North American Journal of Economics and Finance 38 (2016) 102–110

Contents lists available at ScienceDirect

North American Journal of Economics and Finance

journal homepage: www.elsevier.com/locate/ecofin

Land conservation, growth and welfare

Meng-Yi Tai [a], C.C. Chao [b,*], Lee-Jung Lu [c], Shih-Wen Hu [b], Vey Wang [b]

[a] *Department of Applied Economics, Fo Guang University, Yilan, Taiwan*
[b] *Department of Economics, Feng Chia University, Taichung, Taiwan*
[c] *Department of Leisure Management, Tungnan University, Taipei, Taiwan*

ARTICLE INFO

Article history:
Received 13 January 2016
Received in revised form 30 August 2016
Accepted 31 August 2016

JEL classification:
Q18
O13

Keywords:
Land conservation
Growth
Welfare

ABSTRACT

This paper identifies the factors, such as leaving land fallow and conservation inputs, for conserving and enhancing soil fertility of land. The growth and welfare effects of these land policies are then examined. Leaving land fallow and conservation inputs raise the equilibrium soil fertility. In the short run, the polices can render unfavorable impacts to the economy, such as decreases in the land supply by the fallow plan, or reductions in public services and falls in private capital formation. Nonetheless, both policies have ambiguous impacts on growth and welfare of the economy in the long run. Furthermore, due to the favorable impact on initial consumption, the welfare-maximizing tax rate or transfer ratio is larger than the one for growth maximization. However, for the land fallow ratio, both rates are the same.

1. Introduction

"To the people, food is heaven." This ancient Chinese proverb tells how important food in our daily life. Sustainable development in agriculture has therefore occupied a high priority in both developing and developed economies. In particular, for sustaining and further enhancing soil fertility, policy measures, such as leaving land fallow and organic fertilizers, etc., have been promoted and implemented. For purchases of agricultural machinery and facilities for irrigation and water conservation as well as technologies for improving soil organic matters, the U.S. government has promoted "the fallow plan," and fallow areas reached nearly 15 million hectares in 1995–1996. This plan has greatly contributed to the conservation of land for agricultural production, which is essential to sustain economic growth in the long run.

Nonetheless, farmers have argued that the implementation of the fallow plan could be more flexible because it can affect their short-run earnings as a result of less land being available in agricultural production. However, in the literature on economic growth, less attention has been paid to agricultural issues and there have been no theoretical studies on the effects of the land fallow policy on agricultural production and the consequent impact on economic growth. Therefore, by incorporating soil fertility into an endogenous growth model a la Romer (1986) and Barro (1990), the purpose of this paper is to study the growth and welfare effects of the land fallow plan. In general, soil fertility is affected by its natural growth and fertilizer inputs, while it can be depleted through agricultural production. To preserve natural growth, it is hence necessary for land to be left fallow. On the other hand, land can be nourished by using organic fertilizers and biomass energy. This lends support to

* Corresponding author.
E-mail addresses: mytai@mail.fgu.edu.tw (M.-Y. Tai), chichurchao@gmail.com (C.C. Chao), ljlu@mail.tnu.edu.tw (L.-J. Lu), swhu@fcu.edu.tw (S.-W. Hu), wangwei@fcu.edu.tw (V. Wang).

http://dx.doi.org/10.1016/j.najef.2016.08.004
1062-9408/

policies to conserve land. This paper also compares the financial policies, i.e., taxes or transfers, adopted to facilitate growth and improve welfare in the economy.

The remainder of this paper is organized as follows. Section 2 presents the analytical framework of an endogenous growth model for the economy, while Sections 3 and 4 examine the growth and welfare effects of the policies on leaving land fallow and agricultural subsidies. Section 5 concludes.

2. The model

We consider an economy that consists of a representative household and a government. The economy produces a single good Y and the household consumes it to maximize the discounted sum of instantaneous utilities:

$$Max \int_0^\infty U(C)e^{-\rho t}dt, \tag{1}$$

where C is the amount of consumption, $U(\cdot)$ represents the utility function and ρ denotes the subjective rate of time preference. Moreover, it is assumed that the instantaneous utility function is:

$$U(C) = \ln C. \tag{2}$$

As for the production of good Y, following Barro (1990), a Cobb-Douglas functional form is adopted. By utilizing private capital (K), public services (G) and land capacity (L), good Y is produced under the production function:

$$Y = A[(1-\upsilon)L]^\gamma G^\delta K^{1-\delta} \tag{3}$$

where A denotes the technology state of the economy. It is noted that the capacity of land is in terms of soil fertility, and for conserving it, a portion υ of the land is left fallow.

There is also a government in the economy. The government collects income taxes for providing public services G and transfer payments R to the household. Therefore, at each instant in time, the household's budget constraint is

$$\dot{K} = (1-\tau)Y - C + R \tag{4}$$

where τ represents the income tax rate and a dot over a variable denotes the rate of change with respect to time. Eq. (4) states that savings from unspent revenue becomes capital formation.

Noted that soil fertility (L) in Eq. (3) is affected by the variables such as land fallow and land conservation via the government transfer program. Households hold perfect expectations for the future values of land fertility, while the decision variables are their consumption and investment. That is, households choose consumption (C) and investment (K) to maximize the discounted sum of utilities in Eq. (1), subject to the budget constraint in Eq. (4). The current-value Hamiltonian function is therefore given by

$$H = \ln C + \lambda\{(1-\tau)A[(1-\upsilon)L]^\gamma G^\delta K^{1-\delta} - C + R\} \tag{5}$$

where λ expresses the co-state variable for the shadow value of capital. The first-order optimality conditions for C and K are:

$$\frac{1}{C} = \lambda \tag{6a}$$

$$\dot{\lambda} = \rho\lambda - \lambda(1-\delta)(1-\tau)A[(1-\upsilon)L]^\gamma G^\delta K^{-\delta} \tag{6b}$$

where Eq. (6a) defines the marginal utility of consumption as being equal to the shadow value of capital. As stated in Eq. (6b), the change of λ depends on the difference between the rate of time preference and the marginal productivity of capital, while the transversality condition is given by

$$\lim_{t\to\infty} \lambda K e^{-\rho t} = 0 \tag{6c}$$

Using Eqs. (6a) and (6b), the optimal rate of change in consumption is obtained as

$$\frac{\dot{C}}{C} = -\frac{\dot{\lambda}}{\lambda} = (1-\delta)(1-\tau)A[(1-\upsilon)L]^\gamma G^\delta K^{-\delta} - \rho \tag{7}$$

which is the standard Keynes-Ramsey rule for consumption.

Turning to the government, the policy variables are the proportion of land left fallow (υ) and the income tax rate (τ). Noted that the (φ) share of the income tax revenue is to finance public services (G) and the left ($1-\varphi$) share is used for transfer payments to the households for land conservation, as follows

$$G = \varphi\tau Y \tag{8a}$$

$$R = (1-\varphi)\tau Y \tag{8b}$$

where Y is the production income of the economy.