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Ricardian equivalence for local government bonds

Budget constraint approach

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Abstract

It is shown that if consumers own land, the free rider problem does not occur because a change in local government financing is completely reflected in the price of land. This means that the Ricardian equivalence theorem holds not only for national government bonds but also for local government bonds.

JEL classification: H74

1. Introduction

The Ricardian equivalence theorem indicates that a change in local government financing from taxation to debt, keeping government expenditure constant, is independent on the consumption path.[1] But, when bonds are regional, it is said that the free rider problem arising as a result of the regional mobility makes it difficult for this theorem to hold.[2]

Our focus is to verify whether this problem occurs. Daly (1969) suggested that if consumers own land, the free rider problem does not arise because a change in local government financing is completely reflected in the price of land. Following Daly, Noguchi (1981) criticized the regulation on the issuance of local government bonds. But they do not define a model. Tsuneki (1985) discussed it by using the framework of the Modigliani–Miller Theorem. However, this does not include regional mobility explicitly and the bonds are financed by a land tax not an income tax.

The purpose of this paper is to show clearly that even when regional mobility and an income tax are considered, the free rider problem does not occur. This means that a change in local government financing does not affect the consumer's consumption path, that is, the Ricardian equivalence theorem holds even when bonds are regional.

In section 2 we set up the model with land. In section 3 the land price is derived. That the free

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[1] For most recent survey, see Seater (1993).

[2] The equivalence of the burden of internal and external bond was shown by Mutoh (1985).

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rider problem does not occur is derived in section 4 by comparing two types of behavior. Conclusions are given in section 5.

2. The model

We assume that consumers live infinitely and that they are identical in preferences and wealth. For simplicity we ignore the intergenerational problem.[3] In addition, we assume that many identical local governments exist and finance local public goods with taxation. Now we introduce the land market as the regional fixed asset and all available land is held by someone. We suppose that the total amount of land in one region is fixed. Consumers have land as the production space. They can receive a land revenue, defined by a, at each period. Then the representative consumer's budget constraint at period t becomes

$$(1+r)S_{t-1} + Y_t + a_t L_t - \tau_t = C_t + S_t ,$$

where r is the interest rate and is constant through time, Y is income, which is equal in all regions and is constant, S is the gross savings at each period, L is the amount of land owned, τ is an income tax level levied when bonds are not issued, and C is the consumption level. Also r and Y are given exogenously. The subscript refers to the period.

We assume that the utility of consumers depends on only the consumption level. Consumers can select the consumption path, that is, the saving path with utility maximizing. Here we suppose that consumers take account not only of the budget constraint of consumers but also of the budget constraint of the regional government. This means that consumers can anticipate the future tax stream.

Now we can think of a change in local government financing, that, is, the introduction of debt finance and the reduction of the tax level. Here we assume that one local government issues a new bond at period 1 and that this bond reaches maturity at period 2. When the level of per capita local government bonds is defined by b, the tax level of the local government becomes $\tau_1 - b$ at period 1 and $\tau_2 + (1+r)b$ at period 2.

3. Land price

Let p_t be the land price at period t. Consumers can get land revenue at the beginning of the period and can sell the land at the beginning of the next period if they want to move to another region. If consumers sell the land at period 1 and invest the sales in the money market, they can get revenue of $(1+r)p_1$ per unit of land. While if consumers hold the land at period 1 and sell it at period 2, they can get land revenue of $(1+r)a$ and sales of p_2 per unit of land.[4,5] The equilibrium price of land is achieved when the revenue in both cases is equal. The equilibrium condition of the land market becomes

$$(1+r)p_1 = (1+r)a + p_2 .$$

[3] The Ricardian equivalence theorem with intergenerational problems was shown by Barro (1974).

[4] For example, suppose that the land is used for agriculture. Then a represents the agricultural revenue.

[5] Here we assume for simplicity that a is constant. But this assumption is not essential to the results of this paper.

This equation represents an arbitrage condition between the monetary asset and the land. Similarly, the equilibrium condition at the next period becomes

$$(1+r)p_2 = (1+r)a + p_3 .$$

Eliminating p_2 from the above two equations, we get

$$p_1 = a + a/(1+r) + p_3/(1+r)^2 .$$

By repeating this operation, we have

$$p_1 = \{a + a/(1+r) + a/(1+r)^2 + \cdots + p_{t+1}/(1+r)^t\} .$$

This equation means that the land price is considered as the discounted present value of land. By converting t to infinity, we get $p_1 = (1+r)(a/r)$.

4. The existence of region mobility

Most of the papers that discuss Ricardian equivalence assume that consumers cannot move to another region. We may be persuaded of this assumption when we are thinking about the problems between countries. But we are considering the problem among regions. Therefore we allow mobility of consumers in this section. To show the equivalence of the regional bond, we think of two kinds of budget constraints, though consumers are identical. One is the constraint of a consumer who does not change region. The other is the constraint of a consumer who does change region.

4.1. Consumer who does not change region

We assume that a consumer cannot know the behavior of the other consumer. Then a consumer who does not change region anticipates that some consumer may change region. Under this anticipation, assuming the population in this region changes from N_1 at period 1 to N_2 at period 2, the constraints of a consumer who does not change region becomes

$$(1+r)S_0 + Y_1 + aL_1 - (\tau_1 - B/N_1) = C_1 + S_1 \tag{1}$$

and

$$(1+r)S_1 + Y_2 + aL_2 - (\tau_2 + (1+r)B/N_2) = C_2 + S_2 + P_2(L_2 - L_1) , \tag{2}$$

where N_t is the population of this region at period t and B is the total level of bonds issued. Equation (1) means that, by the issuance of local government bond B, the tax level per capita decreases by B/N_1 to $\tau_1 - B/N_1$ at period 1. Similarly Eq. (2) means that the tax level per capita increases by $(1+r)B/N_2$ to $\tau_2 + (1+r)B/N_2$ at period 2. Some consumers who move to other regions sell their land and consumers who do not change regions buy this land at the equilibrium land price, p_2, equalizing the demand and supply of the land. The last term on the RHS of Eq. (2) shows that the amount of land held by a consumer changes from L_1 to L_2 at period 2. Since the total land size of the region is fixed, the equilibrium condition of the land market becomes

$$N_1 L_1 = \bar{L} = N_2 L_2 , \tag{3}$$

where $\bar{L}$ is the total land size of this region.

Next we consider the land price at period 2. When the population is N_2 at period 2, the real revenue, RR, which a consumer can get by living in this region becomes

$$RR = aL_2 - (1+r)B/N_2 .$$

With Eq. (3), we get

$$RR = \{a - (1+r)B/\bar{L}\}L_2 . \tag{4}$$

Equation (4) means that the real revenue per unit of land decreases by $(1+r)B/\bar{L}$ to $a-(1+r)B/\bar{L}$. Then the land price at period 2 is derived as

$$p_2 = \{a - (1+r)B/\bar{L} + a/(1+r) + a/(1+r)^2 + \cdots + p_{t+2}/(1+r)^t\} .$$

By converting t to infinity, we get

$$p_2 = (1+r)(a/r - B/\bar{L}) . \tag{5}$$

Using (5), (2) is formulated by

$$(1+r)S_1 + Y_2 + aL_2 - (\tau_2 + (1+r)B/N_2) = C_2 + S_2 + (1+r)(a/r - B/\bar{L})(L_2 - L_1) .$$

Separating L_2, we get

$$\begin{aligned}&(1+r)S_1 + Y_2 + aL_1 + a(L_2 - L_1) - (\tau_2 + (1+r)B/N_2)\\ &\quad = C_2 + S_2 + \{(1+r)a/r\}(L_2 - L_1) - \{(1+r)B/\bar{L}\}(L_2 - L_1) .\end{aligned} \tag{6}$$

Eliminating S_1, N_1, and N_2 from (1) and (6) with (3), we get

$$\begin{aligned}&(1+r)\{(1+r)S_0 + Y_1 + aL_1 - \tau_1 - C_1\}\\ &\quad = -Y_2 - aL_1 + \tau_2 + C_2 + S_2 + \{(1+r)a/r - a\}(L_2 - L_1) .\end{aligned} \tag{7}$$

The last term on the RHS vanishes in the intertemporal budget constraint. This is because the change in the amount of land from L_1 to L_2 derives revenue of $a(L_2 - L_1)$ at each period, and the discounted present value equals the land price multiplied by the change in the amount of land, $(1+r)a/r(L_2 - L_1)$. Then the constraint is independent of L_2, that is, N_2. Also this equation is independent of the debt level, B. Therefore we conclude that Ricardian equivalence obtains for consumers who do not change region, even if the population of the region varies.

4.2. *Consumer who changes region*

The land price in the region where the local government financing does not change becomes $(1+r)a/r$ from section 3 similarly. This shows that consumers who move to another region can buy land at the land price $(1+r)a/r$. With this in mind we can set out the budget constraints of consumers who change regions. At period 1 these become

$$(1+r)S_0 + Y_1 + aL_1 - (\tau_1 - B/N_1) = C_1 + S_1 . \tag{8}$$

At period 2 consumers sell the land at the land price $(1+r)(a/r - B/\bar{L})$ in the region where local

government bonds are issued, and buy land at the land price $(1+r)a/r$ in the other region. Therefore the budget constraint at period 2 becomes

$$(1+r)S_1 + Y_2 + aL_2 - \tau_2 + (1+r)(a/r - B/\bar{L})L_1 - (1+r)a/rL_2 = C_2 + S_2 . \quad (9)$$

The fifth term on the LHS of Eq. (9) represents the revenue created by selling land and the sixth term represents the cost paid to buy land in another region.

Eliminating S_1 and N_1 from (8) and (9) with (3), we have the same equation as (7). Thus the intertemporal budget constraint of a consumer who changes region is identical to the constraint of a consumer who does not change region. Therefore, even if they change regions to avoid the burden of local debt at the next period, consumers' utility does not increase. Consumers cannot become free riders as long as they own land, even if they move regions.

5. Conclusions

In this paper we have shown that the existence of regional mobility does not affect the consumption path. This fact is demonstrated by introducing a regional fixed asset into the model.[6] The change in local government financing affects the price of the fixed asset in this region. Since we assume that consumers must own land as a production space, this change in local government financing will surely affect consumers. Therefore consumers cannot become free riders. This means that, even if bonds are regional, the Ricardian equivalence theorem holds. The regulation of regional bonds must be reconsidered.

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[6] In this paper this asset is land.