Original Research Article

Rural public infrastructure and agricultural development under the "manufacturing supporting agriculture" policy in developing countries

Abstract:

This paper analyzes the impacts of rural development through the provision of rural public infrastructure under the "manufacturing supporting agriculture"policy. Government appropriates fund from the manufacturing alone to finance the cost of public infrastructure. Conclusions are that an increase in per supporting fund results in a lower urban unemployment ratio,a larger provision of public infrastructure and promotion of rural development. The manufacturing sector may not experience a loss in output if the impact of public infrastructure on agricultural output is large enough when the government conducts the policy. Further, the optimal level of per supporting fund is larger(smaller) than that under open economy, if the price impact on national income is positive(negative).

JEL: H4,J6,O2

Keywords: Rural public infrastructure,rural development, manufacturing supporting agriculture

1. Introduction

In the process of industrialization, how to handle the intersectoral relation between manufacturing and agriculture is critically important in developing counties. At the initial stage of the industrialization of developing countries, governments adopted the experience took from the successful developed counties that the transfer of massive surplus agricultural labor was a precondition for initiating a process of industrialization(Ghatak and Ingersent, 1984). Therefore, they focused attention on how agriculture could contribute to manufacturing and largely ignored the issue of what if any contribution manufacturing could make to agriculture. And governments tended to view agriculture as a subsidiary sector whose task is to underpin an industrialization process. Lipton(1977) summarized the policies which favored manufacturing at the expense of agriculture as ‘‘urban bias” . It is obvious that implement of urban-based policies for a long term has an adverse impact on the development of rural areas and particularly on peasants' income. Yang (1999) holds that the rise in rural-urban income disparity has resulted from urban-biased policy, like urban subsidies, investments, and credits, which have affected higher inflationary taxes on rural earnings in China. Fesselmeyer and Le (2010) argue that government investment policies and the manipulation of price incentives were important factors behind the rural-urban gap in Vietnam in the 1990s and in particular government policies created some benefit to urban dwellers at the expense of rural areas.

The pro-manufacturing policies have resulted in serious problems in rural development. Since agricultural growth not only provides food for the whole economy but also reduces poverty and the regional gap, a series of rural-favored policies were made and a dramatic rise in the fund was appropriated to promote agricultural development, in particular for the countries with rapid process of industrialization. For example, from the beginning of the 21st century, China has released sets of pro-agriculture policies and changed from "agriculture supporting manufacturing" to "manufacturing supporting agriculture"[1]. Since 2000, the fiscal expenditure on agriculture and rural development has increased dramatically. The government allocated 123.15 billion yuan on agriculture and rural development in 2000, then the figure raised sharply (or an annualized growth of 21%), arriving at in 1738.05 billion yuan in 2015. From the 13th Five-Year Plan that would set the tone for the government's social and economic policy from 2016 to 2020, the government will regard industry supporting agriculture as long-term guiding principles in order to form a new pattern of integrated urban-rural development. Vietnam also adopted similar policies to support agricultural development. In 2008, the ruling party approved Resolution 26/NQ-TW, which is recommended as a big breakthrough policy on agriculture and rural[2]. Since the Resolution, the government has issued many policies to support agricultural development from various aspects, like policies for investment promotion (the Decree No.210/2013/NQ-CP), for building infrastructure (the Decree No.210/2013/NQ-CP). In general, government drafts policies and appropriates fiscal fund are the main channels for supporting agricultural development. Since revenue from agriculture composites only a fraction of total fiscal income in the developing countries with rapid industrialization[3], the fund assigned to support agriculture is mainly from the urban region. From this aspect, we could view such pro-agriculture policies as "manufacturing supporting agriculture" or "urban supporting rural".

Strengthen rural public infrastructure is given high priority among those policies and assigned fund[4]. Concerning the role of public infrastructure in the production, Meade(1952) distinguished two types of public infrastructure: "creation of atmosphere" and "unpaid factors". In the "creation of atmosphere" type, public infrastructure is fully available to every firm, such as legal and economic institutions, environmental protection, free information about technology, research and development activities. The technology of each private sector exhibits constant returns to scale only in the primary factors in production and the public infrastructure plays a role of external economies in production circumstances. In the "unpaid factors" type, public infrastructure, such as highways, bridges and communication facilities, can be viewed as public infrastructure in the production process of private industry. The private production function exhibits constant

[1]For example, China's No.1 Central Document focuses on the agriculture for 14th consecutive year(from 2004 to 2017), which means agricultural and rural development are top policy priorities in these years.

[2]In 2013, the Prime Minister of Vietnam issued a decision to approve the plan of restructuring agriculture towards the improvement of added value and sustainable development so as to enhance the implement the Resolution 26/NQ-TW.

[3]This figure is only 0.13%in China in 2014.

4 Over 85% of the public fund is allocated in infrastructure construction and rural public services affair in China and only a mere portions are used for direct cash subsidies.

returns to scale with respect to public infrastructure and primary inputs. However, unlike private inputs, the public infrastructure needs enormous funds for construction, maintenance, operations and overall development, and usually is provided by the government and financed by taxation. Though private industries pay the cost ultimately, their payments do not affect the quantity of the semi-public infrastructure directly and the input is essentially an unpaid input from the private industries' perspective.

Among the existing literature, provision of public infrastructure is bound up with urban area or manufacturing sector when considering the dual economy(Chao etal, 2006;Pi and Zhou, 2012;Pi and Zhou, 2014). However, few works have examined the impacts of the provision of rural public infrastructure. In addition, it is customarily assumed that financing of public infrastructure is carried out by lump-sum tax(Abe,1990;Chambers and Lopez, 1993;Suga and Tawada, 2007), the issue of how control of rural public infrastructure by financing from urban region alone affects the economy has never been examined under the "manufacturing supporting agriculture" policy.

The paper considers a dual economy characterized by a high-wage urban area co-existing with a low-wage rural area. Wage differential leads to rural-urban migration and urban unemployment due to the high rigid manufacturing wage, which is the typical Harris-Todaro economy(1970). Under the "manufacturing supporting agriculture" policy, government appropriates a certain fund to finance the provision of public infrastructure from the manufacturing alone so as to support rural development. Consequently, a change in expenditures on public inputs will affect income available for consumers, thereby altering the demand for final goods. This will further affect prices, factor rewards, unemployment and social welfare. Questions naturally arise as to how the change of supporting fund affects the economy and what is the optimal level of provision of public agricultural infrastructure under the "manufacturing supporting agriculture" policy. This paper examines this issue.

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 per supporting fund on the price of manufacturing good, public infrastructure, manufacturing and agricultural output and urban unemployment ratio, the welfare and optimal level of per 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(1970), 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 (1952), Tawada and Okamoto (1983), Tawada and Abe (1984), and Abe (1990). The basic idea of agricultural production with accommodation of public infrastructure is derived from Meade (1952). 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 (1983) and Tawada and Abe (1984) 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(1974).

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 fundout of per manufacturing output to finance the provision of public infrastructure (afterward we call t as "per supporting fund"). Under the condition that the private markets are perfectly competitive, we could obtain the following

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

$$C^2(w, X_R) = 1 \quad (2)$$

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[5], then the government's budget constraint is expressed as

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

Next, consider the equilibrium condition for the labor market. The Harris-Todaro allocation mechanism between sectors can be shown as:

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

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:

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

$$C_r^1 X_1 + C_r^R X_R = K \quad (6)$$

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 per 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 per supporting fund into two partial effects:

[5]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(see Djankov and Ramalho, 2009).

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 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

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

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

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 $\sigma_{rr}^1\lambda_{K1}\theta_{K1}$ and $\sigma_{rr}^R\lambda_{KR}\theta_{KR}$ are the elasticity of substitution of capital in the unit cost of manufacturing sector and public sector, respectively[6]. 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 $\hat{X}_R = \Omega_3\hat{p} + \Omega_4\hat{t}$,

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

[6]Similar denotations see Beladi and Chao(2006).

where $S_L = \sigma_{LK}^1 \lambda_{L1}\theta_{K1} + \sigma_{LK}^R \lambda_{LR}\theta_{KR} > 0$, $S^2 = S_L^2 - (1+\lambda)(\lambda_{L1} + \lambda_{LR}) < 0$, $S_L^2 = \sigma_{ww}^2 \lambda_{L2}\theta_{L2} < 0$.
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 per 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:

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

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

$$E(p,u) = (p-t)X_1 + X_2 \quad (9)$$

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 market-clearing condition can be demonstrated by:

$$E_p(p,u) = X_1 \quad (10)$$

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

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

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 per 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 ofper supporting fund on the price of the manufacturing can be obtained as

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

where $\Delta=-\dfrac{m\varepsilon_p}{up}+\dfrac{\lambda_{I2}[\Omega_1(1+\lambda)\lambda_{L1}\theta_{K1}+(1+\lambda)S_L+\Omega_6\Omega_3\theta_{K1}]}{up\varepsilon_c\lambda_{L2}\theta_{K1}}>0$. An increase in per 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 per 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 per 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 per 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 per 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 per 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 per 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 per 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 per 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,

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

When rural development through the government provision of public infrastructure, a higher per 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 per 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 per 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 per 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 per supporting fund on manufacturing output weighted by its share in national income is equal to that of agricultural output. Compare the optimal level of per 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 per 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 per supporting fund adds (reduces) the national income and welfare.Therefore, the optimal level of per 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 per 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 per supporting fund results in a lower urban unemployment ratio and a larger provision of public infrastructure. Meanwhile, a larger of per supporting fund promotes rural development without sacrificing the manufacturing sector under a certain condition. When considering the level of per supporting fund, we obtain that the optimal level of per 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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