PROPERTY TAXES ON AGRICULTURAL ASSETS

by

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This thesis examines effective property tax rates on agricultural assets in the U.S., and attempts to use two models to explain why differences exist among states. One is the "majority rule voting model," and the other is the "special interest model." The former hypothesizes that political influence will increase with increases in the number of farmers, while the special interest model argues that small size will be more effective in exerting pressures on government because the smaller group is easier to organize and less susceptible to the free rider problem. Also, we analyze how tax differences affect land allocation between agricultural use and nonagricultural use.

Some other variables besides group size are also considered to affect tax rates, such as proportion of the property tax base that is agricultural, homogeneity of an interest group and value of assets per farm. Regression analysis is used to determine what effects these factors have on tax rates and on whether a tax penalty must be paid when agricultural land is converted to an alternative use.

We find that tax rates are inversely related to the number of farmers and positively related to the number of nonfarmers. The proportion of the tax base that is agricultural appears to have little influence on tax rates, given the numbers of farmers and nonfarmers. There is only weak evidence that tax rates are inversely related to the value of assets per farm. Tax rates are positively related to the homogeneity of the agricultural sector, as measured by the a Herfindahl index of the value of output from 12 sectors. Thus the results are broadly supportive of majority rule voting models, and broadly inconsistent with special interest models.
PROPERTY TAXES ON AGRICULTURAL ASSETS
Lei Chao, 1990

ABSTRACT

This thesis examines effective property tax rates on agricultural assets in the U.S., and attempts to use two models to explain why differences exist among states. One is the "majority rule voting model", and the other is the "special interest model." The former hypothesizes that political influence will increase with increases in the number of farmers, while the special interest model argues that small size will be more effective in exerting pressures on government because the smaller group is easier to organize and less susceptible to the free rider problem. Also, we analyze how tax differences affect land allocation between agricultural use and nonagricultural use.

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CHAPTER 1

INTRODUCTION

In the United States, like other developed countries, agriculture receives positive protection through a complex set of policies that include price supports, production control, and a variety of tax rules at both the national and state level. One aspect of this system of protection is the favorable property tax treatment of agricultural assets. Several questions about the property tax on agricultural assets are examined in this thesis. Do the states in the U.S. tax agricultural land the same or differently? We find that the tax treatment of agricultural assets differs across states in that some states tax agricultural assets more heavily than other states. For examples, in Alabama between 1982 and 1988, the average effective property tax rate -- that is, property tax as a percentage of the market value of assets -- was .08 percent. The average effective rates for Florida, New Hampshire and Wisconsin were, respectively, .45 percent, .71 percent and 1.21 percent. What are the reasons for the tax differences among the 50 states? What factors influence the tax treatment of agriculture? These are the major questions which are examined in this thesis.
We know that democratic governments acquire information through voting. Since politicians are concerned with winning elections, citizens can use their vote to influence policy decisions. Interest groups may also make implicit or explicit offers of real resources in trade for favorable tax policies, or attempt to affect political outcomes through letter writing campaigns, mass demonstrations and public opinion polls. These means all provide subsidized but selective information to politicians and other policy makers.

Two major hypotheses have been put forth to explain how governments make decisions.

**Majority Rule Voting Model**

In democratic systems, the only formal means of acquiring control of government is to receive a majority of the votes cast in elections. Those in office desire to remain in office, and those outside desire to attain it, so the claim is that political parties formulate policies in order to get elected rather than seek office in order to establish some "best" set of policies. The testable implication from the majority rule voting model is that states which have a large population in agriculture or where farmers are a large fraction of the population will have a lower tax rate on agricultural land.

The majority rule voting model is disputed by some economists. The main points are that politicians realize
that voters make their decisions on the basis of perceived utility, but they are not certain as to the perceptions or the preference functions of individuals. As a result politicians suffer from uncertainty as to which actions will really improve their vote positions, and they are susceptible to influence in the form of subsidized information as to the nature and intensity of voter preferences. In such a situation interest groups will attempt to utilize political influence to insure that their interests enter the decision-making process. They will see an opportunity to gain by influencing the process of collective choice.

The outcome of the taxing decisions will depend on the manner in which the uncertainty of the government is reduced. By providing selective, subsidized information those interest groups with a strong enough incentive, and also sufficient means to produce influence, will affect the decisions that the government makes. In many cases these decisions will reflect the desires of the most intensely interested minorities rather than the will of the majority. This point is reflected by another hypothesis called the special interest model.

Special Interest Model

The argument put forth by economists such as Gary S. Becker (1983) and Bruce L. Gardner (1987) stresses the capacity of pressure groups to influence political outcomes
as they jockey for political power. Both argued that there is competition among the different interest groups, and that the effectiveness of interest groups depends upon expenditures of time and money on campaign contributions, ability to control free riding, the deadweight losses of policies favored, and access to political influence. This kind of interest group is usually characterized by a relatively small size. When the special interest model is applied in agriculture, the testable implication is that farmers will have the most political power (and hence receive lower taxes) in states where they are a small, homogenous group. There are several reasons to expect this outcome. One is that with a small group organizing and overcoming free rider problems are easier. Another is that any tax preference as a subsidy to farmers will be a relatively smaller cost to the rest of nonfarm population, thus reducing the opposition.

Objective

This thesis examines the property tax treatment of agriculture across states. The majority rule voting model suggests that tax rates on agriculture will tend to be lower in states where farmers are a larger fraction of the total population. The special interest model suggests the opposite. The principal objective of this thesis is to empirically test these hypotheses.
Procedure

Chapter 2 contains a review of the literature. In Chapter 3, a theoretical discussion of why taxes are important in terms of how they affect land use and resource allocation in agriculture is presented. In Chapter 4 the empirical study is reported. The data available to the study and the methods used for hypothesis testing are described and the results are presented. In Chapter 5, the conclusions drawn from the results are discussed, and avenues for further research are suggested.
This thesis examines one aspect of government's role in agriculture. Government intervention in agriculture all over the world can be distinguished by two different forms (Johnson, 1988). One is positive intervention, which occurs in industrial countries. The main feature of positive intervention is that farmers receive prices higher than the prices in world markets; i.e., the government subsidizes agriculture. According to Johnson (1988), there are two reasons for subsidies. The first reason is the shift of comparative advantage from agriculture to industry. A decline in agriculture's advantage would, in a free market, result in substantial adjustment costs as resources are reallocated toward the industrial sector. Positive protection reduces the need for adjustment. Secondly, contraction of agriculture's importance in the economy reduces the cost per nonfarm household of protection, thus reducing opposition.

The other form of intervention is negative intervention which occurs primarily in developing countries. The main feature is that the prices farmers receive are lower than the international market because government taxes exports, imposes domestic price controls, sells imported products at
subsidized prices, and/or maintains an overvalued exchange rate.

Again there are two reasons. First, taxing exports is a source of government revenue, and in developing countries few alternative sources of revenue are available. Secondly, negative protection keeps food relatively cheap in cities, which helps to maintain political stability and the power of incumbents.

Johnson's analysis of the international treatment of agriculture is closely related to the "public choice" approach to politics. The public choice approach to non-market decision-making has been to make the same behavioral assumptions as general economics (rational, utilitarian man), often to depict the preference revelation process as analogous to the market (voters engage in exchange, citizens exit and enter clubs) and to ask the same questions as traditional price theory. This part of the literature resembles positive economics so closely that it is often referred to as positive public choice.

Albert Breton (1974) examined the various activities utility-maximizing citizens can engage in to reduce, or even to eliminate, the coercion (or the expected coercion) that is placed on them by the government's supply of policies with public and non-private goods characteristics. Citizens have preferences for expenditure and tax policies and thus will seek redress from a coercive situation by working for changes
either in expenditure policies or in tax policies or in both. They will do this by engaging in various activities which, given the nature of the problem, will in practice often turn out to be support for or opposition to political parties. According to Albert Breton, these activities include participating in efforts to influence the actions of lobbies and large pressure groups, engaging in actions to influence politicians directly, joining social movements, regulating one's own private economic behavior, organizing the private provision of public and non-private goods, moving from one jurisdiction to another and voting or the act of giving one's support to or withholding it from a candidate of a political party or a policy.

It is noted that the economic approach to political behavior assumes that actual political choices are determined by the efforts of individuals and groups to further their own interests. Most applications of the economic approach emphasize voters, politicians, bureaucrats, and political parties. In the 1980's, however, attention began to be focused on political pressure groups. This approach is emphasized by both Gary S. Becker (1983) and Bruce L. Gardner (1987). In their models they present theories of competition among pressure groups for political influence. Political equilibrium depends on the efficiency of each group in producing pressure, the effect of additional pressure on their influence, the number of persons in different groups,
and the deadweight cost of taxes and subsidies. An increase in deadweight costs discourages pressure by subsidized groups and encourages pressure by taxpayers. This analysis unifies the view that governments correct market failures with the view that they favor the politically powerful: both are produced by competition for political favors.

A major point of Becker's and Gardner's models is that the cost of redistribution is the deadweight loss associated with any transfer that results in gains to producers in economic rents at the expense of taxpayers' income and consumers' surplus. The rationale is that a tax will produce a burden that is larger than necessary to raise a given amount of tax revenue. This additional burden occurs because the tax leads to a misallocation of resources that remain in the private sector and output is reduced. There is a loss which exceeds the gain, which is called the "welfare cost" or "deadweight loss".

We can use the following example to further understanding. Assume an efficient market with equilibrium Q₀, P₀ in the absence of a tax (Figure 1). When a tax is levied, the supply curve shifts upward to S+T, so equilibrium output falls from Q₀ to Q₁ and price rises from P₀ to P₁. Tax revenue is equal to P₁P₂BD. Note that the price to consumers P₁ is now above the marginal cost of production P₂ and producers only receive price P₂. This difference is the source of the misallocation of resources that causes the
Figure 1. Deadweight Loss.
welfare cost. The tax has driven a wedge between the price that guides consumer decisions and the price that guides producer decisions.

The misallocation of resources as a result of the tax leads to a welfare cost equal to the area ABD. The reduction in the output from $Q_0$ to $Q_1$ means that consumers sacrifice output that is worth more than the cost of producing it. The reduction in output means a loss of benefits equal to $Q_0Q_1BA$—the sum of the consumer's marginal value of units from $Q_0$ to $Q_1$. This area is not the welfare cost because it is not a net loss in welfare. The resources that were producing the $Q_0-Q_1$ units can be used to produce more of other goods. Thus, the tax restricts production of the taxed good and diverts resources to other uses, so that we get more of other goods. The value of the other goods produced, however, is less than the loss in value caused by the smaller output of the taxed good. The resources that produced the $Q_0-Q_1$ units have a market cost of $Q_1Q_0AD$, which is a measure of how much these resources are worth in the production of other goods. Thus, consumers sacrifice $Q_1Q_0AB$ in benefits because of restricted production but gain $Q_1Q_0AD$ as a result of stimulated production of other goods. The loss exceeds the gain by the area ABD. Thus, this triangular area is a measure of the net loss or welfare cost caused by the misallocation produced by the tax.
Efficient redistribution minimizes deadweight losses for a given transfer. In other words, the size of deadweight losses directly determines efficiency in producing pressure by different interest groups for political favors. An increase in the deadweight losses of taxation encourages pressure by taxpayers because they are then harmed more by tax payments. Similarly, an increase in the deadweight losses of subsidies discourages pressure by recipients because they then benefit less from subsidies received.

To show this point empirically, Gardner (1987) hypothesized that policies are chosen to minimize deadweight losses, i.e., to max \( B + \theta R \), where \( B \) is consumer's surplus and \( R \) is producer's surplus. The parameter \( \theta \) is determined by political effectiveness, which reflects costs of organizing, homogeneity and other variables.

Gardner considers two different redistribution programs. One is production control (Figure 2), and the other is price supports (Figure 3). Also, they can be represented by the following two equations:

\[
B - \int_0^{Q1} D(Q) dQ - D(Q1) Q1
\]

\[
R - D(Q1) (Q1) - \int_0^{Q1} S(Q) dQ
\]
Figure 2. Production Control.
Figure 3. Price Support.
Here B stands for consumers' surplus, R is producers' rents. Restricting output to $Q_1$, less than competitive output $Q_0$, increases producers' rents, $R$, at expense of buyers' surplus, $B$. $D(Q)$ and $S(Q)$ are prices as given by the inverse demand and supply curves for output $Q$.

The rationale is:

$$\text{max: } W = B + \theta K$$

subject to:

$$B = \int_0^{Q_1} D(Q) dQ - D(Q_1)Q_1$$

$$R = S(Q_1)Q_1 - \int_0^{Q_1} S(Q) dQ$$

Using first and second order condition, the optimum level for a production control program is given by:

$$\frac{Q^*}{Q_0} = \left[ \frac{1}{\eta} (1 - \frac{1}{\theta}) + 1 \right] \frac{1}{(\frac{1}{\varepsilon} - \frac{1}{\eta})}$$

where $Q^*$ is optimal output, $Q_0$ is no program output, $\eta$ is the elasticity of demand, and $\varepsilon$ is elasticity of supply. The optimal level for price support program is given by:

$$\frac{P^*}{P_0} = \left[ \frac{1}{\varepsilon} (\theta - 1) + 1 \right] \frac{ne}{(\varepsilon - \eta)}$$
where $P^*$ is the optimal price and $P_0$ is the no program price.

From the above equations, we can see that efficient redistribution, given the use of the production control program or price support program, depends on $\theta$, $\eta$ and $\epsilon$.

Becker (1987) presents a generalized version of his earlier (1983) model. The "representative" member of a group maximizes his utility by spending resources on political activities to create pressure that affects his subsidies or taxes. These expenditures compete with expenditures by other pressure groups because of the budget constraint that the total amount collected in taxes must equal total government expenditures. To explain his point, Becker sets up several functions.

**Influence Function**

In Becker's paper, he defined the "influence function" as one that relate subsidies and taxes to the pressures exerted by all groups and to other variables.

$$S - T = I(P_s, P_t, \frac{n_s}{n_t}, X)$$

where $I$ is the "influence function", $P_s$ and $P_t$ are pressures by recipients and taxpayers, $n_s/n_t$ is the relative number of recipients, and $X$ refers to the political system and other relevant considerations. This is the way to relate the taxes
levied and subsidies transferred to political pressure by different groups.

Assume only two groups in the society, S and T. Let $Z_s^0$ and $Z_t^0$ measure the income of each member of S and T prior to redistribution. Let $Z_s$ and $Z_t$ measure their incomes after redistribution, so that

$$R_s = Z_s - Z_s^0$$

and

$$R_t = Z_t^0 - Z_t$$

are the redistributions to each S and away from each T. All political activities that raise the income of a group will be considered a subsidy to that group, and all activities that lower incomes will be considered a tax. So the amount raised by all taxes on T can be written as

$$S = n_t F(R_t)$$

where $n_t$ is the number of members of T, and $R_t$ is the taxes paid by each member. The function F is the revenue from a tax of R and incorporates the deadweight costs, so $F(R_t) \leq R$, $F' < 1$, and $F'' < 0$. If taxes do not distort behavior, that is, $F(R_t) = R_t$, $F' = 1$ and $F'' = 0$ are used.

The subsidy to each member of S is determined from

$$n_s G(R_s) = S - n_t F(R_t)$$
where \( n_s \) is the number of members, \( R_s \) is the subsidy to each member, and \( G \) is the cost of providing \( R_s \). The function \( G(.) \) incorporates the deadweight costs, so \( G(R_s) \geq R_s \), \( G' \geq 1 \) and \( G'' \geq 0 \). If subsidies do not distort behavior, \( G(R_s) = R_s \), \( G' = 1 \), and \( G'' = 0 \).

The amount raised in taxes on \( T \) is determined by an influence function that depends on the pressure (\( P \)) exerted by \( S \) and \( T \) and other variables (\( X \)):

\[
n_t F(R_t) = -I^t (P_s, P_t, n_s/n_t, X)
\]

Similarly, the amount available to subsidize \( S \) is determined by an influence function that also depends on political pressure and other variables:

\[
n_s G(R_s) = I^s (P_s, P_t, n_s/n_t, X)
\]

It is apparent that these influence functions cannot be independent because increased influence of \( S \) that raises its subsidy must be financed by increased taxes, and hence must lower the influence of \( T \). That is

\[
n_t F(R_t) = -I^t = n_s G(R_s) = I^s
\]

or

\[
I^s + I^t = 0
\]

implies that increased influence of some groups decreases the influence of others by equal amounts.
Pressure Production Function

The second point Becker emphasized in his paper is that there is competition among the pressure groups. Groups compete for political influence by spending time, energy, and money on the production of political pressure. To model this competition, he assumed that each group has a function relating its production of pressure to various inputs, \( P = P(m, n) \), where \( m = an, a \) are the resources spent per member for campaign expenditures.

The full incomes of each member of S and T net of expenditures on political activities, including expenditures to control free riding are defined by:

\[
Z_s = Z_s^0 + R_s - a_t, \quad \text{and} \quad Z_t = Z_t^0 - R_t - a_t
\]

In conclusion, it means that total expenditures on the production of pressure equal the sum of expenditures on direct political activity and the control of free riding.

Becker points out that there are several other independent variables which determine the efficiency of redistribution. One is the ability to control free riding. From the pressure production function

\[
P = P(m, n)
\]
Pressure Production Function

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The full incomes of each member of S and T net of expenditures on political activities, including expenditures to control free riding are defined by:

$$Z_s = Z_s^0 + R_s - \alpha_s, \text{ and } Z_t = Z_t^0 - R_t - \alpha_t$$

In conclusion, it means that total expenditures on the production of pressure equal the sum of expenditures on direct political activity and the control of free riding.

Becker points out that there are several other independent variables which determine the efficiency of redistribution. One is the ability to control free riding. It can be seen from the pressure production function

$$P = P(m, n)$$
with
\[ \frac{\partial P}{\partial n} = P_n \leq 0 \]
and
\[ \frac{\partial P}{\partial m} = P_m \geq 0 \]

it can be seen that free riding and shirking increase the cost of producing pressure. If the incentive to free ride increases with the number of members, the pressure produced by a given total expenditure \((m)\) would decline as the number of members increased because the cost of "collecting" \(m\) would rise. Greater control over free riding raises the optimal pressure by a group and thus increases its subsidy or reduces its taxes.

Efficiency is also partially determined by the size of a group. Becker argues that at first when group size is very small, the influence may increase more than proportionately when size is increased, because the group can take advantage of economies of scale. The benefit from a larger scale would exceed the cost from free riding. But as group size increases further, the problem of free riding also increases, and marginal products of their expenditures will decline too. Lastly, each group chooses its expenditure on political pressure to maximize the utility of its members, where optimal expenditures are conditional on the political budget equation and pressure production functions.
Summary

This chapter has examined the major theories of public choice in recent years. Instead of a "benevolent government model" or "bureaucratic model," income redistribution is explained by majority rule voting model and special interest models. Although no specific theory explains the property tax treatment of agriculture across states, some major points from majority voting models and special interest models are directly applied to the income redistribution in agriculture. Becker (1983, 1985) and Gardner, which represent special interest models, argue that taxation and subsidies in agriculture are determined by the efficiency of different interest groups which exert pressures on government. Efficiency in producing pressure is determined by the deadweight losses, group size, homogeneity of products and expenditures on political pressure.
CHAPTER 3

TAXATION OF LAND

In Chapter 1, tax rates on agricultural assets were shown to differ across states. In Chapter 2 two models with alternative explanations for the differences were presented. In this chapter, we will show how the differential tax treatment affects land allocation between agricultural use and nonagricultural use, and thus, affects economic efficiency.

The Market for Land

The market for land can be divided into two segments, one is the exchange of land used for agricultural purposes, and the other is the exchange of land used for nonagricultural purposes. Suppose there are \( i = 1, \ldots, N \) plots of land, that \( V_i^a = \) value in agriculture, and that \( V_i^n = \) value in other (nonagricultural) use. If we order the plots by their relative value in agriculture, where the relative value in agriculture is given by

\[
P_i = \frac{V_i^a}{V_i^n},
\]
there will be some $i^* > P_{i*} = 1$. Thus, for plot $i^*$ the value of the land in agriculture is equal to the value in the highest valued nonagricultural use, and $i^* \geq i$, $P_i > 1$. This means value in agriculture is greater than value in non-agricultural use. Also, $i^* \leq i$, $P_i < 1$. This means value in agriculture is less than value in nonagricultural use.

If land is allocated to use according to its relative value, then equal property tax rates do not affect relative value, and hence do not affect the allocation of land. However, unequal property tax rates do affect relative value. For example, if there were a lower tax rate for land in agricultural use, then, the lower tax rate may lead to a change in relative value such that $P_i > 1$, although $P_i < 1$ without the differential tax. Hence, a differing tax rate structure may change the allocation of land.

**Land Values and the Allocation of Land Among Competing Uses**

A landowner seeking to maximize income would employ parcel $i$ of land in the use which maximizes its value. First, consider the case in which there are no taxes. Let $R_i^a =$ annual rents (profits) that can be earned by employing parcel $i$ for agriculture, and $R_i^n =$ annual real rents (profits) that can be earned by employing parcel $i$ in nonagricultural use. This value would be the maximum among
nonagricultural uses, whether that be commercial, industrial or residential.

For simplicity, assume that the annual rents are constant over time. In the absence of taxes, the market values of a parcel of land in its agricultural and nonagricultural uses would be the discounted values of the rents

\[
V_i^a = R_i^a + \frac{R_i^a}{(1+r)} + \frac{R_i^a}{(1+r)^2} + \ldots = \frac{R_i^a}{r}
\]

where \( r \) is the real rate of interest. Similarly,

\[
V_i^n = \frac{R_i^n}{r}.
\]

Thus, a landowner seeking to maximize income would employ parcel \( i \) in the use which maximizes its value. That is, land for which \( R_i^a > R_i^n \) would be used for agriculture while land for which \( R_i^a < R_i^n \) would be employed in some alternative use.

Such an outcome is in most circumstances efficient, since each parcel is devoted to the use in which it is most productive. However, this allocation of land may not be efficient if externalities are present, a subject discussed below.
Market values and land allocation are affected by property and other taxes. For example, if income taxes are levied on rents (profits) from land use, the market value of the land will be the capitalized value of the after tax rents or profits. The analysis here focuses on just one type of tax, the property tax, but the argument can easily be extended to other types of taxes. Like other taxes, a property tax will affect market values and -- if the tax rate differs across uses -- will also affect the allocation of land between uses.

First consider a tax with effective rate $t$ that is the same for all uses of land. The after tax rents per year from parcel $i$ in agricultural use are $R_i^a - tV_i^a$. The capitalized value of these returns is then

$$V_i^a = \frac{R_i^a - tV_i^a}{r} = \frac{R_i^a}{r + t}$$

and the annual after tax return $NR_i^a$ is

$$NR_i^a = R_i^a - tV_i^a = R_i^a - \frac{tR_i^a}{r + t} = rV_i^a$$
Thus, landowners earn the competitive rate of return $r$ on the market value of their land. Similarly, the market value of parcel $i$ in nonagricultural use is,

$$V^n_i = \frac{R^n_i}{r + t}$$

and the annual return is

$$NR^n_i = R^n_i - tV^n_i - rV^n_i$$

Thus, a property tax reduces the annual (after tax) return and the market value of land.

If the tax rates are uniform across the uses of land, the allocation of land will not be affected. Landowners, seeking to maximize their after tax returns to landholding, will still employ their landholding in agriculture if $R^a_i > R^n_i$ and in some other use if the opposite is true.

However, if the tax rates differ across uses of land, some parcels of land will in general be employed in a different use than if there were no taxes or tax rates were uniform. Suppose that the effective tax rate in agriculture, $t^a$ is less than that in nonagriculture, $t^n$, as is typically the case in the U.S. Then, for land used for agriculture

$$V^a_i = \frac{R^a_i}{r + t^a}.$$
while in a nonagricultural use

\[ V_i^n = \frac{R_i^n}{r + t^n}. \]

Now if the tax rate is lower in agriculture \((t^a < t^n)\), some parcels of land may have higher after tax returns and market values in agriculture, even though their pretax returns are higher in other uses. For example, if agriculture is taxed at half the rate applied to other uses \((t^n = 2t^a)\),

\[ V_i^a > V_i^n \]

iff

\[ \frac{R_i^a}{r + t^a} > \frac{R_i^n}{r + 2t^a} \]

iff

\[ \frac{R_i^a}{R_i^n} > \frac{r + t^a}{r + 2t^a} < 1 \]

This implies that some parcels of land have higher after tax returns and market value in agriculture while their pretax returns in agriculture are lower than in nonagricultural use.

An efficiency cost results from the misallocation of land between agricultural use and nonagricultural use due to the property tax. Because of the tax, more land is used in agriculture instead of being used for nonagricultural purposes. Thus, \(R_i^n - R_i^a\) is the amount of efficiency cost of using parcel \(i\) for agricultural use when in fact \(R_i^n > R_i^a\).
In other words, when the pretax return in nonagriculture is greater than that in agriculture, the efficiency cost is the difference between them.

**External Effects**

Sometimes in the processes of production, distribution, or consumption of certain goods, there are harmful or beneficial side effects called externalities that are borne by people who are not directly involved in the market exchanges. These side effects of ordinary economic activities are called external benefits when the effects are beneficial and external costs when they are harmful.

Activities involving external benefits will be underproduced and those involving external costs will be overproduced by a competitive price system.

We know that in urban areas a large amount of land has been used for commercial and residential uses. So open (agricultural) land may have a positive externality in increasing the value of nearby residential land. If this is the case, the social value (SV) of agricultural land would diverge from the private market value. In the case,

\[ SV_i^a = \frac{R_i^a + E_i}{r} \]
and

\[ SV^n_i = \frac{R^n_i}{r} \]

Where, \( SV^a_i \) is social value in agriculture, \( SV^n_i \) is social value in nonagriculture, and \( E_i \) is the value of the positive externality.

Some parcels of land for which \( R^a_i < R^n_i \) (pretax private return in agriculture is lower than that in nonagriculture) will be employed in a nonagricultural use while \( R^a_i + E_i > R^n_i \) (social value is greater in agriculture than in nonagriculture), so for efficiency should be allocated for agricultural use.

In this case, government may encourage land use for agriculture by subsidizing agriculture or reducing tax, and thus a lower tax rate for agriculture may enhance economic efficiency.

State Laws Regarding Assessment of Agricultural Real Estate

In the U.S, there are three types of state laws on taxation of farm real estate.

1. Preferential tax assessment. With preferential assessment, land devoted to a qualifying use is assessed on the basis of its value in current use rather than its market value. Market value is more than value in current use if
land is not allocated to its highest valued use. In addition, the assessed value in current use may understate actual value in current use, which further reduces assessed value below market value. Thus, we have three different concepts of land value:

\[
\text{market value} = \text{value in highest valued use};
\]

value in current use \leq \text{market value}; and

assessed value in current use \leq \text{value in current use}

One reason that assessed values frequently understates values in current use is that profits or rents are capitalized using nominal rather than real interest rates. Thus, if \( i \) is the nominal interest rate and \( \pi \) is the rate of inflation, then \( r = i - \pi \) is the real interest rate. For example, suppose

\[
i = .10 \quad \pi = .05, \text{ and thus } r = .05.
\]

If \( R = \$100 \) per acre per year, then, using the nominal interest rate we get

\[
V = \frac{100}{.1} = \$1000/\text{acre}
\]

If we use the real interest rate we get

\[
V = \frac{100}{.05} = \$2000/\text{acre}
\]

This means that using nominal interest rates will imply smaller land values than using real interest rates, as long as inflation is positive. But the actual value of the land (in current use) is determined by the real interest rate, not the nominal rate.
Assume profits (rents) of \( R_0 \) per year at time \( t = 0 \). If \( \pi > 0 \), then nominal profits will increase at the inflation rate

\[
R_1 = R_0 (1 + \pi)
\]

\[
R_2 = R_1 (1 + \pi) = R_0 (1 + \pi)^2
\]

\[
\vdots
\]

\[
R_n = R_0 (1 + \pi)^n
\]

Thus, the value of the land, which is the present value of the nominal profits discounted at the nominal interest rate, is

\[
V = R_0 + \frac{R_1}{1 + i} + \frac{R_2}{(1 + i)^2} + \ldots
\]

\[
= R_0 + \frac{R_0 (1 + \pi)}{(1 + i)} + \frac{R_0 (1 + \pi)^2}{(1 + i)^2} + \ldots
\]

\[
= R_0 \left[ 1 + \frac{1}{1 + \frac{i}{r}} + \frac{1}{(1 + \frac{i}{r})^2} + \ldots \right]
\]

\[
= \frac{R_0}{r} > \frac{R_0}{i}
\]

Thus, the value of land can be obtained by discounting the future stream of nominal profits at the nominal interest rate, or by capitalizing current profits at the real interest rate.
rate but not by capitalizing current profits at the nominal interest rate.

2. Deferred taxes (rollback tax). A rollback tax is imposed in some states when the land is converted to a nonqualifying use. The deferred tax is based on the amount of taxes that would have been paid if there had been no preferential assessment. There are 27 states that have both preferential assessment laws and deferred taxes.

3. Restrictive agreements. In a restrictive agreement, the landowner enters into an agreement with a state or local governing body to restrict the use of the land in exchange for tax concessions. The penalty for breaking an agreement is essentially a deferred tax and in most states (such as Hawaii) the statute specifically refers to the penalty as a deferred tax.

Interest Group

These considerations suggest that we might classify the population of a state into three groups according to their interests with regard to these laws. The first group is owners of agricultural (or other open) land, the second group is nearby residents, and the third group is all other taxpayers.

The different groups have different interests with regard to taxation of agricultural land. For example, the first group and the second group differ as to whether there
should be penalty provisions for changing from agricultural to nonagricultural (residential or commercial) use. Owners of open (agricultural) land prefer no penalty for transfer, so that they can use their land freely. But nearby residents prefer a penalty for transfer, because they benefit when nearby land is used for agricultural purposes. They may also have a common interest in a lower tax rate for agriculture. All other taxpayers would not be expected to favor reduced tax rates for agricultural land, because by reducing taxes on agriculture the government either has to reduce expenditures on public services such as roads, public schools and so on which will benefit taxpayers, or increase the taxes paid by members of the third group. So neither outcome is beneficial to this group.

If there are in fact positive externalities associated with open space, we expect that in more urbanized areas there will be more tendency to have penalty provisions for changing from agricultural use to nonagricultural use, because open space is more valuable there.

Summary

This chapter examined how taxes on property affect land allocation between agricultural use and nonagricultural use. Because agricultural land receives a tax preference, some parcels of land have higher after tax returns and market values in agriculture, while their pretax returns in
agriculture are lower than in nonagricultural use. In such a situation, landowners, seeking to maximize their after tax returns to landholding, will still employ their landholding in agriculture. An efficiency cost results from this misallocation of land between agricultural use and non-agricultural use due to the property tax.

In more urbanized states, open space (agricultural land) may provide external benefits to nearby residents, and thus a tax preference for open land may enhance economic efficiency.

Citizens can be divided into three groups according to their interests in tax policy. Owners of agricultural land support preferences for agriculture. However, some nearby residents, especially in the more urbanized states, may benefit from provision of open space and thus support a tax preference coupled with penalties for conversion out of agricultural use.
In this chapter an econometric model is specified to test the hypotheses stated earlier, the data sample is described, and the econometric methods employed to obtain parameter estimates are presented. The discussion of the data sample includes identifying the sources of the data and the adjustments performed by the author. In the last part of the chapter, the empirical results are presented.

Econometric Model

As discussed in Chapter 1, there are two major hypotheses concerning how a group's relative size affects its political influence. The majority rule voting model suggests that states which have relatively large fractions of the population in agriculture will likely have lower agricultural tax rates, because farmers have more political power, consequently, lower property tax rates. The special interest model implies that farmers will have the most political power, and hence expect to receive lower taxes, in states where they are a small, homogenous group. The reasoning is that, first, smaller numbers are easier to organize and face less difficulty in overcoming free rider problems. Secondly,
any tax preference for farmers will be a relatively smaller cost to the rest of the nonfarm population, so that less opposition will be expected. Thirdly, the property tax treatment of agriculture may reflect pressures to preserve "open space." Thus in more urbanized states, greater pressure would be expected for preserving agriculture land, possibly through tax preferences or penalties for conversion to nonagricultural use.

The factors which determine effective property tax rates -- the conditions stated in the majority rule voting model and/or the special interest model -- vary among the states. The purpose of this chapter is to estimate the marginal impacts of these variables on the tax rate. Thus the econometric model is of the form $TR_i = f(X_{ij}), i = 1, \ldots, n, j = 1, \ldots, k$, where $TR_i$ is tax rate on agricultural land in the $i$th state; and the $X_{ij}$ are the variables affecting $TR_i$. The basic specifications of the relationship are as follows (detailed descriptions of the variables are presented later in the chapter):

$TXB = C_0 + C_1 \text{RESTX} + C_2 \text{LNUM} + C_3 \text{LNUMO} + C_4 \text{VALUE}$

$+ C_5 \text{HOMO} + \epsilon_1$

and

$TXB = C_0 + C_1 \text{RESTX} + C_2 \text{FARMPROP} + C_3 \text{LNUM} + C_4 \text{LNUMO}$

$+ C_5 \text{VALUE} + C_6 \text{HOMO} + \epsilon_2$
where TXB is the tax rate on agricultural assets
RESTX is the tax rate on residential real estate
LNUM is the logarithm of the number of farmers
LNUMO is the logarithm of the number of nonfarmers
VALUE is average value of assets per farm
HOMO is an index of the homogeneity of the agricultural sector
and FARMPROP is the percentage of the property tax base that is agricultural

The disturbance terms, $\varepsilon_1, \varepsilon_2$ are assumed to be normally distributed, $E(\varepsilon) = 0, \text{Var}(\varepsilon) = \sigma^2$.

We also use the PROBIT method to assess the relationship between the probability of a penalty for conversion to nonagricultural use and the same independent variables. The probability a state will have a penalty is given by,

$$\Pr (\text{Penalty} = 1) = F (C'X),$$

where $C$ is a vector of parameters,

$X$ is the same set(s) of independent variables discussed previously, and $F$ is the standard normal cumulative probability function.

**Variable Definitions**

This section sketches the definitions of the variables used in the empirical analysis. Detailed references to sources are contained in the appendix.
Since our hypotheses concerns the determinants of effective tax rates, we define $TXB = \frac{\text{property taxes}}{\text{the market value of farm real assets}} \times 100$ (property taxes as a percentage of market value) as a dependent variable. Real assets include farm land and buildings (excluding residents), machinery and vehicles, and inventories of crops, livestock and poultry.

The first explanatory variable is $RESTX$, which is defined as the average effective property tax rate (property tax as a percentage of market value) on single family houses. States with higher residential tax rates may either have higher levels of expenditure or rely more on property taxes (as opposed to sales or income taxes). Thus states with higher residential tax rates are expected, ceteris paribus, to have higher tax rates on agriculture. In addition, the deadweight loss associated with a tax preference for agriculture increases with the square of the difference between the agricultural and non-agricultural tax rates, as discussed in Chapter 3. Thus higher residential tax rates would also tend to create pressure for higher agricultural tax rates, because of the increasing deadweight costs of a widening gap between the two rates.

Second explanatory variable is $NUM = \text{Number of Farms} \times 2.65$ which is a measure of farm population. The number of persons per household in 1986 was 2.65. The units of $NUM$ are thousands of people.
The third explanatory variable is $\text{NUMO} = \text{population} - \text{NUM}$. We expect that not only the numbers of farmers in states affect the tax rates, but also the numbers of nonfarmers. $\text{NUMO}$ is also measured in thousands of people.

The fourth explanatory variable is the value of real estate per farm, $\text{VALUE}$, which equals total farm assets less financial assets divided by the number of farms. The larger the value of real farm assets per farm, the more incentive farmers will have to spend time and money to lobby for a tax preference, and thus lower tax rates are expected.

The fifth variable we consider is $\text{KQRATIO}$, which is equal to $\text{VALUE} \times \text{Number of farms} / \text{REC}$. Here we use $\text{KQRATIO}$ to measure the farm assets as percentage of total agricultural product. We expect taxes to be lower when $\text{KQRATIO}$ is larger, because the bigger $\text{KQRATIO}$ means farm assets are a bigger percentage of total agricultural products, and we would predict farmers will have more incentive to seek tax breaks.

We also construct a variable to measure the homogeneity of the farm sector in each state. First, we compute total receipts from receipts by commodity group for 1988:

$$\text{REC} = \text{Meat Animal} + \text{Dairy} + \text{Poultry and Eggs} + \text{Miscellaneous Livestock} + \text{Food Grains} + \text{Feed Crops} + \text{Cotton} + \text{Tobacco} + \text{Oil Crops} + \text{Vegetable} + \text{Fruit and Nuts} + \text{All Other}.$$
Then each of the above 12 variables is divided by total receipts to obtain shares. The shares are then squared and summed.

\[
HOMO = \left( \frac{\text{Meat Animal}}{REC} \right)^2 + \left( \frac{\text{Dairy}}{REC} \right)^2 + \left( \frac{\text{Poultry and Eggs}}{REC} \right)^2 + \left( \frac{\text{Miscellaneous Livestock}}{REC} \right)^2 + \left( \frac{\text{Food Grains}}{REC} \right)^2 + \left( \frac{\text{Feed Crops}}{REC} \right)^2 + \left( \frac{\text{Cotton}}{REC} \right)^2 + \left( \frac{\text{Tobacco}}{REC} \right)^2 + \left( \frac{\text{Oil Crops}}{REC} \right)^2 + \left( \frac{\text{Vegetable}}{REC} \right)^2 + \left( \frac{\text{Fruit and Nuts}}{REC} \right)^2 + \left( \frac{\text{All Other}}{REC} \right)^2.
\]

If homogeneity is very high in one state, say that state only produces meat animal, the value of HOMO in that state will equal one. If, on the other hand, a state has a lot of agricultural products, say 10, HOMO will almost approach 0. The value of HOMO is between 0 and 1. When HOMO is smaller, the degree of homogeneity gets smaller. It is expected that agricultural interests will find it less costly to organize if they are more homogeneous, and thus that farm tax rates will be negatively related to homogeneity.

Another way to measure the degree of homogeneity is to create a variable called ORGANIZ, which measures the share of agricultural receipts coming from certain sectors. \[
\text{ORGANIZ} = \frac{\text{Dairy + Food Grain + Feed Crop + Cotton + Tobacco}}{REC}
\]
We choose these variables because they are the more organized agricultural industries nationwide. The more organized groups are expected to get lower tax rates. When we use
ORGANIZ in our model, we will not use HOMO at the same time, since they actually reflect the same idea we want to express. That is, more organized groups will have less free rider problem, smaller costs to organize, and thus lower taxes will be expected.

The eighth variable is FARMPROP, which is the farm tax base as a percentage of the total property tax base. Here total is a weighted sum with weights equal to average effective property tax rates of farm, residential, commercial and industrial, utility property, or total = .0064 * farm + .0159 * residential + .0126 * commercial / industrial + .0143 * utility. Then FARMPROP = .0064 * farm / total * 100. The rationale here is that if FARMPROP is small, then farming is a small percentage of the property tax base, so any particular tax break for farms will mean a small cost to the rest of the population per dollar of asset value, and thus there will be little incentive to organize opposition.

According to Becker (1983, 1987), group size will partially determine the tax rates. At first when group size increases, the group may take advantage of economies of scale in the production of influence. But as group size continues to increase, the free rider problem will also increase. According to this view, we would expect a relation between TXB and NUM like that displayed in Figure 4.
Figure 4. Expected Relation Between Tax Rate on Farms and Number of Farms.
Variations of the Basic Models

In region I, economies of scale in organizing and producing influence predominate so that tax rates fall at an increasing rate. In region II, the tax rate continues to fall as the numbers of farmers increases, but at a decreasing rate as free rider problems become more important. At a sufficiently large number of farmers, further increases could actually reduce influence and thus result in higher tax rates.

The range of farm numbers across states may not span the entire range implicit in Figure 4. If this is the case, we would not be able to estimate a function that reflects all three of the regions. In particular, if the data are confined to regions II and III, then the relevant part of Figure 4 might be represented by a quadratic function in NUM. If the data are entirely confined to Region II, then the relationship might be adequately captured by writing TXB as a function of the logarithm of the number of farmers, so that the marginal effect of an additional farmer declines as the number of farmers increases. This last functional form, while not very general, has the advantage of requiring the estimation of only one parameter.

Hence we create the following transformations of the numbers of farmers and nonfarmers,

\[ \text{LNUM} = \log(\text{NUM}) \]
An alternative approach is to ignore the numbers of farmers and instead focus on the relationship between tax rates and the importance of agriculture. For example, consider the expected relationship between the tax rate and the percentage of the property tax base that is farm property, FARMPROP. As FARMPROP increases, agriculture would be expected to be relatively more influential. But as FARMPROP increases, two factors would make the success of agricultural interests tend to increase at a diminishing rate or even decrease. First, agriculture will suffer from (relatively) greater free rider problems, and, second, the costs (including deadweight losses) to nonagricultural interests of any given tax preference would tend to increase. Thus, the relationship between TXB and FARMPROP might be quadratic, and we define:

\[ \text{FARMPROP}^2 = \text{FARMPROP} \times \text{FARMPROP} \]

Effective property tax rates, discussed above, are one outcome of the political system. As will be seen below, agricultural property generally receives preferential treatment and the degree of preference varies a great deal across states. Another aspect of this preference is state policy regarding conversion of land from agricultural (or other qualifying) use to a use that is not accorded a
preference. Much the same theory and many of the same variables discussed previously would be expected to affect how conversions of use are treated for tax purpose.

There are 52 state programs for preferential assessment. New Hampshire and Pennsylvania each have two, one based on preferential property tax assessment with deferred taxation and the other on restrictive agreements. There are 27 states that have both preferential assessment laws and deferred taxes. There are 6 states which have preferential assessment with restrictive agreements and deferred taxation. Nineteen states have preferential assessment laws but no rollback (penalty) provisions.

This information is used to examine the determinants of another outcome of tax policy: whether or not there is a penalty for conversion to nonagricultural use. A dummy variable, PENALTY, is equal to one if there is a penalty (Alabama, Alaska, Connecticut, Delaware, Georgia, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, California, Hawaii, Michigan, New Hampshire, Pennsylvania, and Wisconsin) and zero if there is not (Arizona, Arkansas, Colorado, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Mississippi, Missouri, Montana, New Mexico, North Dakota, Oklahoma, South Dakota, West Virginia, and Wyoming).
The hypotheses tested are the effects of the explanatory variables in conditioning the probability that a state has a penalty provision, i.e., that PENALTY equals 1. The model specified is a probit model and parameter estimates are obtained with maximum likelihood procedures.

**Empirical Results**

Since some data were from 1982-1988, and some data from 1986-1988, some data only for 1986, we average them over the available years. More importantly, effective tax rates changed a lot because of fluctuations in land values during the 1980's. The average reduces the effects of these fluctuations on the measured tax rate.

Table 1 is the lists of the means, standard deviations, minima and maxima of the data. Several features are noteworthy. Effective tax rates on agricultural assets vary widely, from less than .1 percent of market value to about 1.5 percent. Residential tax rates also vary widely, and these two variables are positively correlated ($\rho=.82$). The ratio of the residential tax rate to the agricultural tax rate (not shown in the table) ranges from 1.3 to 9.5 with a mean of 3, so agriculture receives a tax preference in every state and it is in most cases substantial. Sixty-one percent of the states assess some sort of penalty when agricultural land is converted to a nonqualifying use. The numbers of farmers and nonfarmers vary widely, partly as a result of
Table 1. Descriptive Statistics.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXB</td>
<td>0.508</td>
<td>0.347</td>
<td>0.750E-01</td>
<td>1.496</td>
</tr>
<tr>
<td>RESTX</td>
<td>1.227</td>
<td>0.554</td>
<td>0.190</td>
<td>2.545</td>
</tr>
<tr>
<td>PENALTY</td>
<td>0.612</td>
<td>0.492</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NUM</td>
<td>1.217E+02</td>
<td>1.032E+02</td>
<td>1.701</td>
<td>5.040E+02</td>
</tr>
<tr>
<td>NUMO</td>
<td>4.682E+03</td>
<td>4.964E+03</td>
<td>4.875E+02</td>
<td>2.562E+04</td>
</tr>
<tr>
<td>FARMPROP</td>
<td>6.982</td>
<td>7.741</td>
<td>0.368</td>
<td>3.576E+01</td>
</tr>
<tr>
<td>VALUE</td>
<td>0.374</td>
<td>0.193</td>
<td>0.108</td>
<td>1.103</td>
</tr>
<tr>
<td>HOMO</td>
<td>0.265</td>
<td>0.108</td>
<td>0.128</td>
<td>0.565</td>
</tr>
</tbody>
</table>

state population and partly because agriculture's relative importance varies. Agricultural property is on average about 7 percent of the property tax base, but this varies from less than one half of one percent (Alaska, Connecticut, Massachusetts, New Jersey, Rhode Island) to more than 25 percent (Montana, North Dakota and South Dakota). The average value of farm assets varies from $108,000 (West Virginia) to $1,100,000 (Arizona), and the index of homogeneity varies from about .1276 (South Dakota) to .565 (Wyoming).

Another feature of the data is that, while there is a great deal of variation from state to state, there is considerable multicollinearity. For example, a regression of
FARMPROP on LNUM, LNUMO, VALUE, HOMO and RESTX yields an $R^2$ of .74. This is not entirely surprising, since the proportion of the tax base which is agriculture would be expected to depend on the numbers of farmers and nonfarmers as well as the value per farm. The concern here is that multicollinearity may lead to imprecise parameter estimates and associated difficulty in rejecting almost any hypothesis.

Table 2 lists the estimated coefficients and t-ratios from estimation of the basic equations. We discuss the tax rate results first. The estimated coefficient of RESTX is about .5 in the two OLS equations and has a high t-ratio. This implies that when the residential tax rate is increased by 1 percent, the tax rate on farmers will increase by about .5 percent. This is in accord with our theoretical expectation that RESTX positively affects TXB.

However, it is somewhat surprising that the coefficient is not closer to one. The estimates imply that, ceteris paribus, the difference between agricultural and residential tax rates is larger in states with higher residential tax rates, and thus the deadweight loss will be larger.

The estimated coefficients of LNUM are -.05 and -.09 in the OLS equations and each is significantly different from zero at about the 10% level. The point estimates thus suggest that a larger number of farmers leads, ceteris paribus, to lower agricultural tax rates. This is
Table 2. Estimates of the Basic Models.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
<th>Equation 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tax Rate</td>
<td>Tax Rate</td>
<td>Penalty</td>
<td>Penalty</td>
</tr>
<tr>
<td>RESTX</td>
<td>0.475</td>
<td>0.452</td>
<td>1.489</td>
<td>2.419</td>
</tr>
<tr>
<td></td>
<td>(8.892)</td>
<td>(7.531)</td>
<td>(1.986)</td>
<td>(2.521)</td>
</tr>
<tr>
<td>LNUM</td>
<td>-0.048</td>
<td>-0.086</td>
<td>-1.458</td>
<td>0.277</td>
</tr>
<tr>
<td></td>
<td>(1.679)</td>
<td>(1.616)</td>
<td>(2.905)</td>
<td>(0.363)</td>
</tr>
<tr>
<td>LNUMO</td>
<td>0.087</td>
<td>0.139</td>
<td>1.124</td>
<td>-0.904</td>
</tr>
<tr>
<td></td>
<td>(2.239)</td>
<td>(1.916)</td>
<td>(2.701)</td>
<td>(1.002)</td>
</tr>
<tr>
<td>FARMPROP</td>
<td>0.006</td>
<td></td>
<td>-0.276</td>
<td>(2.127)</td>
</tr>
<tr>
<td></td>
<td>(0.854)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VALUE</td>
<td>-0.133</td>
<td>-0.219</td>
<td>-3.352</td>
<td>-0.064</td>
</tr>
<tr>
<td></td>
<td>(0.801)</td>
<td>(1.125)</td>
<td>(2.164)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>HOMO</td>
<td>0.678</td>
<td>0.712</td>
<td>-1.976</td>
<td>-3.030</td>
</tr>
<tr>
<td></td>
<td>(2.255)</td>
<td>(2.339)</td>
<td>(0.665)</td>
<td>(0.926)</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>-0.696</td>
<td>-0.945</td>
<td>-2.028</td>
<td>6.394</td>
</tr>
<tr>
<td></td>
<td>(2.319)</td>
<td>(2.256)</td>
<td>(0.771)</td>
<td>(1.416)</td>
</tr>
<tr>
<td>R²/LOG(L)</td>
<td>0.694</td>
<td>0.692</td>
<td>-20.403</td>
<td>-17.52</td>
</tr>
</tbody>
</table>

inconsistent with the notion that smaller interest groups are more successful than larger ones.

The estimated coefficients of LNUMO are positive, and significant at the 5% and 10% levels when FARMPROP is excluded and included, respectively. These estimates also suggest that an interest group has more influence if it is relatively larger rather than smaller.

The estimated coefficients of VALUE indicate that tax rates on agriculture are lower in states where the average
values of assets per farm are higher, but neither estimate is significantly differently from zero at conventional levels. The coefficients of HOMO are statistically significant, but of unexpected sign. They imply that tax rates are higher in states with more concentrated agricultural sectors, while the special interest model suggests the opposite. More homogeneous agriculture should be easier to organize to influence political outcomes.

Comparing columns (1) and (2) of Table 2, it is apparent that adding FARMPROP into the equation typically increases the absolute values of the estimated coefficients of the other variables, but has little effect on statistical significance. The estimated coefficient for FARMPROP itself is positive, which is consistent with the theoretical expectation: If FARMPROP is small, agriculture is a small percent of the property tax base, so any particular tax break in farming will mean only a small cost to the rest of the population. However, the t-ratio is very small which results in failing to reject the hypothesis that its effect is zero. This may be attributable to the collinearity among the explanatory variables or it may simply be that FARMPROP does not affect tax rates.

Consider now the Probit estimates of the probability of a penalty for conversion of land out of a use qualifying for a tax preference (Columns 3 & 4). With FARMPROP excluded, all of the estimated coefficients have the same signs as the tax
rate equations, except that the coefficient of HOMO now has the negative sign predicted by the special interest model. Furthermore, all of the estimates, excepting HOMO, are significantly different from zero at the 5 percent level. Thus, these results strengthen the findings from the tax rate equations, again excepting the coefficient on HOMO.

With FARMPROP included in the penalty equation (Column 4), the results change substantially. The signs of the coefficients on LNUM and LNUMO reverse, and the coefficient of FARMPROP itself is unexpectedly negative and significant at 5 percent level. Thus these estimates imply that a lower probability of a penalty results if farm assets are a larger proportion of the tax base. The t-ratios on most of the other variables decline substantially, so that only the RESTX coefficient remains significantly different from zero.

One interpretation of these results is that LNUM, LNUMO, and VALUE simply proxy for FARMPROP in equation 3, and hence are unimportant when FARMPROP is included in equation 4. Under this interpretation, FARMPROP is the sole important determinant of whether a penalty is assessed for conversion out of agricultural or other open space use. If this is so, it is consistent with the hypothesis that penalties are most likely to exist in states where open space is relatively scarce, i.e., that penalty provisions may result from lobbying by third parties who enjoy external benefits associated with agricultural use.
Alternatively, the results are also consistent with the hypothesis from the majority rule voting model that agricultural interests will be more effective in opposing penalty provisions in states in which they are relatively larger and LNUMO suggest the opposite, at least in terms of numbers of farmers and non-farmers. Indeed, these coefficients could be given a special interest interpretation: Given the relative economic power of agriculture as measured by FARMPROP, agricultural interests will be more effective if they are fewer in number and non-farmers are relatively larger. However, the lack of statistical significance of these coefficients makes such a conjecture highly tentative.

An alternative specification of the regression equations may provide additional evidence on the theoretical model. The estimates reported in Table 3 drop LNUM and LNUMO but include the square of FARMPROP (FARMPROP2) as an additional explanatory variable. As discussed previously, simple voting models suggest that tax rates and the probability of a penalty for conversion should be negatively related to the relative size of a group, while interpretations of the special interest model often emphasize the advantage to being relatively small. Combining these two ideas, one might expect that political success would first increase with relative group size, but then decline as an increasingly larger size made it more and more difficult to shift tax burdens to a smaller and smaller nonfarm population. If this is the case, one would expect the
Table 3. Estimates Including FARMPROP2.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Tax Rate</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTX</td>
<td>0.499</td>
<td>1.486</td>
</tr>
<tr>
<td></td>
<td>(9.145)</td>
<td>(2.166)</td>
</tr>
<tr>
<td>FARMPROP</td>
<td>-0.016</td>
<td>-0.302</td>
</tr>
<tr>
<td></td>
<td>(1.309)</td>
<td>(2.329)</td>
</tr>
<tr>
<td>FARMPROP2</td>
<td>0.003</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.885)</td>
<td>(1.093)</td>
</tr>
<tr>
<td>VALUE</td>
<td>-0.072</td>
<td>-0.747</td>
</tr>
<tr>
<td></td>
<td>(0.442)</td>
<td>(0.630)</td>
</tr>
<tr>
<td>HOMO</td>
<td>0.577</td>
<td>-0.386</td>
</tr>
<tr>
<td></td>
<td>(1.972)</td>
<td>(0.142)</td>
</tr>
<tr>
<td>R²/LOG(L)</td>
<td>0.678</td>
<td>-18.637</td>
</tr>
<tr>
<td>FARMPROP²</td>
<td>22.858</td>
<td>29.796</td>
</tr>
<tr>
<td></td>
<td>(2.118)</td>
<td>(1.819)</td>
</tr>
</tbody>
</table>

coefficients of FARMPROP and FARMPROP2 to be negative and positive respectively.

This model, which combines elements of both voting and special interest models, suggests that there may exist an "optimal" relative group size which minimizes the tax burden on farmers. Such a minimum would occur where the derivative of the tax rate (or probability of penalty) with respect to FARMPROP is equal to zero. If we write the equation for TXB as,

\[
TXB = C_0 + C_1 \text{ RESTX} + C_2 \text{ FARMPROP} + C_3 \text{ FARMPROP}² \\
+ C_4 \text{ VALUE} + C_5 \text{ HOMO} + \epsilon_3
\]
then the "optimal" value of FARMPROP is given by,

\[ \text{FARMPROP}^* = - \frac{C_1}{2C_2}. \]

A similar calculation can be made for the penalty equation.

The results in Table 3 are broadly consistent with these ideas. The coefficients of the linear and squared terms in FARMPROP have the expected signs, although only the linear term in the penalty equation is significantly different from zero. The lack of significance may reflect collinearity between FARMPROP and its square: the correlation between the estimated coefficients exceeds .9 in both equations. The estimated coefficients of the other variables are similar to those in Table 2. The summary statistics (R^2 and the log of the likelihood function) indicate that the explanatory power of these equations is also similar to those in Table 2.

The implied "optimal" values, FARMPROP^*, are reported at the bottom of Table 3 together with a t-statistic for the null hypothesis that FARMPROP^* equals zero. These statistics would lead to rejection of the null hypothesis at the 5 percent and 10 percent levels, respectively. The point estimates of FARMPROP^* are fairly high, given the range of the data. Only three states have values of FARMPROP of 23 percent or greater: South Dakota - 26.7%, Montana - 27.9%, and North Dakota - 35.8%. Thus, the vast majority of states appear to be at levels in which political success increases with increases in the relative size of the agricultural sector. Of course, the
estimates of FARMPROP* are quite imprecise, but in fact there are only nine states in which agriculture is even 10 percent of the property tax base.

Another extension of the basic equations from Table 2 is to include quadratic terms in an attempt to estimate "optimal" absolute group sizes. The results are reported in Table 4. Unfortunately, the collinearity between the numbers and their squares leads to rather imprecise estimates. (The correlation of each pair of estimates exceeds .9.) The summary statistics also indicate that there is little additional explanatory power over the results in Table 2. The point estimates of the coefficients on NUM and NUM2 indicate that increases on the number of farmers cause tax rates and the probability of a penalty to first increase and then eventually decrease, a pattern that is not predicted by either the majority rule voting model or special interest models. The estimated coefficients of NUMO and NUMO2 reverse in sign between the tax rate and penalty equations, as they did in Table 2. Taken together, these results suggest that either marginal effects of groups size do not change sign as group size increases, or the tests are simply not powerful enough to discern these sign changes.

These equations were also estimated using KQRATIO in place of VALUE, and using ORGANIZ in place of HOMO. These substitutions had little effect on the results and are not reported.
Table 4. Estimates Including Number Squared.

<table>
<thead>
<tr>
<th></th>
<th>Tax Rate</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTX</td>
<td>0.483</td>
<td>2.694</td>
</tr>
<tr>
<td></td>
<td>(8.408)</td>
<td>(2.556)</td>
</tr>
<tr>
<td>NUM</td>
<td>0.679E-03</td>
<td>0.709E-02</td>
</tr>
<tr>
<td></td>
<td>(0.737)</td>
<td>(0.451)</td>
</tr>
<tr>
<td>NUM2</td>
<td>-0.287E-05</td>
<td>-0.161E-05</td>
</tr>
<tr>
<td></td>
<td>(1.527)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>NUMO</td>
<td>0.286E-04</td>
<td>-0.827E-03</td>
</tr>
<tr>
<td></td>
<td>(1.249)</td>
<td>(1.320)</td>
</tr>
<tr>
<td>NUMO2</td>
<td>-0.932E-09</td>
<td>0.372E-07</td>
</tr>
<tr>
<td></td>
<td>(1.069)</td>
<td>(0.942)</td>
</tr>
<tr>
<td>FARMPROP</td>
<td>-0.315E-02</td>
<td>-0.350</td>
</tr>
<tr>
<td></td>
<td>(0.615)</td>
<td>(2.616)</td>
</tr>
<tr>
<td>VALUE</td>
<td>-0.319E-02</td>
<td>-0.397</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.239)</td>
</tr>
<tr>
<td>HOMO</td>
<td>0.689</td>
<td>-2.918</td>
</tr>
<tr>
<td></td>
<td>(2.333)</td>
<td>(0.775)</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>-0.346</td>
<td>2.061</td>
</tr>
<tr>
<td></td>
<td>(2.369)</td>
<td>(1.275)</td>
</tr>
<tr>
<td>(R^2/\log(L))</td>
<td>0.689</td>
<td>-15.336</td>
</tr>
<tr>
<td>NUM*</td>
<td>118.25</td>
<td>2202</td>
</tr>
<tr>
<td></td>
<td>(1.209)</td>
<td>(0.055)</td>
</tr>
<tr>
<td>NUMO*</td>
<td>15322</td>
<td>11105</td>
</tr>
<tr>
<td></td>
<td>(2.861)</td>
<td>(2.655)</td>
</tr>
</tbody>
</table>
In this thesis, the theory of public choice was applied to explain the property tax treatment of agricultural land across states. Two models of political outcomes were tested: the "majority voting model" and the "special interest model." The former hypothesizes that political influence will increase with increases in the number of farmers, while the special interest model argues that small size will be more efficient in exerting pressures on government because the smaller group is easier to organize and less susceptible to the free rider problem. The analysis considered the possibility that there are elements of truth in both models, so that political success might first increase and then decrease with increases in numbers, or vice versa.

The analysis also examined several other factors in addition to group size that might be expected to affect political success. One of these is the proportion of the property tax base that is agricultural. Special interest models suggest that the political success of agricultural interests would be negatively related to this variable, because a given tax preference for agriculture becomes more
expensive for the nonagricultural population and thus would be expected to engender more opposition. Strict majority rule voting models -- relying on the one person one vote concept -- make no prediction about the effect of this variable. However, if a larger agricultural proportion reflects larger relative resources available for political persuasion, an extended voting model would, presumably, suggest a positive relationship between the agricultural proportion and political success.

Special interest models also suggest that political success will be greater, ceteris paribus, the greater is the homogeneity of an interest group, and the greater is the "stake" individual members have in the outcome. Empirical measures of homogeneity and importance of property taxes were constructed for use in this thesis.

The empirical portion of this thesis examined these hypotheses in the context of the property tax treatment of agricultural assets across states in the U.S. during the 1980's. Specifically, regression analysis was used to estimate what effects these factors have on tax rates and on whether a tax penalty must be paid when agricultural land is converted to an alternative use. The conclusions differ somewhat between these two outcomes of the political process, but in neither case is much evidence found to support the special interest model.
In the case of tax rates on agricultural assets, the data suggest that tax rates are inversely related to the number of farmers and positively related to the number of nonfarmers. When quadratic terms in group size are included in the regressions, the estimated coefficients are not significantly different from zero. This result may stem in part from collinearity with the linear terms, but no strong evidence was provided in any case on which to reject the linear form in group size.

The proportion of the tax base that is agricultural appears to have little influence on tax rates, given the numbers of farmers and nonfarmers. An alternative specification, which excludes numerical measures of group size but includes both a linear and a quadratic term in the proportion of the tax base that is agricultural, also fails to reject the linear form. The point estimates imply that all but three states are in the range for which tax rates fall as the relative size of the agricultural sector increases.

There is only weak evidence that tax rates are inversely related to agriculturalists' incentives to lobby, as measured by the value of nonfinancial assets per farm. Tax rates are positively related to the homogeneity of the agricultural sector, as measured by the a Herfindahl index of the value of output from 12 sectors.

Whether or not a state imposes a penalty when agricultural land is converted to another use appears to be
determined primarily by proportion of the tax base that is agricultural and the residential tax rate. A penalty is less likely in the more agricultural states and more likely in states with higher residential tax rates. None of the other variables, including measures of group size, were statistically significant.

These results also contradict the special interest model, but the failure of group size to be significant is not particularly consistent with voting models either. It may be that the penalty provisions result from a more complex web of influence involving nonfarmers who may benefit from open space as well as farmers and other taxpayers.

There are several points which need to be considered further.

First, according to Becker (1983,1987) and Gardner (1985), deadweight losses have substantial effects in determining the efficiency of the political competition among groups. However, the empirical portion of this thesis did not attempt to measure deadweight losses, and thus this is an omission that should be considered in future research.

Second, it is not clear how to measure "homogeneity." As we discussed above, the variable HOMO was expected to be negatively related to tax rates, because it is harder to organize the activities of a diverse group than a group with common interest. One problem is whether one should focus on the number of groups or the numbers in a group. Assuming two
states have equal number of farmers, if we measure HOMO by the number of groups, then smaller values will be expected to have greater political influence because of less free rider problems between groups. On the other hand, if we consider the numbers in each group instead of the number of groups, a large number of groups would imply small numbers of farmers in each group. Thus, each group would be expected to be well organized internally and HOMO could be positively related to tax rates.

Third, we have not solved the multicollinearity problem among the variables. Some variables are highly correlated with each other, which lead to imprecise parameter estimates and associated difficulty in rejecting hypotheses.

Despite these problems, this thesis has cast considerable light on the determinants of the property tax treatment of agriculture, and, indirectly, on the determinants of political influence. In general, the results support majority voting type models and fail to confirm - indeed even contradict - the implications of special models.
BIBLIOGRAPHY


DATA SOURCES

1. We have the following data from USDA, Economic Research Service, *Economic Indicators of the Farm Sector*, "State Financial Summary" (1986 and 1988) ECIFS7-2 and ECIFS8-2, WADC for the years 1982-88 and for each state:

   Property Taxes ($ million) -- Table 4, Net Business Income.


   Real Estate value ($ million).

   Total Farm Assets less Financial Assets ($ million).

   Number of Farms -- Table 4, Farm Income Indicators, 1984-1988.

   Cash receipts -- Table 5, by commodity groups and selected commodities, United States and States - we get the following data in 1988 for each state.

   Meat Animal, Dairy, Poultry and Eggs, Miscellaneous Livestock Food Grains, Feed Crops, Cotton, Tobacco, Oil Crops, Vegetables, Fruit and Nuts and All Other.
2. The following data are from United States Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1989 / Volume 69 Number 8:

Net Farm Income ($ million) Table 3 -- Personal Income by Major Sources, 1986-88.

Total Personal Income ($ million) Table 3 -- Personal Income by Major Sources, 1986-88.


Data are available in at least some of the years, 1982-87 for 49 of the states, but data are not available for all states in all years.


5. The following data are from U.S. Department of Commerce, Bureau of The Census; *Statistical Abstract of the United States*, 108th Edition, 1988:


Persons Per Household (1,000) (1986) Table 61 -- Households States, 1980 to 1986.
