund on manufacturing output weighted by its share in national income is equal to that of agricultural output. Compare the optimal level of unit supporting fund under the closed and open economics, we have

Proposition 3: *For the established model, if the price impact on national income is positive(negative),the optimal level of unit supporting fund is larger(smaller) than that under the small open economy.*

If the price impact is positive, which means that an increase in price of manufacturing raises(drops) the national income. From results of equation (11), price rises as a result of a greater *t*, and an increase in the unit supporting fund adds (reduces) the national income and welfare. Therefore, the optimal level of unit supporting fund is larger (smaller) than that under the open economy with no price-effect.

6. CONCLUSION

This article analyzes theoretically the economic impacts of an increase in unit supporting fund on domestic price, urban unemployment ratio, output and welfare through the provision of public intermediate agricultural inputs in the developing economy. When considering the financing cost of the public sector is from the manufacturing alone, an increase in unit supporting fund results in a lower urban unemployment ratio and a larger provision of public infrastructure. Meanwhile, a larger of unit supporting fund promotes rural development without sacrificing the manufacturing sector under a certain condition. When considering the level of unit supporting fund, we obtain that the optimal level of unit supporting fund is larger(smaller) than that under small open economy, if the price impact on national income is positive(negative). Since similar analyses have been sparse, the main contents of this paper

provide new perspectives to the best of our knowledge.

Here, we point out several possible extensions for future studies. Firstly, “manufacturing supporting agriculture” policy may affect skilled-unskilled wage inequality. Wage inequality is an important issue in developing countries. The policy aims to reduce the urban-rural gap and what its effect on wage inequality when considering the heterogeneous labor. In the further, we can consider the impact of “manufacturing supporting agriculture” policy on skilled-unskilled wage inequality. Secondly, pollution is not considered in the model. In reality, the manufacturing emits pollution and harms the rural environment, which is detrimental to agricultural output, and offsets the positive effect resulted from “manufacturing supporting agriculture” policy. The consideration of environmental problem may also be a direction for future research.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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