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# Ricardian equivalence for local government bonds: A utility maximization approach

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ABSTRACT

We show that Ricardian equivalence holds for local public finance if and only if subnational units use property taxes. However, for other tax bases, the unique equilibrium has the same economic outcome as in models where districts may not issue debt.



## 1. Introduction

Ricardian equivalence is the proposition that the method by which a government finances expenditures is irrelevant to economic outcomes. While a great deal of attention has centered on whether Ricardian equivalence holds at the national level, there has been little work on Ricardian equivalence in local public finance.[1] In this paper, we show that Ricardian equivalence will hold at the local level if and only if the local tax base is land-based. If income or other taxes are used to finance local expenditures, then Ricardian equivalence will not hold, and districts may issue debt to improve the welfare of their citizens.

In an earlier piece in *Economics Letters*, Akai (1994) claims that Ricardian equivalence holds so long as districts compete for second period residents regardless of the tax base, building on a suggestion regarding competition in Daly (1969). A number of empirical works have also built upon this result.[2] In the model by Akai, the price of land is not determined in a market, but rather each agent choosing to live in a district pays a price to obtain an equal share of land and reside in that district. If we introduce a market for land into each district, then the price of land is determined by demand among the residents of that district for land, and Ricardian equivalence will fail to hold.[3]

The key insight is that for Ricardian equivalence to hold at the local level, there must be an equal number of residents in each district after debt has been issued. But if that is the case, then the price of land must be the same in each district after debt has been issued, since the price of land must be equal to the marginal utility of land for each resident. But if the price of land is the same in both districts, then the onus of paying back the debt will fall completely on the second period residents of the issuing district; the first period residents of the issuing district receive the proceeds from the debt as a windfall, and will have a higher consumption overall. Hence, those residents are better off when debt is issued and Ricardian equivalence fails.

However, while Ricardian equivalence does not hold, we can obtain a weaker result. Specifically, for a model where all districts may issue debt, in equilibrium each district will issue an equal amount of debt and, furthermore, all real variables (i.e. consumption, land use, and the number of residents per district) will be the same as in the model where no district can issue debt. Note, however, that this is purely an equilibrium phenomenon; if one district were to deviate from the equilibrium strategy, real outcomes such as consumption patterns would change, a violation of Ricardian equivalence. The equilibrium is characterized by each district choosing the optimal

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[1] For an overview of the vast literature on Ricardian equivalence at the national level, see Seater (1993).

[2] See Banzhaf and Oates (2008) and Banzhaf et al. (2008).

[3] Note that with a land tax, it is immediate from the results of Feldstein (1977) that Ricardian equivalence holds when districts use land taxes, as then the cost of debt is immediately incorporated into the price of land. See Bailey (1993) for a formal proof of this statement in a model of long-lived agents. See Hatfield (2008) for a formal proof of this statement in the context of an intergenerational model.

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amount of debt to issue to maximize the welfare of its first period residents. Issuing debt and returning the proceeds to the first period residents helps those residents directly, but harms them indirectly as in the second period living in the district is less desirable, which drives down the value of their land; the local government chooses the debt issuance to balance these two forces.

The section below introduces the model, and the subsequent section shows that Ricardian equivalence does not hold, and characterizes the unique equilibrium with the same location and consumption decisions as in a model with no debt. The last section concludes.

## 2. Model

We consider a two period model. There are $J$ equivalent districts. In each district, there is a continuum of agents of mass 1 and 1 unit of land. Each district $j$ chooses $B_j$, the value of the bond it issues in period 1; the revenue from selling these bonds is then returned lump-sum to each agent in district $j$ in the first period. In period 2, each district will generate revenues using a head tax $T_j$ on current residents in order to pay back the bond.

The utility of agent $i$ in district $j$ is given by

$$U(c_{i,j}, l_{i,j}^{t,j'}, l_{i,j}^{t,j''}) = c_{i,j} + \sum_{t=1}^{2} v(l_{i,j}^{t,j'})$$

where $c_{i,j}$ is his consumption and $l_{i,j}^{t,j'}$ is the amount of land (or property) enjoyed in period $t$ in district $j'$. We assume $v(\cdot)$ is strictly increasing, strictly concave, and twice continuously differentiable.[4]

Each agent is endowed with a wealth $w$ and an equal amount of land in the district, i.e. each agent is endowed with 1 unit of land. Hence, the budget constraint of an agent $i$ who is born in district $j$ and chooses to live in district $j'$ in the second period, buying an amount of land $l_{i,j}^{2,j'}$ is

$$w + B_j + p_j l_{i,j}^{1,j} = c_{i,j} + p_{j'} l_{i,j}^{2,j'} + T_{j'} \tag{1}$$

where $p_{j'}$ is the price of land in district $j'$ in period 2. Note that budget balance requires that

$$T_{j'} = \frac{B_{j'}}{N_{j'}}$$

where $N_{j'}$ is the measure of residents of district $j'$ in period 2, i.e.

$$N_{j'} \equiv \sum_{j=1}^{J} \int_0^1 \mathbb{I}[i,j,j'] di$$

where $\mathbb{I}[i,j,j'] = 1$ if agent $(i, j)$ chooses to live in district $j'$ and $\mathbb{I}[i,j,j'] = 0$ if agent $(i, j)$ chooses to live in a district other than $j'$.

We can now formally define an equilibrium of our economy. Our definition of equilibrium has four parts. First, in the second period, the agents must maximize their own welfare as private actors when deciding how much land to consume. Second, the land market within each district must clear. Third, districts pay back any debt using a head tax in the second period. Fourth, district governments maximize the welfare of their current residents when choosing how much debt to issue. When doing so, districts consider the effect of how debt issuance affects the second period population and, hence, the price of land; we assume that districts consider themselves to be small, and take the outside option of possible residents as given.[5]

[4] We assume quasilinear utility for simplicity; the results presented would be unchanged for any additively separable utility function.

[5] The assumption that districts are small, and hence each district does not consider its effect on aggregate outcomes, is innocuous. An equivalent analysis could be done allowing for general equilibrium effects with the same results; we present this model to more clearly show the intuition behind our results.

Formally, then, an equilibrium is a set of debt levels, head taxes, land prices, and second period populations $\{B_j, T_j, p_j, N_j\}_{j=1}^{J}$ in each district, and consumption and locational choices by each agent $\{c_{i,j}, l_{i,j}^{2,j'}\}$ for $i \in [0, 1]$, $j = 1,\ldots, J$, such that:

1. Given the locational choices of the second generation, as well as taxes, the second generation agents maximize their utility given the price of land. That is, each second generation agent $i$ from district $j$ who chooses to live in district $j'$ solves

$$(\hat{c}_{i,j}^{2,j'}, \hat{l}_{i,j}^{2,j'}) \equiv arg \max_{c_{i,j}, l_{i,j}^{2,j'}} \{c_{i,j} + v(l_{i,j}^{2,j'})\} \tag{2}$$

subject to the budget constraint that

$$w + B_j + p_j = c_{i,j} + T_{j'} + p_{j'} l_{i,j}^{2,j'}$$

2. The land market clears:

$$\sum_{j=1}^{J} \int_0^1 [l_{i,j}^{2,j'}] di = 1 \tag{3}$$

for all $j' = 1,\ldots, J$.

3. Debt is paid:

$$B_j = N_j T_j \tag{4}$$

for all $j = 1,\ldots, J$.

4. In the first period, district governments choose debt to maximize the welfare of its first period citizens:

$$B_j = arg \max_{B_j} \{B_j + p_j\} \tag{5}$$

subject to the constraint that

$$\bar{u} = -T_j - p_j \hat{l}_{i,j'}^{2,j} + v(\hat{l}_{i,j'}^{2,j})$$

for all $j$, where $\bar{u}$ is fixed from the perspective of the district; that is, that the utility of the residents of the district must be equal to their outside option.[6] In equilibrium, we can calculate the quantity $\bar{u}$ by simply calculating $-T_j - p_j \hat{l}_{i,j'}^{2,j} + v(\hat{l}_{i,j'}^{2,j})$ for any district $j$.

## 3. Results

### 3.1. Preliminary results

We first solve for the price of land in jurisdiction $j'$. Substituting in the budget constraint (1), we have that for an agent $i$ from district $j$ who chooses to live in district $j'$, he solves

$$\max_{l_{i,j}^{2,j'}} \left\{ -p_j l_{i,j}^{2,j'} + v\left(l_{i,j}^{2,j'}\right) \right\}$$

and so we have that

$$p_j = v'(l_{i,j}^{2,j'}) \tag{6}$$

[6] Note that there is an implicit assumption that no district issues so much debt that no agent in the second period wishes to live there; realistically, no one would wish to hold debt in a district which would be unable to pay it back in the second period.

Note that the price of land does not depend directly on the taxes in district $j$, and that each agent in district $j'$ buys the same amount of land, which we shall denote $l_{j'}$.

### 3.2. The failure of Ricardian equivalence

We have from Eq. (6) that

$$p_j = v'(l_j) = v'\left(\frac{1}{N_j}\right)$$

In order for Ricardian equivalence to hold, an equal number of agents must live in each of our districts. However, now consider how average utility changes in district $j$ as a function of debt issued:

$$u_j \equiv -p_j\frac{1}{N_j} - \frac{B_j}{N_j} + v\left(\frac{1}{N_j}\right)$$

If the issuing of bonds had no effect on the real economy, then a change in $B_j$ should have no effect on the number of agents who choose to live in district $j$. But then

$$\frac{\partial u_j}{\partial B_j} = -\frac{1}{N_j}$$

and the utility of agents who chose to live in district $j$ in the second period would be determined by the amount of the debt issued; debt would be borne completely by the new residents of district 1, and consumptions would change as a result of issuing the debt.

The key insight here is that the price of land will be determined not by the level of debt, but rather the intradistrict land market. Since the marginal utility for land is unchanged by the level of debt, the price of land can only be a function of the number of people who choose to live in the district. If the issuance of debt had no effect on real variables, then an equal number of residents must live in each district regardless of debt issued, and hence the second period price of land in each district would be the same. But then no one would choose to live in the district that issued the most debt, a contradiction.

In Akai (1994), there is an implicit assumption that each member of the district automatically receives a set amount of land and has to pay a price for that amount of land and to live in the district, instead of having land holdings determined in a market. This assumption means that each resident of a district must pay an amount of the debt proportional to his land holding, and so Ricardian equivalence holds. However, if agents were allowed to enter into the land market, they would push up the price of land to its marginal value, and this intradistrict land market destroys Ricardian equivalence.

### 3.3. Equilibrium

We now consider the equilibrium of the model when all districts may issue debt. Consider the problem of district 1 in the first period. It wishes to maximize the utility of its current residents. Hence, it solves

$$\max_{B_1}\{p_1 + B_1\}$$

where $p_1$ is a function of $B_1$ and other variables, including the debt decisions by other states. In particular, it faces the constraint that

$$-p_1 l_1 - B_1 l_1 + v(l_1) = \bar{u}$$

where $l_1 = \frac{1}{N_1}$. Substituting this constraint into the maximization problem, and then solving for the equilibrium level of debt, we have[7]

$$B_j = 0 \qquad (7)$$

in equilibrium.

Hence, we can state the following theorem:

**Theorem 1.** *The unique equilibrium is symmetric, and all districts issue no debt. Hence, all agents' consumption and land use is the same as in the equilibrium where we restrict $B_j \equiv 0$ for all $j$.*[8,9]

Since all districts issue the same amount of debt in the symmetric equilibrium, agents will choose to distribute themselves evenly amongst districts. However, if some district deviated from the equilibrium, and issued a positive amount of debt, then agents from different districts would have different outcomes, violating Ricardian equivalence.

## 4. Conclusion

We have shown that Ricardian equivalence does not hold for local public finance when districts do not use land taxation. The equilibrium of this model will, however, have the same values for real variables as in a model where districts can not issue debt, but that will be purely an equilibrium phenomenon. If a district were to deviate from the equilibrium strategy, and issue additional debt, then in the latter period less residents would choose to live in that district and real economic outcomes such as consumption and locational decisions would change. Given this, we must consider more carefully the effects of local debt financing. Indeed, whether or not we expect Ricardian equivalence to hold at the local level depends on whether property taxes act more like land taxes or head taxes, an issue still under debate.[10]

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## Appendix A

The problem of the governement of district $j$ in the first period is

$$\max_{B_j, l_j, T_j}\{p_j + B_j\}$$

subject to the constraints

$$B_j = T_j N_j$$

and

$$\bar{u} = -T_j - p_j l_j + v(l_j)$$

fixing $\bar{u}$. We also have from Eq. (6) that

$$p = v'(l_j)$$

[7] See Appendix A for the derivation.

[8] A proof may be found in Appendix A.

[9] If we consider the case where districts consider the effect of their policy decisions on aggregate outcomes, then districts will issue a small amount of debt in order to take advantage of their 'market power'.

[10] See Mieszkowski and Zodrow (1989) and Fischel (2001) and references contained therein for a discussion of this point.

for all districts. Substituting these constraints into the maximization problem, we have

$$\max_{N_j}\left\{v'\left(\frac{1}{N_j}\right)+N_j\left(-\ u-v'\left(\frac{1}{N_j}\right)\frac{1}{N_j}+v\left(\frac{1}{N_j}\right)\right)\right\}$$

$$\max_{l_j}\left\{N_j\left(-\ u+v\left(\frac{1}{N_j}\right)\right)\right\}$$

which obtains a first-order condition of[11]

$$-\bar{u}+v\left(\frac{1}{N_j}\right)+v'\left(\frac{1}{N_j}\right)\frac{1}{N_j}=0$$

$$v(l_j)-p_jl_j=\bar{u}$$

and so subtituting into the earlier constraint, $B_j = 0$.

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[11] The second-order condition is

$$v''\left(\frac{1}{N_j}\right)N_j^{-3}<0$$

so this is indeed the global maximum.