



Labor Supply, Income and Government Purchasing in Chinese Agricultural Sector

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Abstract

This paper provides a simple model to analyze the effect of government purchasing on labor supply and income in Chinese agricultural sector. We find that there are two steady states in this model, in which government purchasing gives agricultural households an incentive to work harder. However, households' income is dependent on the relative value between government's purchasing price and market price.

Keyword: Labor supply; Income; Government purchasing price; Market price

LEL classification Numbers: Q11, P32

1. Introduction

China's economic reform began in agricultural sector since 1978. In order to raise the productivity of households in agricultural sector, the land that belongs to government as public goods is distributed to each household (strictly speaking, that is a family). The development in agriculture sector can be divided into four stages. In

the first stage, almost farm products are necessary to sell to government because farm products market is incomplete and the collection of agricultural tax is necessary to be secured. In the second stage, as farm products market becomes complete and agricultural tax greatly lightened, only a part of farm products is necessary to sell to government and the rest is allowed to be freely traded in market. In this stage, the government's purchasing price is often less than market price. In the third stage, because the stagnation of agriculture development, government purchases a part of farm products with a higher price than market price so as to increase household's productivity. Finally, from 2004, in order to solve three problems in agriculture: agricultural problem, agrarian problem and peasant life problem, the agricultural tax is repealed and all farm products can sell in market. This paper will study why government renounces the purchasing policy in the second and third stages.

In almost transitional economies, the problem about the reform in state-owned enterprise is more studied. Relatively, the study of agricultural development is very few. Domar (1966), Brady (1971), Cameron (1973) and Bonnin (1976) analyze the development of Soviet collective farm, in which they provide statistic analyses about impacts of government's purchasing planning on the development of agricultural production. Miyamoto (2004) uses a dynamic model to analyze an effect of government's purchasing on the development of agricultural production for a transitional economy. Based on the model proposed by Miyamoto (2004), this paper analyzes the role of Chinese government purchasing in labor supply and income of agricultural households.

In this paper, we assume that there are a large number of homogenous households who supply labor to produce and consume one single goods in China. A part of the single goods produced by households is necessary to sell to government and the rest is allowed to be treated in market. Since a large number of homogenous households exist, market price is assumed to be given. The part purchased by government includes the two parts: the one is the fixed level, and another is a constant proportion of the increase in production of the single goods. Furthermore, we assume that households know the government's purchasing planning in advance.

Based on these assumptions, we find that there are two steady states when government's purchasing price and market price co-exist. When government's purchasing price is less than market price, the households only want to supply lower labor to produce the single goods because the government purchasing planning hinders households' incentive. On the other hand, when government's purchasing price is higher than market price, the households want to supply more labor to produce the single goods because government purchasing planning gives household an incentive to work harder. However, it is unclear that which of households' income in the two steady states is larger. Households' income only depends on the relative value between government's purchasing price and market price.

This paper organizes as follows. Section 2 provides a simple model. Section 3 provides a dynamic analysis about the simple model. Section 4 provides statistic

analyses about effects of the change in parameter on households' labor supply and income. Section 5 provides some conclusions.

2. The model

Assuming there is a large number of homogenous households who supply labor to produce and consume one single goods. The intertemporal problem for a representative household in agriculture industry is to maximize its discounted lifetime utility given by

$$\int_0^{\infty} u(c_t) e^{-\gamma t} dt, \quad (1)$$

where γ denotes the constant rate of time preference, $c(t)$ is the consumption, and $u(\cdot)$ is a concave function, that is it satisfies $u'(\cdot) > 0$, $u''(\cdot) < 0$.

The production function of the single goods is given by

$$y = y(L), \quad (2)$$

where the production function is a concave function, that is it satisfies $y' > 0$, $y'' < 0$. Eq. (2) means that the single goods is produced by only labor.

The income of the representative household is given by

$$I = \bar{p} \bar{y} + p(y - \bar{y}) - k(L) - T_0 = c \quad (3)$$

where I is the income of the representative household and all the income is assumed to be used to consumption, \bar{y} is the level of the single goods purchased by government, $k(L)$ is the cost for producing the single goods and it is an increasing function of labor, that is $k' > 0$, $k'' > 0$, T_0 is a constant agricultural tax, \bar{p} is a government's purchasing price, and p is a market price. Since a large number of homogenous households exist as both consumer and producer in the transitional country, the market price p is assumed to be given.

\bar{y} is the level determined by government in advance. \bar{y} is given by

$$\bar{y} = y_0 + \beta \dot{y}, \quad (4)$$

where y_0 is the fixed level purchased by government, and β is a adjusted coefficient that satisfies $0 < \beta < 1$. Eq. (4) means that the total level of the single goods purchased by government includes the two parts: the one is the fixed level and another is a constant proportional part of the increase in production of the single goods. In this paper, we assume that households know the government's purchasing planning in advance.

Substituting Eq. (4) into Eq. (3), we obtain

$$I = (\bar{p} - p)y_0 + (\bar{p} - p)\beta \dot{y} + py - k(L) - T_0 \quad (5)$$

Substituting Eq. (2) into Eq. (5), we can obtain the following equation

$$\dot{I} = \frac{1}{(\bar{p} - p)\beta y'} [I - (\bar{p} - p)y_0 - py + k(L) + T_0] \quad (6)$$

The representative household seeks to maximize Eq. (1) with respect to variables I and L subject to Eq. (6). The first-order conditions for the maximization are

$$\dot{I} = \frac{u'(I)}{u''(I)(\bar{p} - p)\beta y'} [((\bar{p} - p)\beta\gamma + p)y' - k'(L)] \quad (7)$$

$$\lim_{t \rightarrow \infty} L_t y'(L_t) u'(I_t) \exp(-\gamma t) = 0, \quad (8)$$

Eq. (7) implies the income how to be determined. Eq. (8) is the transversality condition for the representative household.

3. Dynamic structure

Eqs. (6) and (7) describe an evolution of the economy along a perfect foresight equilibrium path. Setting Eqs. (6) and (7) to zero can yield steady state values of labor supply and income as follows:

$$I^* = (\bar{p} - p)y_0 + py(L^*) - k(L^*) - T_0 \quad (9)$$

$$[(\bar{p} - p)\beta\gamma + p]y'(L^*) - k'(L^*) = 0 \quad (10)$$

Eq. (9) means that the income of the respective household in steady state is a function of labor supply, the government's purchasing price, market price, the fixed level purchased by government and the constant agricultural tax. Furthermore, this equation satisfies $\partial I/\partial L = py' - k'$ and $\partial^2 I/\partial L^2 = py'' - k'' < 0$, which means that Eq. (9) is an increasing function of labor supply at first and then a decreasing function of labor supply. Eq. (10) is a determination function of labor supply in steady state, which can be shown in Fig.1:

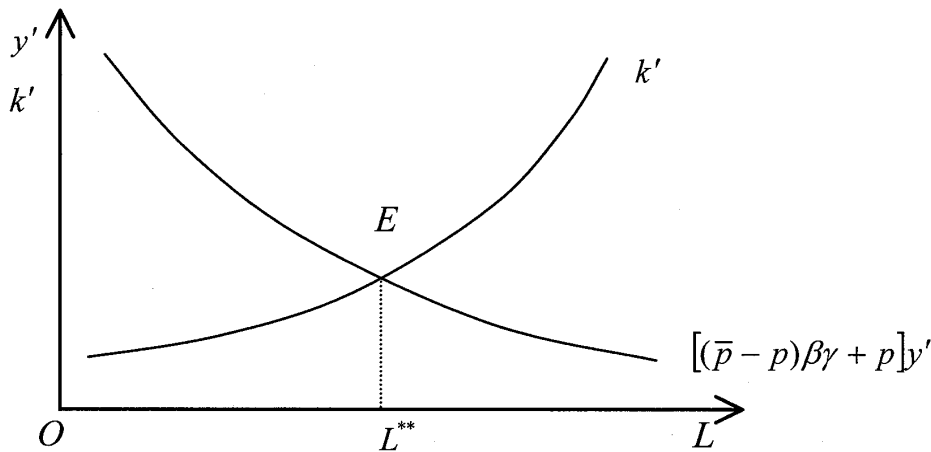


Fig. 1 The determination of labor in steady state

In order to analyze the stability of this dynamic model, we must study the relationships between income and labor supply in Eqs. (6) and (7) around steady state. Since I is a jumping variable and L is a predetermined variable, a saddle path is required in this model. As shown in Appendix, a saddle path condition is satisfied since there are one negative and one positive eigenvalues in the Jacobian matrix of Eqs. (6) and (7). However, there are two steady states in this dynamic model when considering $\bar{p} < p$ and $\bar{p} > p$. Fig. 2-1 shows a phase diagram when $\bar{p} < p$. Since $\bar{q} < q$, so $L_1^* < L^{**}$, where L^{**} is the value of labor supply when income takes maximum values. Fig. 2-2 shows a phase diagram when $\bar{p} > p$, in which the curve of $\dot{L} = 0$ is represented by a dotted line. Compared to Figs. 2-1 and 2-2, we find that labor supply in the steady state E_1 is less than it in the steady state E_2 . In order to distinguish the line of $\dot{L} = 0$ in Fig.2-1 from it in Fig.2-2. We use a thin solid line to indicate the curve of $\dot{L} = 0$ in Fig.2-1, while using a thick solid line to indicate it in Fig.2-2.

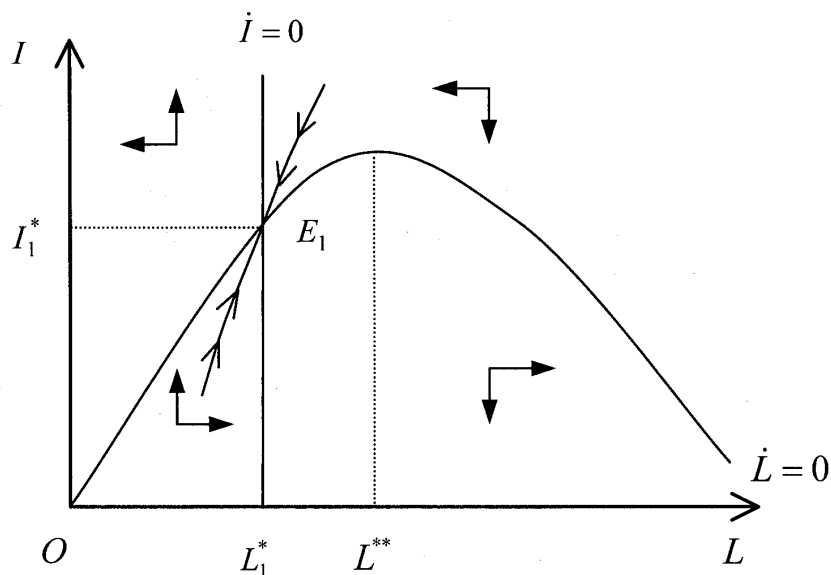


Fig. 2-1 The phase diagram when $\bar{p} < p$

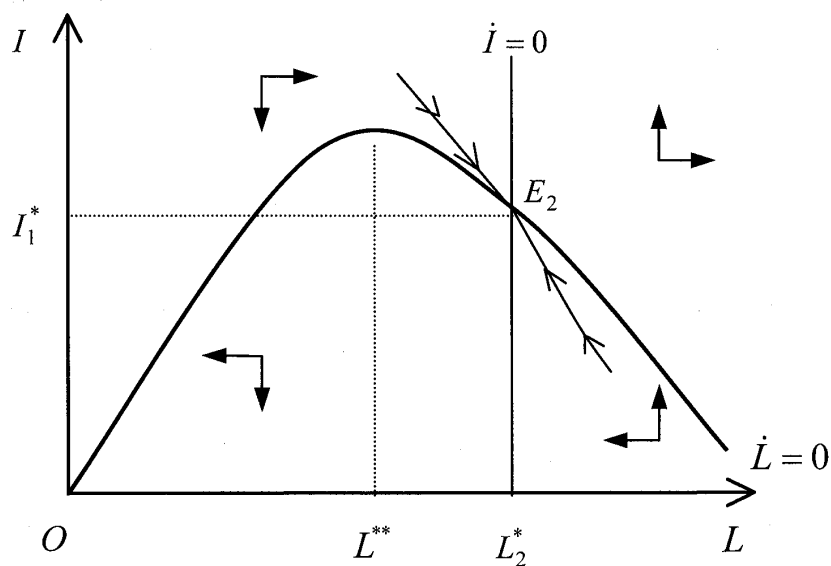


Fig. 2-2 The phase diagram when $\bar{p} > p$

4. Comparative statistic analysis

In this section, we will analyze the changes in parameters in the dynamic model how to affect labor supply and income. Thus, we can obtain the following four propositions.

Proposition 1 The rise in government's purchasing price will raise both income and labor supply when keeping the government's purchasing price less than the market price. On the other hand, if the increase in government's purchasing price brings itself exceed market price, it will raise labor supply but the effect on income is ambiguous.

Fig. 3-1 shows the effect of the rise in the government's purchasing price on labor supply and income when keeping $\bar{p} < p$. In the case, the curve $\dot{I} = 0$ will shift toward to right and the $\dot{L} = 0$ curve will shift upward when the government's purchasing price rise. Therefore, as the steady state shifts to E'_1 from E_1 , the rise in the government's purchasing price will raise both labor supply and income. However, when the rise in the government's purchasing is high enough to bring the government's purchasing price larger than the market price, the phase diagram will convert into the figure shown by Fig. 2-2 from Fig. 2-1. The new steady state will shift to E_2 or E'_2 from E_1 . In the steady state E_2 , both labor supply and income will rise, while income will drop though labor supply increase in the steady state E'_2 .

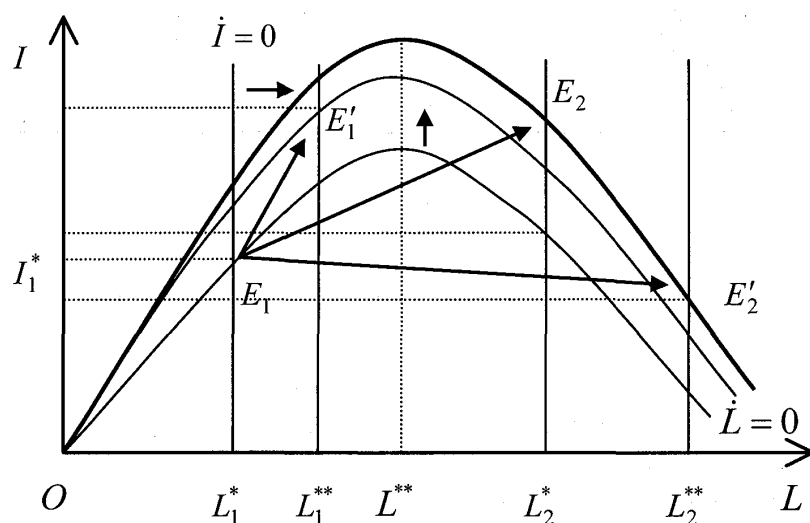


Fig. 3-1 The effect of the rise in \bar{p} when $\bar{p} < p$

Fig. 3-2 shows the effect of the rise in the government's purchasing price on labor supply and income when $\bar{p} > p$. In the case, the curve $\dot{I} = 0$ will shift toward to right and the $\dot{L} = 0$ curve will shift upward when the government's purchasing price rise. Therefore, there are two case can be considered. The one case is that income increases as labor supply rises, in which the steady state will shift to E'_2 from E_2 . Another case is that the income may decrease as labor supply rises, in which the steady state will shift to E''_2 from E_2 .

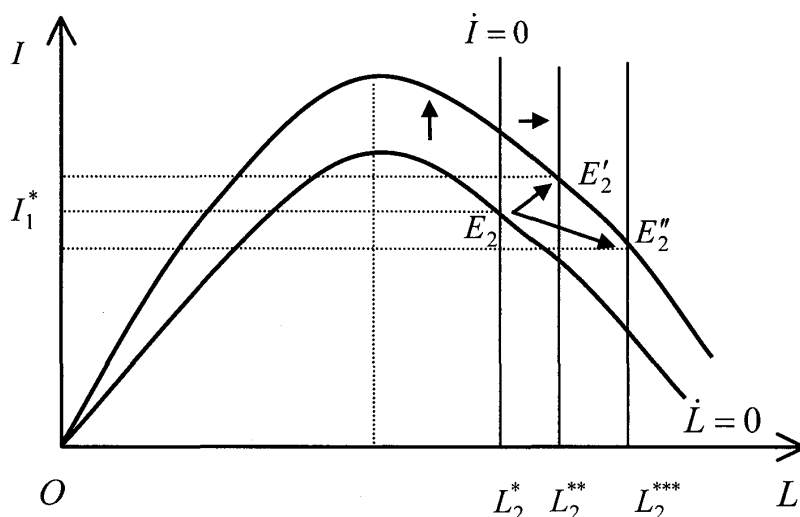


Fig. 3-2 The effect of the rise in \bar{p} when $\bar{q} > q$

Proposition 2 The rise in market price will raise both income and labor supply when market price is higher than government's purchasing price, while it will raise labor supply and give ambiguous effect on income when keeping market less than government's purchasing price. Furthermore, in the latter case, if the increase in market price brings itself to exceed government's purchasing price, labor supply will decrease, but the impact on income is ambiguous.

Fig. 4-1 shows the effect of the rise in the market price on labor supply and income when $\bar{q} < q$. In the case, the $\dot{L} = 0$ curve will shift toward to right and the $\dot{I} = 0$ curve will shift upward. Therefore, the steady state will shift to E'_1 from E_1 . Income increases as labor supply rises.

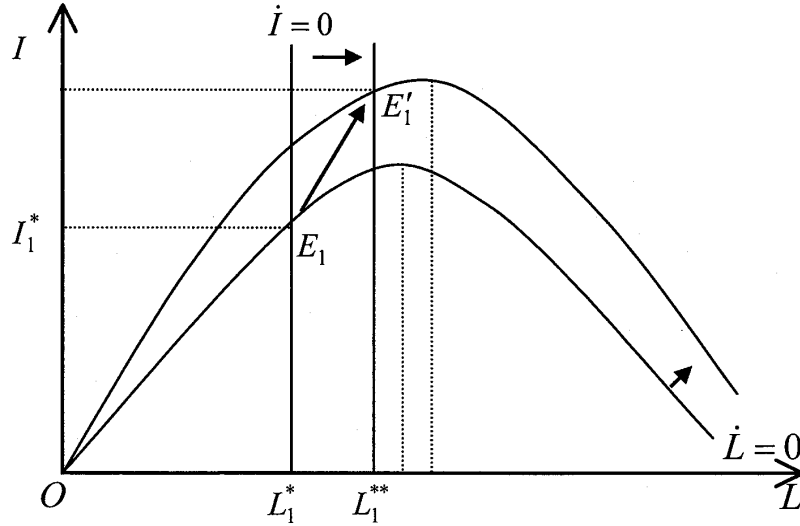


Fig. 4-1 The effect of the rise in p when $\bar{q} < q$

Fig.4-2 shows the effect of the rise in the government's purchasing price on labor supply and income when $\bar{q} > q$. If $\bar{q} > q$ is kept, the $\dot{I} = 0$ curve will shift toward to right and the $\dot{L} = 0$ curve will shift upward when the government's purchasing price rise. Therefore, there are two case can be considered. The one is the case that income increases as labor supply rises, in which the steady state will shift to E_2' from E_2 . Another case is that the income may decrease as labor supply rises, in which the steady state will shift to E_2'' from E_2 . However, when the rise in the market price is high enough to bring itself larger than the government's purchasing price, the phase diagram will convert into the figure shown by Fig. 2-1 from Fig. 2-2. The new steady state will shift to E_1 or E_1' from E_2 . In the steady state E_1 , income will rise though labor supply decreases, while both income and labor supply will drop in the steady state E_1' .

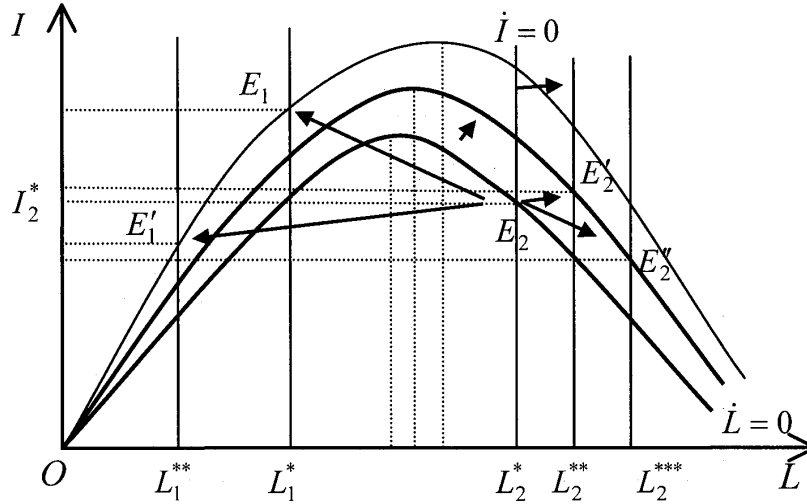


Fig. 4-2 The effect of the rise in p when $\bar{q} > q$

Proposition 3 The rise in both the adjusted coefficient and the constant rate of time preference will decrease both labor supply and income when government's price is less than market price. On the other hand, the rise in both the adjusted coefficient and the constant rate of time preference will decrease income even when it let labor supply rise.

Fig. 5-1 shows the effect of the rise in β and γ on labor supply and income when $\bar{q} < q$. In the case, the $\dot{c} = 0$ curve will shift toward to left and the $\dot{L} = 0$ curve will keep unchanged. Therefore, as the steady state shifts from E_1 to E'_1 , income will drop as labor supply decrease.

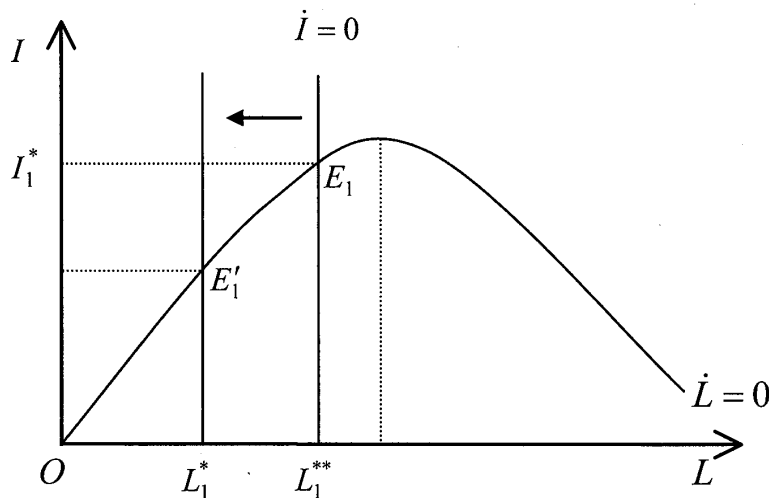


Fig. 5-1 The effect of the rise in β and γ when $\bar{q} < q$

Fig. 5-2 shows the effect of the rise in β and γ on labor supply and income when $\bar{q} > q$. In the case, the $\dot{c}=0$ curve will shift toward to right and the $\dot{L}=0$ curve will keep unchanged. Therefore, as the steady state shifts to E'_2 from E_2 , income will drop as labor supply increase.

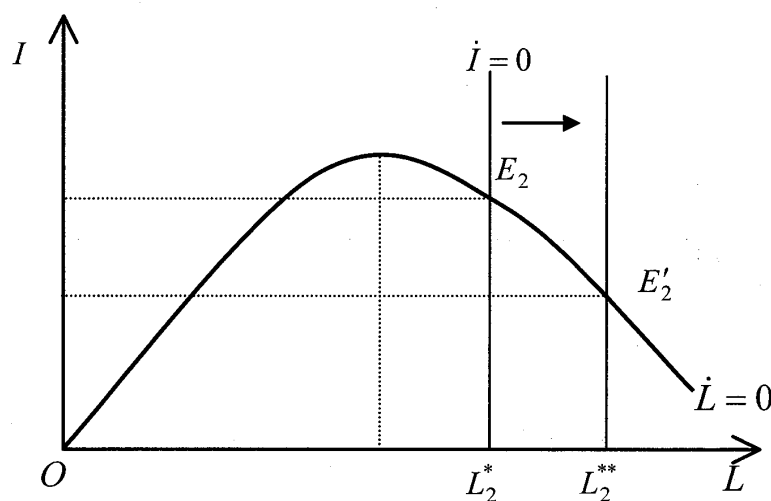


Fig. 5-2 The effect of the rise in β and γ when $\bar{q} > q$

Proposition 4 The rise in the fixed level purchased by government will decrease income when government's price is less than market price and increase income when government's price is higher than market price. On the other hand, labor supply keeps unchanged in both cases.

Fig. 6-1 shows the effect of the rise in the rise fixed level purchased by government on labor supply and income when $\bar{q} < q$. In the case, the $\dot{L}=0$ curve will shift downward and the $\dot{I}=0$ curve will keep unchanged. Therefore, as the steady state shifts from E_1 downward to E'_1 , income will drop while labor supply keeps unchanged.

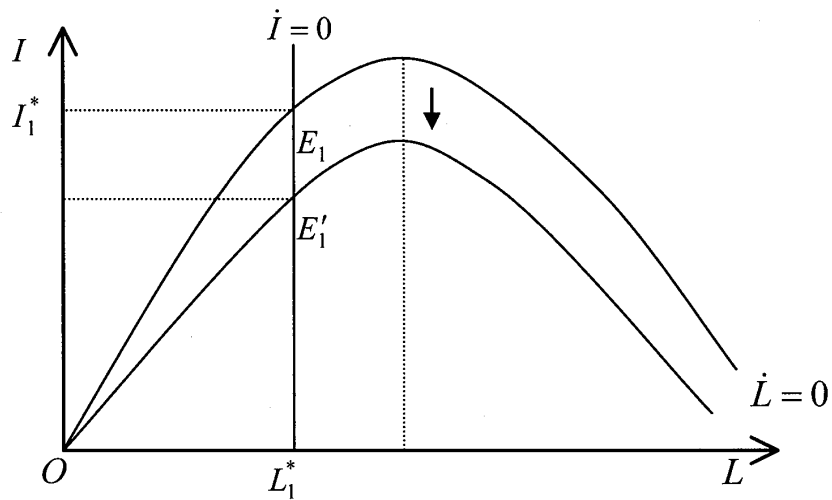


Fig. 6-1 The effect of the rise in Y_0 when $\bar{q} < q$

Fig. 6-2 shows the effect of the rise in the rise fixed level purchased by government on labor supply and income when $\bar{q} > q$. In the case, the $\dot{L} = 0$ curve will shift upward and the $\dot{i} = 0$ curve will keep unchanged. Therefore, as the steady state shifts to E_2' from E_2 , income will rise while labor supply keeps unchanged.

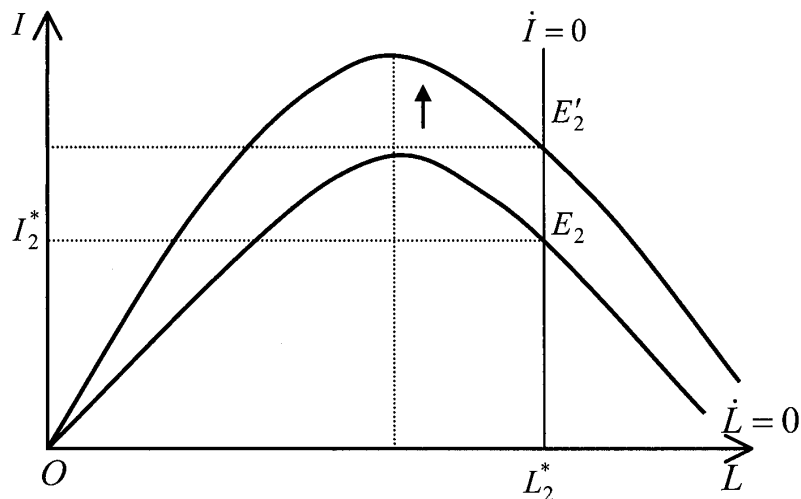


Fig. 6-2 The effect of the rise in y_0 when $\bar{q} > q$

5. Conclusions

This paper analyzes the effect of government purchasing planning on agriculture development in China. In this paper, we assume that there are a large number of homogenous households who supply labor to produce and consume one single goods. We also assume that the production of the single goods only relies on labor supply of households. A part of the single goods produced by households need to sell government and the rest is allowed to be treated in market. Since a large number of homogenous households exist, market price is assumed to be given. The government purchasing planning includes two parts: the one is the fixed level and another is a constant proportion of the increase in production of the single goods. Therefore, when the greater the production of the single goods is, the greater the part purchased by government is. Furthermore, we assume that households know government's purchasing planning in advance.

Based on these assumptions, we found that there are two steady states when considering the case that government's purchasing price is less market price and the case that government's purchasing price is higher than market price. When keeping the government's purchasing price less than market price, the rise in government's purchasing price will raise income as households supply more labor. However, if the government's purchasing price exceeds market price, the steady state will be altered, in which the households' income may rise or drop even though they supply more labor. Simultaneously, when keeping market price less than government's purchasing price, the rise in market price will raise income as households supply more labor. However, if the increase in market price makes itself exceed government's purchasing price, the steady state will be altered, in which the households' income may rise or drop even though they supply less labor.

This paper also studies the effects of the rise in both the adjusted coefficient and the constant rate of time preference. The rise in both the adjusted coefficient and the constant rate of time preference will decrease both labor supply and income when government's price is less than market price. On the other hand, the rise in both the adjusted coefficient and the constant rate of time preference will make income decrease but make rise labor supply.

Furthermore, this paper studies the effect of the rise in the fixed level purchased by government. The rise in the fixed level purchased by government will decrease income when government's price is less than market price but increase income when government's price is higher than market price. On the other hand, labor supply keeps unchanged in both cases.

The conclusions obviously are dependent of the assumptions in this paper. However, some assumptions may be inadequate. Actually, the government action may not be prognosticated. And government's purchasing price and market price may be endogenously determined. Furthermore, we also will not consider the case that government renounces the purchasing of the single goods so that the price of single goods is perfectly determined in market. These problems will be considered in future.

Acknowledgements

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Appendix

Linearizing Eqs. (6) and (7) around the steady state, we can have

$$\begin{bmatrix} \dot{I} \\ \dot{L} \end{bmatrix} = \begin{bmatrix} \frac{\partial \dot{I}^*}{\partial I} & \frac{\partial \dot{I}^*}{\partial L} \\ \frac{\partial \dot{L}^*}{\partial I} & \frac{\partial \dot{L}^*}{\partial L} \end{bmatrix} \begin{bmatrix} I - I^* \\ L - L^* \end{bmatrix}$$

where

$$\begin{aligned} \frac{\partial \dot{I}^*}{\partial c} &= 0 \\ \frac{\partial \dot{I}^*}{\partial L} &= \begin{cases} \frac{u'}{u''(\bar{p} - p)\beta y'} [((\bar{p} - p)\beta\gamma + p)y'' - k''] > 0 & \text{if } \bar{p} > p \\ \frac{u'}{u''(\bar{p} - p)\beta y'} [((\bar{p} - p)\beta\gamma + p)y'' - k''] < 0 & \text{if } \bar{p} < p \end{cases} \\ \frac{\partial \dot{L}^*}{\partial I} &= \begin{cases} \frac{1}{(\bar{p} - p)\beta y'} > 0 & \text{if } \bar{p} > p \\ \frac{1}{(\bar{p} - p)\beta y'} < 0 & \text{if } \bar{p} < p \end{cases} \\ \frac{\partial \dot{L}^*}{\partial L} &= \frac{k' - py'}{(\bar{p} - p)\beta y'} > 0 \end{aligned}$$

We denote two eigenvalues of the Jacobian matrix as λ_1 and λ_2 . We can therefore obtain the following two equations, even in case of $\bar{q} < q$ or in case of $\bar{q} > q$:

$$\lambda_1 + \lambda_2 > 0, \quad \lambda_1 \lambda_2 < 0$$

Therefore, there are one negative and one positive eigenvalues in the dynamic system described by Eqs. (6) and (7). In other words, there exists unique perfect foresight equilibrium in the dynamic system.

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