INFORMATION TO USERS

While the most advanced technology has been used to photograph and reproduce this manuscript, the quality of the reproduction is heavily dependent upon the quality of the material submitted. For example:

- Manuscript pages may have indistinct print. In such cases, the best available copy has been filmed.

- Manuscripts may not always be complete. In such cases, a note will indicate that it is not possible to obtain missing pages.

- Copyrighted material may have been removed from the manuscript. In such cases, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, and charts) are photographed by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each oversize page is also filmed as one exposure and is available, for an additional charge, as a standard 35mm slide or as a 17”x 23” black and white photographic print.

Most photographs reproduce acceptably on positive microfilm or microfiche but lack the clarity on xerographic copies made from the microfilm. For an additional charge, 35mm slides of 6”x 9” black and white photographic prints are available for any photographs or illustrations that cannot be reproduced satisfactorily by xerography.
Bureaucrat and voter strategies for determining public good expenditure levels by local jurisdictions

Garasky, Steven Brian, Ph.D.
The Ohio State University, 1987

Copyright ©1987 by Garasky, Steven Brian. All rights reserved.
Bureaucrat and Voter Strategies for Determining Public Good Expenditure Levels by Local Jurisdictions

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

Steven Brian Garasky, B.A., M.A.

The Ohio State University
1987

Dissertation Committee:

D.R. Haurin
G.E. Mumy
R.J. Olsen

Approved by

Advisor
Department of Economics
To My Parents
ACKNOWLEDGEMENTS

To my family and friends I say thank you for your patience, understanding, and support throughout the last five years. Especially to Michelle I express my deepest appreciation for cheering me on to the finish line. Thank you Professors Don Haurin and Randy Olsen for guidance and advice on academic and extracurricular matters. Thanks to Professor Gene Mumy for his suggestions and comments. I am also grateful to the Ohio State University for their financial assistance with my research via the Graduate Student Alumni Research Award program.
VITA

March 28, 1958 ........................ Born - Youngstown, Ohio
1980 .................................. Bachelor of Arts
Wittenberg University
Springfield, Ohio
1980-1982 .............................. Applications Programmer
Chemical Abstracts Service
Columbus, Ohio
1982-1984 .............................. Graduate Teaching Associate
Ohio State University
Columbus, Ohio
1984 .................................. Master of Arts
Ohio State University
Columbus, Ohio
1984-Present .......................... Graduate Research Associate
Ohio State University
Columbus, Ohio

FIELDS OF STUDY

Public Finance (State and Local), Public Choice, Urban Economics
TABLE OF CONTENTS

DEDICATION ...................................................... ii
ACKNOWLEDGEMENTS ................................................ iii
VITA ............................................................ iv
LIST OF TABLES .................................................... vii
INTRODUCTION .................................................... 1

ESSAY

<table>
<thead>
<tr>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. THE MEDIAN VOTER VERSUS THE AGENDA SETTER: USING A</td>
<td>6</td>
</tr>
<tr>
<td>WEIBULL DURATION MODEL TO ESTIMATE THE TIMING AND SIZE OF SCHOOL</td>
<td></td>
</tr>
<tr>
<td>OPERATING TAX PROPOSALS</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>6</td>
</tr>
<tr>
<td>B. The Theoretical Model</td>
<td>12</td>
</tr>
<tr>
<td>1. Household Behavior</td>
<td>12</td>
</tr>
<tr>
<td>2. School Superintendent Behavior</td>
<td>16</td>
</tr>
<tr>
<td>3. Determining the Levy Millage and Length</td>
<td>17</td>
</tr>
<tr>
<td>4. Determining When to Propose a Levy</td>
<td>21</td>
</tr>
<tr>
<td>C. The Empirical Model</td>
<td>28</td>
</tr>
<tr>
<td>1. The Duration Model</td>
<td>28</td>
</tr>
<tr>
<td>2. The Endogenously Proposed Millage</td>
<td>30</td>
</tr>
<tr>
<td>3. Risk Preferences</td>
<td>33</td>
</tr>
<tr>
<td>4. Proposal Costs</td>
<td>34</td>
</tr>
<tr>
<td>5. Levy Renewals</td>
<td>35</td>
</tr>
<tr>
<td>6. State Aid Formulae</td>
<td>36</td>
</tr>
<tr>
<td>7. Inflation</td>
<td>37</td>
</tr>
<tr>
<td>8. Estimating the Duration Model</td>
<td>37</td>
</tr>
<tr>
<td>D. The Data</td>
<td>41</td>
</tr>
<tr>
<td>1. The Dependent Variable</td>
<td>41</td>
</tr>
<tr>
<td>2. The Independent Variables</td>
<td>43</td>
</tr>
<tr>
<td>E. Results</td>
<td>44</td>
</tr>
<tr>
<td>1. Ad Hoc Analyses</td>
<td>44</td>
</tr>
<tr>
<td>2. Regression Estimates</td>
<td>46</td>
</tr>
<tr>
<td>F. Conclusions</td>
<td>51</td>
</tr>
</tbody>
</table>
II. **DEANNEXATION: A TEST OF BOUNDARY MOBILITY IN A VOTING BEHAVIOR MODEL** ........................................... 66

A. Introduction ........................................ 66

B. The Theoretical Model .............................. 69
   1. Fiscal Subsidies and Deannexation ............... 69
   2. Individual Voting Behavior ....................... 71
   3. The Deannexing Voter’s Model .................... 73
   4. The Remaining Voter’s Model .................... 74

C. The Empirical Model ................................ 78
   1. The Logit Model ................................ 78
   2. The Voter Characteristics Vector ............... 79

D. The Data ............................................ 83
   1. The Election .................................... 83
   2. The Units of Observation ........................ 84
   3. The Dependent Variable .......................... 84
   4. The Independent Variables ...................... 84

E. Results ............................................ 87

F. Conclusions ........................................ 92

**CONCLUSIONS** ......................................................104

**REFERENCES** ........................................................106
<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. Sources of public elementary and secondary school revenues</td>
<td>55</td>
</tr>
<tr>
<td>1.2. Levy duration versus the average annual inflation rate over the proposal spell</td>
<td>56</td>
</tr>
<tr>
<td>1.3. Empirical estimates of the homogeneous superintendent behavior model while assuming group risk neutrality</td>
<td>57</td>
</tr>
<tr>
<td>1.4. Empirical estimates of the homogeneous superintendent behavior model while assuming homogeneous risk preferences</td>
<td>58</td>
</tr>
<tr>
<td>1.5. Empirical estimates of the heterogeneous superintendent behavior model using fixed effects while assuming group risk neutrality</td>
<td>59</td>
</tr>
<tr>
<td>1.6. Empirical estimates of the heterogeneous superintendent behavior model using fixed effects while assuming homogeneous group risk behavior</td>
<td>60</td>
</tr>
<tr>
<td>1.7. Estimating the effects of school district demographics on an index of school district superintendent behavior</td>
<td>61</td>
</tr>
<tr>
<td>2.1. Election results for the Olentangy Highlands deannexation referendum</td>
<td>96</td>
</tr>
<tr>
<td>2.2. Characteristic means of all the Columbus SMSA census tracts and only those used in the study</td>
<td>97</td>
</tr>
<tr>
<td>2.3. Empirical estimates of the voting logit using the median home value of the potentially annexing area and an indicator variable for each potentially annexing area as regressors</td>
<td>98</td>
</tr>
<tr>
<td>2.4. Median home values for all potentially annexing areas and Columbus</td>
<td>99</td>
</tr>
<tr>
<td>2.5. Chow tests of the non-white census tracts using both logit models</td>
<td>100</td>
</tr>
</tbody>
</table>
INTRODUCTION

Paul Samuelson (1954) originally claimed that no "market type" solution exists to determine public good expenditure levels. "There is still this fundamental technical difference going to the heart of the whole problem of social economy: by departing from his indoctrinated rules, any one person can hope to snatch some selfish benefit in a way not possible under the self-policing competitive pricing of private goods." For the last thirty years researchers have been trying to determine the allocation of public goods given their unique consumption features.

Public goods expenditure decisions are often made in the political arena. Even though budgets are proposed for voter approval, voters have heterogeneous preferences and differing abilities to pay for the goods and services. Additionally, bureaucrats may not give voters the choice of setting public spending at their preferred level. This dissertation is comprised of two essays that individually examine aspects of public goods provision.

Among the theories of public good expenditure level ascertainment are those that consider the political aspect of the problem. The first essay models the behavior of local school district bureaucrats using two of the more predominant spending determination theories. The essay is entitled "The Median Voter Versus the Agenda
 Setter: Using a Weibull Duration Model to Estimate the Timing and Size of School Operating Tax Proposals."

The median voter expenditure model claims the incumbent must provide services at a level preferred by the median voter. If she strays from this amount, a coalition can be formed to remove her from office by offering a spending level closer to the median preference. Empiricists supported by the median model have estimated the effect of various median voter characteristics across school districts on local educational spending. Inman (1978) was even bold enough to suggest the median model removes the political aspect of determining single service budgets. "In effect we can bury politics (in the median voter assumptions) and use the individual utility maximizing model applied to the median income family to analyze governmental fiscal performance!"

Not everyone is as convinced by the median theory as Inman. Romer and Rosenthal (1978, 1979a, 1979b, and 1982) challenged the median voter model claiming the theoretical assumptions were unrealistic and the empirical evidence inconclusive. The median theory requires an open agenda and single peaked voter preferences. Romer and Rosenthal found the empirical results could not guarantee that some multiple of the median spending preference was not actually being observed, while the same results could be obtained by fractiles of the population other than the median. They felt another model was needed.

The Romer and Rosenthal agenda setter model is based on the bureaucrat’s power to set the voting agenda. While the median model requires an open agenda to determine spending levels, the setter model recognizes that generally voters are given two predetermined choices.
A budget proposal can be approved or it can be defeated with the proposal's reversion rate then going into effect. With the power to limit voter choices, agenda setting bureaucrats could obtain spending levels higher than the median voter preference.

This first essay attempts to determine which model represents the real world more accurately. The bureaucrat, while determining the size of a tax increase request, also decides when to make the proposal. Using data from all 620 Ohio school districts, and taking advantage of the state's tax structure (Ohio holds annual nominal tax revenues constant), hypotheses based on the two models are tested empirically. A duration model tests for a relationship between the time since the last tax proposal and the requested millage. The agenda setter would ask for a larger increase as the real alternative (the status quo in Ohio) decreases, while the median model predicts no such correlation.

Another aspect of public goods allocation is encompassed in an individual's jurisdictional choice. Rather than living where the local public goods expenditure level is unsatisfactory, households can always relocate. Charles Tiebout (1956) responded to Samuelson's contention of no market type solution for public goods expenditures by hypothesizing that under certain, strict assumptions individuals state their preferences via their location. Households "vote with their feet," and select that jurisdiction that offers a level of taxes and services they most prefer.

The second essay is entitled "Deannexation: A Test of Boundary Mobility in a Voting Behavior Model." In it, tax capitalization and other effects of a less than Tiebout-like world are discussed as
central city voters consider allowing a subdivision to deannex. In contrast to the first study, voters in this essay are comparing exogenously determined public service-tax payment packages across jurisdictions.

More specifically, a neighborhood desires to change jurisdictions to enjoy among other things a higher service to tax dollar ratio. The taxpayers seeking deannexation have been subsidizing central city public services through their relatively large property tax payments. If jurisdictional boundaries are thought to be fixed, these negative fiscal surpluses have been capitalized into their property values (Epple and Zelenitz, 1981). If fiscal surpluses are capitalized, the deannexing property owners will also gain a windfall profit through increased property values. Even without capitalization, those individuals who deannex will benefit from receiving the more preferred service-tax ratio in their new municipality. The remainder of the central city, however, stands to lose a part of the tax base that generates more revenue than it consumes in services. The central city will suffer the consequences (possible reduced services or increased taxes) that would go along with the deannexation.

If the extreme majority of those involved in the decision (everyone in the central city votes on the issue) are made worse off by allowing the boundary change, why did the measure only fail by ten percent? This essay employs a two-period voting model that allows individuals to consider the value of setting a deannexation precedent. Property owners and renters in the model decide whether their neighborhood is a likely candidate for deannexation in the next period.
They then consider possible changes in their property values, rental payments, public services, and taxes from either their own redistricting or allowing others to leave the jurisdiction.

The essays that follow model two aspects of public service expenditure determination. While Samuelson may be correct in stating no market type solution exists to determine spending levels in the public sector, market forces are at work establishing these levels.
ESSAY I

THE MEDIAN VOTER VERSUS THE AGENDA SETTER: USING A WEIBULL DURATION MODEL TO ESTIMATE THE TIMING AND SIZE OF SCHOOL OPERATING TAX PROPOSALS

A. Introduction

Education is a publicly provided good in the United States. Often a financial resource for schools is a local property tax of voter approved millage. As recently as the 1969-70 school year local tax revenues comprised over half the total income for elementary and secondary schools. (See Table 1.1.) Although local revenues are declining in importance, they still account for 43 cents of every revenue dollar nationally, and have risen to 52 cents for every dollar in Ohio.

Economists have estimated the effect of various voter and community characteristics on local educational spending levels. From these studies two major models, the median voter and the agenda setter, have come forward. This essay develops hypotheses of local school district bureaucratic behavior to possibly determine which model is more appropriate.

The median voter public expenditure model developed from the spatial location theory of Hotelling (1929). Hotelling concluded the competitive equilibrium location of two merchants of identical goods on a uniformly populated street was for each to set up business at the
midpoint. Each vendor would then serve one half of the total, transport cost minimizing public.

Downs (1957), Black (1958), and later authors put the Hotelling model in a political framework. Politicians maximize votes. With single-peaked voter preferences, two candidates in a one-issue contest will each migrate to the preference of the median voter. Similarly, in determining expenditures for public goods in a community, the incumbent will always provide that level preferred by the median voter. With any other level a coalition promising spending closer to the median preference can gain enough support to oust the current power. The strong assumptions of single peaked preferences and an open agenda allow the median voter model to determine spending levels for non-market goods.

With the support of this theoretical model empiricists have estimated the effect of various community characteristics on educational spending. Inman (1978) was even bold enough to suggest the median model removes the political aspect of determining single service budgets. "In effect we can bury politics (in the median voter assumptions) and use the individual utility maximizing model applied to the median income family to analyze governmental fiscal performance!"

Generally, researchers regress proxies for median voter attributes on educational spending levels over a cross section of school districts. Borcherding and Deacon (1972) do not even attempt to identify the median voter, and use average income and tax share variables instead. Bergstrom and Goodman (1973) assume the median voter has median income and that the median voter's tax price is proportional to
the ratio of the tax bill for the home with median value to total revenues for the municipality. Lovell (1978) assumes the number of children attending public schools from the pivotal (median income) household is equal to the mean number of public school children per household in the community. The median voter is assumed, generally, to have all the median attributes of the local school district. Findings are usually that education is a normal good, that is expenditures increase with income. Spending levels are also usually negatively related to the median tax price, the amount it would cost the median home value homeowner to increase spending by one dollar per student.

A second expenditure determination theory developed from a series of articles by Romer and Rosenthal (1978, 1979a, 1979b, and 1982). They challenge the median model on two fronts (1979a). First, they find the empirical studies suffer from the "multiple fallacy." Researchers cannot be certain observed spending is at the median voter level, or some multiple of it. Simply because expenditures rise as the median voter's tax price falls, or as his/her income increases, this does not mean expenditures everywhere are not, say, 50 percent less or 100 percent greater than those desired by the median voter.

Romer and Rosenthal term the second model failure the "fractile fallacy." Demand for educational expenditures can be found to increase with income for all groups. "As long as we have lognormal distributions satisfying the proportionality requirement (Bergstrom and Goodman 1973), any fractile of the income distribution would have the same explanatory power as the median." (Romer and Rosenthal 1979a) Likewise, for most all groups the preferred expenditure level decreases
with an increase in the tax price. Since the median voter model results could be replicated with fractiles of the population other than the median, Romer and Rosenthal felt a new model was needed. "Although we are a long way from modeling the full complexity of political institutions, even a simple threat model would endow politics with a more complex role than that attributed by the median voter hypothesis." (Romer and Rosenthal 1979a)

Romer and Rosenthal's alternative model proposes revenue maximizing bureaucrats exploit their monopoly power over setting the agenda. In many states only local school officials may make a tax proposal. In Ohio, for example, only a two-thirds majority of the school board can initiate a tax increase levy (Banks-Baldwin 1986). Romer and Rosenthal hypothesize the lower the reversion rate, the tax rate if the levy fails, the more likely voters will approve a given increase. Likewise, the lower the reversion, the larger the increase voters will approve.

How much larger an increase will be approved? Mackay and Weaver (1981) claim voters will approve an expenditure level over that preferred by the median voter of up to nearly the same amount the reversion falls short of the median voter's preference. Enelow and Hinich (1984), on the other hand, find that "reasonable conditions exist under which a near-median proposal is optimal for an agenda setter" if he/she "is risk averse and maximizes expected utility."

Using Oregon school district data from 1970 to 1977, Romer and Rosenthal (1982) found a correlation between the reversion rate and current spending levels. Their one period model found a threshold
effect (the reversion is schools close) to be significant in increasing voter approved spending levels. They, however, could not support empirically their theoretical correlation between a decreasing reversion and increasing expenditures.

Alexander and Bass (1974) examined 1,600 California property tax elections in hope of formulating "a better understanding of the reality behind the notion of taxpayer revolt." Using data from 1953 to 1957 and 1966 to 1972, they found the most significant factors in determining the success or failure of a tax levy to be the proposed tax, the existing tax, and the tax change. Each were smaller in the passing districts. They also found the effect of the proposed tax rate on electoral success to be twice as great in the second period than it was in the first. Rather than concluding the school bureaucrats had finally reached or exceeded the median expenditure preference with their later proposals, the authors claimed a shift in behavioral patterns, a "tax revolt", had occurred between the two sample periods.

Alexander and Bass also attempted to find the determinants of calling a tax election. Examining the mean characteristics of districts holding and not holding elections between 1969 and 1972, they found that "it is the lower property wealth districts and those with a higher proportion of owner occupied housing units and a higher proportion of residential to total property who hold elections." Areas with actual tax rates less than Alexander and Bass' estimate of their expected tax rate were also found more likely to hold elections.

The authors made one final test of levy size and outcome using an approach that Romer and Rosenthal (1979b) would later say is a test...
of the agenda setter model. Alexander and Bass compared the most recent election in a school district with those coming before it.

The major differences between these two subsamples are that the most recent elections request smaller tax rate increases from the electorate than did the earlier elections, and they are much more likely to be successful. In looking through the data, we were struck by the fact that, after a failure, repeat elections within the district tend to sweeten the package by reducing both the proposed tax and the period over which it will be effective. In district after district, this process continues until a proposal is passed. However, the community itself is being acted upon by the electoral process; in many instances the same proposal that failed once may pass the second or third time around.

Romer and Rosenthal (1979b) claim the reduced follow up levies are consistent with agenda setting. When the setter does not bear the cost of holding the election,

The setter's optimal sequence of proposals involves choosing a relatively high value of $x$ (the proposed increase) on the first try. Given failure on the first election, a reduction is made, and if the second election fails, the proposal is cut further, down to the last possible election. On the last permissible attempt, the setter offers $x'$, the proposed increase over the reversion point that would be offered if there were only one election.

Perhaps the authors should assume proposals are costless, since those who are financing the levies may not find this sequential process optimal.

Median voter and agenda setter tax proposal strategies will be developed using the theoretical and empirical models that follow. While several tests inspired by Alexander and Bass, and Romer and Rosenthal will be performed, one is most significant. This test takes advantage of a change in the taxing structure instituted in Ohio by the Property Tax Relief Law of 1976 (Ohio House bill HB920). The state now
requires annual nominal tax revenues in a taxing district to be held constant if no increases are approved. No longer can inflation generate additional district income. The new tax rules "put a lid on property tax increases and made frequent property tax referenda necessary." (Edlefson 1983)

Factors effecting the length of time between tax proposals will be examined. Levy length, millage, and frequency will be modeled considering inflation, proposal costs, risk preferences, tax levy renewals, and the various state aid formulae employed during the length of the study. A test of correlation between proposal timing and millage will be used to evaluate the two public expenditure models.

B. The Theoretical Model

1. Household Behavior

Assume each household (i) has a strictly quasi-concave utility function \( u \) that it attempts to maximize subject to a budget constraint.

\[
\begin{align*}
    u_i &= u_i(C_{i}, G_{i}, n_{i}) \\
    I_{i} &= C_{i} + T \cdot w_{i}
\end{align*}
\]

Utility is a function of the household's consumption of a bundle of private goods \( C_{i} \), a publicly provided good \( G_{i} \) (i.e. education), and the number of school age children in the household \( n_{i} \) as they effect household preferences. Income \( I_{i} \) is spent on the consumption of private goods and on educational expenditures made through tax payments. These payments can take two forms. Traditionally, a tax rate
(T) is assumed to be applied uniformly over a tax base. The household’s holding of the locally taxable asset (\(w_1\)) is usually real estate. Alternatively, school districts may propose income taxes to raise operating revenues. Income taxes are theoretically similar to property taxes since they must also be approved by the voters. Since income taxes, however, are rarely proposed and add more complexity than insight to the model, they will not be considered here.\(^4\)

Total expenditures per pupil for education (TE) in a school district come from federal, state, and local sources. Federal aid (\(\overline{AF}\)) is generally in the form of annual financial assistance grants to each district and is assumed independent of state and local contributions.\(^5\) State aid (AS) in Ohio is a function of locally financed expenditures per student (E). While three different aid formulae were used in Ohio over the length of this study, each had a positive correlation between local expenditure levels and state assistance.\(^6\)

Define a function \((h)\) to be the current state aid per pupil formula.

\[
TE(E) = \frac{\overline{AF}}{D} + h(E) + E \tag{1.3}
\]

where

\[
AS = h(E), \tag{1.4}
\]

and

\[
D = \sum_{i=1}^{N} n_i \tag{1.5}
\]

is the number of students in the district. Total expenditures per pupil are the sum of the contributions from each source and are a non-decreasing function of local expenditures per pupil (E).
Define a monotonic transformation of \((G_1)\), call it \((f_1)\), as

\[ G_1 = f_1(TE) . \quad (1.6) \]

Households perceive a direct relationship \((f_1)\) between expenditures for education \((TE)\) and the quantity and/or quality of educational services received \((G_1)\). By this transformation,

\[ U_1(C_1, TE, n_1) = u_1(C_1, f_1(TE), n_1) = u_1(C_1, G_1, n_1) \quad (1.7) \]

is also strictly quasi-concave.

Next assume a balanced budget requirement for each school district with \((N)\) households and \((D)\) students.

\[ \sum_{i=1}^{N} w_i + (AS(E) * D) + \overline{AF} = D * (E + AS(E)) + \overline{AF} \quad (1.8) \]

Substituting (1.8) into (1.2) yields

\[ I_i = C_i + \frac{w_i}{E w_i} (D * E) . \quad (1.9) \]

The quantity \(\tau_i\),

\[ \tau_i = \frac{w_i}{E w_i} * D / (1+\Delta AS) , \quad (1.10) \]

is the household's tax price. An additional dollar for education per student costs the household \((\tau_i)\) dollars where

\[ \Delta AS = h(E+\Delta E) - h(E) . \quad (1.11) \]

\(\Delta AS\) is the change in state aid resulting from an increase in local expenditures. The omission of a relative price term in the budget constraint assumes the supply price of educational services, relative to private consumption goods, is constant across communities. While Gensemer (1981) does not find this assumption to be true, it is necessary to the model and should not detract from the quality of the results. Also assume the state aid formulae are constant across school districts.
Combining (1.7) and (1.9), and the fact that total expenditures (TE) are a non-decreasing function of local expenditures (E), results in a utility function (V) that is a function of (E) assuming (I), (τ), (h), and (n) are exogenous.

\[ V_i(E|I_i,\tau_i,h,n_i) = U_i(I_i-(\tau_i*E),E,n_i|h) \]  

(1.12)

Each household will attempt to maximize (1.12) subject to the given parameters. With the concavity assumptions made above, \( V_1(E) \) is single peaked at the household's most preferred total educational expenditure per pupil level (\( \overline{TE}_i \)), and its most preferred level of locally financed expenditures per student (\( \overline{E}_i \)) given its income, its tax price, outside aid available to the school district, and the number of school children in its household. \( V_1(E) \) is increasing for \( E < \overline{E}_i \), and decreasing for \( E > \overline{E}_i \).

\[
\begin{align*}
\frac{\partial V_i}{\partial E} &> 0 & \text{for } E < \overline{E}_i \\
\frac{\partial V_i}{\partial E} &= 0 & \text{for } E = \overline{E}_i \\
\frac{\partial^2 V_i}{\partial E^2} &< 0 & \text{for } E > \overline{E}_i \\
\frac{\partial^2 V_i}{\partial E^2} &< 0 & \text{for } E > 0
\end{align*}
\]

(1.13) (1.14) (1.15) (1.16)

Define the community's most preferred spending level as that preferred by the median voter (\( \overline{E}_M \)).

\[ \overline{E} = \overline{E}_M \]  

(1.17)
2. School Superintendent Behavior

Even though a school board directs the activities of a school district, assume for simplicity it behaves exactly as the school superintendent wishes. Further assume the superintendent acts as a bureaucrat, maximizing utility gained from her personal income (I) and job related perquisites (PR) (Migue and Belanger, 1974, and Niskanen, 1975).

\[ u = u(I, PR) \] (1.18)

Assume the superintendent's income is a separable function of total educational expenditures per student (TE), and thus local expenditures (E), and other variables that she considers given, such as the state aid formula (h), and the number of students in the district (D).

\[ I = I(E|h(E), D) \] (1.19)

With each expenditure level (TE) voters expect a minimum level of services per student (\( \bar{G} \)). (\( \bar{G} \)) is derived from equation (1.6), and may simply be based on past experiences with the local school district. Perquisites are a function of residual funds once (\( \bar{G} \)) is provided. Assume each level of services is provided efficiently at a minimum per student average cost (C), and any cost inefficiencies are simply one type of perquisite.

\[ PR = PR(TE - \bar{G}) \] (1.20)

where

\[ \bar{G} = \bar{G}(TE|C). \] (1.21)

Incorporate (1.19) and (1.20) into the superintendent's utility function and simplify.
\[ u = u(E, \bar{G}|h, \bar{AF}, D, C) = u(I, PR) \]  

(1.22)

Utility is a function of locally financed expenditures for education and the educational services provided. If one assumes an increase in tax revenues does not require an even larger increase in service expenditures, the school superintendent will maximize her utility by maximizing local revenues. She is constrained, however, by the costs of proposing tax increases, the number of increases that legally can be attempted in a given time period, and the need to be re-elected. Proposal costs will be discussed in more detail later along with the number of possible levies. The re-election constraint will not be developed any further in this essay. The superintendent will maximize (1.22) given

\[ \frac{\partial \bar{G}}{\partial E} < 1, \]  

(1.23)

and the above constraints.

3. Determining the Levy Millage and Length

Note that tax levies are often proposed to be in effect over a number of years. Approving a tax levy for local educational expenditures may mean a long term increase in the property tax that generates this revenue. Each levy then has a millage (M), length (L), and reversion rate (Q), the effective tax rate should the levy fail. In Ohio the reversion is the status quo.

The median voter (MV) model claims voters will approve a millage that changes the current level of locally financed expenditures for education \((E)\) to the median voter's most preferred level \((\bar{E})\).
\[ M_{HV} = M_{HV}(E, \bar{E}) \]  

(1.24)

In some instances this millage may be a reduction.

The agenda setter (AS) literature maintains a millage increase approval is also a function of the reversion rate. While each voter has an optimal level of local spending \((E_i)\), it may not be one of his choices. With only two alternatives, the agenda setter may coerce voters into approving spending levels higher than \((\bar{E})\).

\[ M_{AS} = M_{AS}(E, \bar{E}, Q) \]  

(1.25)

For each model

\[ \frac{\partial M}{\partial E} < 0 \]  

(1.26)

and

\[ \frac{\partial M}{\partial \bar{E}} > 0 . \]  

(1.27)

Voters in either model will approve higher tax rates (or desire smaller reductions) the lower the current local educational expenditure level, or the more they wish to spend on education. In the median voter model

\[ \frac{\partial M_{HV}}{\partial Q} = 0 , \]  

(1.28)

while

\[ \frac{\partial M_{AS}}{\partial Q} < 0 \]  

(1.29)

in the agenda setter framework. The major difference in the two theories is the agenda model claims voters will approve higher rates the lower the reversion. The household's single-peaked utility curve \((V_1(E))\) may cause a spending level higher than its optimum to generate more utility than the alternative choice \((0)\). Accordingly, larger levels may be approved as the alternative is reduced. The median voter model claims levy preferences are independent of \((0)\).
Neither model, however, considers the determination of levy duration. The median voter bureaucrat must maintain the spending level optimal to the median voter to remain in office. For her, a longer lived levy is consistent with minimizing levy renewal costs. Assuming constant community preferences, the expected levy duration for the median voter bureaucrat is forever.

The agenda setter may also consider any proposal to last forever if voter preferences do not change. In Ohio during an inflationary period the agenda model superintendent would propose a finite levy that requires periodic renewals. The real expenditure reversion (the real spending level if the levy expires) at each renewal will have been reduced by recent price increases. As a result of this lower reversion, the setter can get the renewal and possibly an additional increase approved by the voters. With or without an increase, the superintendent can expect the current increase, if passed, to be in effect permanently.

The model suggests the agenda setter may prefer levies that need to be renewed. Renewals become opportunities for increasing expenditures. At renewal time the agenda setter can request a combined renewal and increase if the reversion is to let the levy expire and inflation has eroded real revenues. The median voter bureaucrat if faced with a renewal and the need for an increase would propose each separately to allow voters to set spending levels as close to the median preference as possible.

These hypotheses suggest an empirical test. While both the median voter bureaucrat and the agenda setter expect each levy to be of
infinite duration, the median voter superintendent will ask for infinite length levies to reduce renewal costs. The agenda setter, on the other hand, will vary the levy length with the current inflation rate to maximize revenues. The agenda model predicts a negative correlation between levy length and the inflation rate. This hypothesis will be tested with the Ohio data.

The next task is to model how the superintendent determines the specific millage to request for the proposal. Assume the reversion rate \( Q \) and the tax base \( E_w \) are exogenous and independent of any potential proposals. It is assumed that the superintendent does not, for example, actively seek to annex areas into the school district to increase the tax base. Additionally, she does not work to increase the value of those properties already in the district. It is beyond the scope of this paper to discuss the effect of improved educational services on local property values. Only the millage, length, and timing of a proposal are under the superintendent's control. Based on earlier discussions, also assume the expected length of a levy is forever.

The superintendent can probabilistically determine the approval rate of any levy. At any time voters can be surveyed on how they would respond to an \( M \)-mill, \( L \)-year levy with reversion rate \( Q \). The superintendent's lack of certain voter knowledge may stem from either not polling all voters, or problems in voter preference revelation. From the survey a distribution of election outcomes \( r \) for each combination of millage, length, and reversion rate can be computed.

\[
f_{M,L,Q}(r) = \{(r, f(r)|M,L,Q) : 0 \leq r, f(r) = Pr(r) \leq 1\}
\]

\[
= 0 \quad \text{otherwise}
\] (1.30)
The function \( f_{M,L,Q}(r) \) defines a relationship between the domain of potential election results \((r)\), and the range of result probabilities. It is the probability density function of \((r)\) given \((M), (L), \) and \((Q)\). Define \( \text{MED}[f_{M,L,Q}] \) as the median of \( f_{M,L,Q}(r) \).

\[
\text{MED}[f_{M,L,Q}] = \{ r: F_{M,L,Q}(r) = 0.5 \} \tag{1.31}
\]

where \( F_{M,L,Q} \) is the cumulative distribution function of the density function \((f)\) (Hogg and Craig, 1978). At the median there is a fifty percent chance the election approval rate will be less than \((r)\), and a fifty percent chance it will be greater than \((r)\). Let \( \text{MED}[f_{M,L,Q}] \) represent a predicted approval rate of an \( M \)-mill, \( L \)-year levy with reversion rate \((Q)\).

For now assume the superintendent will only propose a levy if she thinks it will pass. Risk preferences will be discussed later. Given each levy is expected to continue indefinitely, a risk neutral superintendent will request the largest millage \((\bar{M})\) with better than a 50 percent probability of passage.

\[
\bar{M} = \max[M | \text{MED}[f_{M,L,Q}] > 0.5] \tag{1.32}
\]

4. Determining When to Propose a Levy

As households maximize utility each period subject to a budget constraint, the school superintendent maximizes locally provided revenues subject to voter approved tax levies, legal restrictions, and proposal costs. Real tax rates for education change over time. In Ohio, nominal tax receipts are held constant allowing inflation to reduce real tax revenues. Also, tax levies expire. Each of these effect \((E)\), and thus \((\bar{M})\) over time.
Define a function $\bar{H}(t)$ to be the largest millage at time $t$ with over a 50 percent probability of passage given a reversion rate $(Q)$.

$$\bar{H}(t) = (\bar{H}|Q)(t)$$  \hspace{1cm} (1.33)

Time is defined up to the present.

$\bar{H}(t)$ determines the millage and timing of the proposed levy. To simplify the discussion allow the superintendent to consider only the next proposal. It must be realized that revenue maximizing strategies will vary as model assumptions vary. For the agenda setter a larger levy now may reduce future and overall revenues. Likewise, the agenda setter may not need to wait to benefit from a larger levy if she can simply request part of the increase now and ask for the rest in the future. She may not have to tolerate lower current tax revenues as the model suggests to set up a larger increase later. While restricting the model limits the robustness of the results, it does make it more tractable and consistent with the Romer and Rosenthal one-period approach. Additionally, the length of the proposal will not be considered here since all proposals have an infinite expected life.

The agenda setter model predicts $\bar{H}(t)$ is positively correlated with the length of time between proposals. As inflation erodes real tax revenues and reduces the reversion rate, agenda setting superintendents will ask for larger tax increases. The median voter model claims the bureaucrat’s tax requests will be based on the community’s desired spending, and independent of any timing schemes or $(Q)$.

More specifically the median voter bureaucrat must provide the expenditure level preferred by the median voter to remain in office. Given constant preferences during an inflationary period in Ohio, the
median bureaucrat will not be required to call for a tax reducing proposal, but will be controlled by the voters as to the timing and size of the next tax increase request. The superintendent is simply waiting for real expenditures to fall far enough below the median preference before requesting an increase to bring spending back to the preferred amount. There is a "threshold" that must be crossed before a levy is needed. Assume voter preferences are homogeneous across school districts and varying tax bases and enrollments account for the varying levy millages needed to generate this fixed per pupil spending level.

The revenue maximizing school superintendent will never propose to lower the tax rate if she is only considering the next levy. Only if

$$\bar{W}(t) - R > 0$$ \hspace{1cm} (1.34)

will a proposal be made, where $R > 0$ is a margin for error used by a risk averse superintendent to help insure levy passage. If $(R)$ is positive the superintendent will ask for fewer funds at time $(t)$ or will wait longer to ask for $\bar{W}(t)$. $(R)$ equals zero for a risk neutral superintendent, and is less than zero if she is a risk preferrer.

Along with testing the correlation of millage and time between proposals, the model suggests examining how the agenda setter and median voter bureaucrat each handles levy renewals. In Ohio, a levy may only be renewed at the general election prior to the final year of its term or during the final year. It may, however, be renewed anytime during the last twelve months, and any fraction up to one hundred percent of a levy may be renewed.
The agenda setter may find renewing a levy an opportunity to increase expenditures. The unconstrained agenda setter would let the levy expire to reduce the reversion rate, then propose the renewal possibly combined with an increase. This strategy, however, may not be politically feasible. To successfully pass the combined renewal and increase, the setter's effective reversion must be the expiration of the levy.

A strategy comparable to that of the unconstrained setter is to delay the renewal proposal long enough to make it impossible to repropose the renewal before the levy expires. School districts in Ohio are required to file a proposal with the county auditor at least 75 days before it is to be decided. For all practical purposes then, the reversion changes to the expiration spending level two and one half months before the levy actually expires. The agenda model predicts the superintendent will wait until there are less than 75 days before an expiration to propose a combined renewal and increase. If only part or all of the levy is to be renewed (no increase is sought), the agenda setter will delay this proposal as long as possible, too. In a one chance model, waiting gives the setter more time to evaluate voter preferences and to possibly gain an increase that is currently unlikely. In a multi-proposal setting delaying a renewal may or may not be optimal.

The median voter model also predicts the superintendent to delay the renewal proposal as long as possible. In Ohio the renewal immediately supersedes the expiring levy. The median bureaucrat gains nothing by an early renewal, and can avoid the next renewal that much longer by waiting. Regardless of the timing, the median bureaucrat
will propose to renew only that fraction of the levy that would be preferred by the median voter.

One test of these hypotheses will be to compare the number of times a renewal and an increase were combined under one proposal, and how many times they were offered separately. A median voter bureaucrat would never combine a renewal with an increase on the same ballot. Since the marginal cost of a second proposal is nearly zero, she would give the voters a choice. The agenda setter would always combine the renewal and increase. She would never allow a third alternative, to only renew the expiring levy, between the status quo (levy expiration) and the combination tax rate.

Ideally, another test would be to examine how close to the expiration did school districts propose renewals. Unfortunately, levy expiration dates are not available. A related test, however, will be performed. The agenda model predicts a positive correlation between a combined renewal and increase and the length of time until the proposal is made. The median model predicts no such relationship since the median bureaucrat would never make such a proposal. For only a renewal, each model predicts the superintendent will delay the proposal as long as possible. A test for correlation between the time since the last proposal and indicator variables representing the combination renewal and increase, and the renewal alone will be included in the duration model to be developed next.

Levy timing is also effected by proposal costs (PC). The superintendent, for example, may try to combine bond issues and operating levies to reduce total costs. A further model implication is proposal costs may limit the number of levies attempted.
Other factors to be included in the duration model are inflation and the various state aid formulae. Higher inflation reduces real expenditures at a faster rate. For the median bureaucrat a proposal to restore real spending to the median preference will be needed sooner as inflation increases. For the agenda setter higher inflation reduces the reversion more quickly to allow a given milled levy to be proposed sooner. Inflation is predicted positively related to proposal frequency for both models.

The first two state aid programs will be evaluated relative to the third program used during the sample period. The first program was adopted in 1975 and titled The Guaranteed Yield Formula. The two part aid calculation was designed to promote equal opportunities for education through a foundation program and to encourage the local tax effort through a matching funds program. First, a minimum level of revenue per pupil was to be guaranteed to each school district that met the required tax effort of a twenty mill local property tax for education. The state would then grant the district the difference between the revenue the twenty mills generated locally and an annually pegged amount per pupil.

The second part of the program used a power equalization formula to encourage local school districts to raise taxes for education. For districts taxing over twenty mills and up to thirty mills, aid was to be increased at a rate such that the same millage raised the same number of dollars per pupil regardless of the property tax base or enrollment.
The Property Tax Relief Act of 1976 complicated the state aid computation considerably. Increases in assessed value after reappraisals made districts wealthier in the eyes of the power equalization formula. Decreases in effective millages resulting from the reassessments, however, did not allow increases in property tax revenues and reduced state aid in the twenty to thirty mill range. The tax relief act resulted in the need for more frequent tax levy proposals.

In 1981-82 the power equalization part of the formula was abolished. The minimum tax effort to receive aid was still twenty mills, but no longer did additional local taxation generate additional state aid. The state simply made up the difference between a pegged level of revenues per pupil and the amount twenty mills locally would generate. Lastly, in 1982-83 a "cost of doing business" factor was added to the aid formula to assist "high cost" school districts.

Relative to the "cost factor" formula, the original aid program encouraged both the median voter bureaucrat and the agenda setter to request larger levies within the boundaries of the power equalization provision. With the power equalization incentive and the tax relief act, the first formula also encouraged more frequent proposals as inflation decreased local millages.

The second and third formulae are nearly identical. The cost factor instituted in the third aid program is independent of the local tax effort. There should be no significant difference between the two aid equations regarding proposed millages or the frequency of the proposals.
The school superintendent's choices are when to propose a levy, and how large a levy to propose. The next section develops an empirical duration model that accounts for an endogenously proposed millage.

C. The Empirical Model

1. The Duration Model

Duration models estimate the time needed for an event to occur. These models have been used to estimate search unemployment (Lippman and McCall, 1976, and Flinn and Heckman, 1982), job turnover (Jovanovic, 1979), labor supply (Heckman and Willis, 1979), child mortality (Olsen and Wolpin, 1983), and spells of unemployment (Heckman and Singer, 1984). Exogenous effects on the length of time to proposing a tax levy, and the endogenous effect of a variable millage will be examined here.

To develop the duration model, define a nonnegative random variable \( T \) as the failure time of a proposal. \( T \) is the time until the superintendent initiates a levy. The probability density function (pdf) of \( t \), given a vector of observable covariates \( X \), is

\[
f(t|X) = \lim_{\Delta t \to 0^+} \frac{\Pr(t \leq T \leq t + \Delta t)}{\Delta t} \quad \text{for } 0 \leq t < \infty\]

\[
= 0 \quad \text{otherwise .} \quad (1.35)
\]

The hazard function of \( T \) specifies the instantaneous rate of failure at \( t \), conditional upon survival to time \( t \). It is the probability of the event occurring exactly at \( t \) given it has not yet occurred, and is defined as

\[
\lambda(t|X) = \lim_{\Delta t \to 0^+} \frac{\Pr(t \leq T \leq t + \Delta t \mid T > t)}{\Delta t} . \quad (1.36)
\]
As $\lambda(t|X)$ decreases, the probability of survival and $(T)$ increase.

To estimate the effects of $X$ on duration assume the failure times follow a Weibull distribution. The Weibull distribution allows for a time dependent hazard function. The Weibull assumptions also simplify the density and hazard function formulae (Kalbfleisch and Prentice, 1980). With a Weibull distribution, generalized equations (1.35) and (1.36) become

$$f(t|X) = \lambda p(\lambda t)^{p-1} \exp(-\lambda t)^p \geq 0 \quad (1.37)$$

and

$$\lambda(t|X) = \lambda p(\lambda t)^{p-1} > 0 \quad (1.38)$$

The conditional density and hazard of $(T)$ are functions of the hazard rate ($\lambda$), and are dependent on time through $(p)$. If $(p)$ equals one, if the hazard rate is a constant independent of time, the Weibull distribution simplifies to an exponential specification.

Assume the vector of covariates $X$ are linearly related by a parameter vector $\beta$, and have a multiplicative effect on duration through an exponential specification. Since the hazard function must be restricted to positive values, the exponential form does not require restricting the parameter values of interest, $\beta$. The generalized Weibull density and hazard functions now take the forms

$$f(t|X) = \lambda p(\lambda t)^{p-1} \exp(-\lambda t)^p e^{X\beta} \geq 0 \quad (1.39)$$

and

$$\lambda(t|X) = \lambda p(\lambda t)^{p-1} e^{X\beta} > 0 \quad (1.40)$$

By incorporating (1.39) and (1.40), and allowing

$$Y = \log(T)$$

an expression for duration can be defined as

$$Y = X\beta + u \quad (1.42)$$
Equation (1.42) is a log-linear expression with the error term (u) incorporating the scaling factor \( \sigma, \sigma = 1/p \).

To estimate (1.42) one has to determine the elements of the \( X \) vector and their relationship with (Y). To restate (1.34), a necessary condition for a levy proposal is

\[ \bar{W}(t) - R > 0. \]  

(1.43)

One would think a further restriction would be for the levy to recover all proposal costs. In Ohio, the money to pay proposal expenses cannot come from the school district budget (Garner 1987), but must be supplied by outside sources.\(^{10}\) While the superintendent may combine proposals to reduce costs, she cannot let these expenses be met from the funds the levy may generate. The next sections will discuss each independent regressor in turn.

2. The Endogenously Proposed Millage

Levy millage and timing are endogenously determined. The school superintendent while deciding when to propose a property tax increase, must also decide how large an increase to request. A two stage technique is used here to incorporate this simultaneity. An equation to predict the levy millage will be estimated. The predicted values of \( \bar{W} (\bar{W}) \) will then be used as a regressor in the duration model.\(^{11}\)

It should be noted that the millage being considered is the difference in millage from the previous levy after a defeat, and only the actual millage after a success. This adjustment results from defining the duration spells as the time since the previous levy.
Without adjusting the millage after a defeat, the prior success or failure would be treated identically, as a success. Using the change in the proposed millage captures the effects of exogenous factors over the length of the spell independent of the previous outcome when assuming superintendents are risk neutral.

It was proposed theoretically that each household has its own preferred level of locally provided expenditures per student \( (\overline{E}_1) \). Furthermore, a most preferred level for the community \( (\overline{E}) \) was defined as that preferred by the median voter. The school superintendent only has a probabilistic knowledge of how a levy will do given the current reversion rate. While it is not known if the superintendent acts as an agenda setter or a median voter bureaucrat, it is irrelevant since each model claims the size of the levy is a function of \( (E) \) and \( (\overline{E}) \).

The millage the community will pass at time \( (t) \) \( (\overline{M}(t)) \) is a function of \( (E) \) and \( (\overline{E}) \) given \( (Q) \). The current level of locally financed expenditures per student \( (E) \) changes with enrollment. The number of students in the district may also effect the desired level of expenditures \( (\overline{E}) \). What happens to the median voter and/or his desired per pupil spending level as more families with school age children enter the district or more children attend school from each household is ambiguous. \( (\overline{E}) \), however, may drop with higher enrollments due to economies of scale in providing educational services.

Preferred and actual spending also change as current and forecasts of future economic conditions change. Inflation erodes real expenditures. If education is a normal good, as real income increases
desired spending on education should increase as well. The Index of Leading Economic Indicators (ILEI) predicts future economic conditions. Since taxes are levied to be paid in the future, the ILEI should in turn affect desired spending levels as individuals foresee changes in permanent income.

Total expenditures are also a function of the current state aid program. With the various aid formulae, a given amount of local spending will generate differing total expenditure levels. Changing community demographics may also effect desired spending. The intervals considered here are so short, however, that all demographic variables will be considered constant over time.

Since a millage is actually being predicted it is necessary to predict the amount these changing variables will change \((E)\) and \((\bar{E})\). More specifically, cumulative inflation, and the changes in the ILEI and real income should all be interacted with a baseline value. Allow the millage at the start of the interval \((M(t_0))\) to be this benchmark.

The current level of spending \((E)\) is a function of the number of students in the school district \((SISD)\) and cumulative inflation \((INFLAT)\) over the spell. The desired level \((\bar{E})\) is a function of \((SISD)\) as well, along with the change in real income \((INCOME)\), and the change in permanent income \((ILEI)\) as reflected in the index of economic indicators. As local expenditures generate state aid, total expenditures and \((E)\) are also effected by the current state educational aid formula \((h)\).

\[
M = M(SISD, INFLAT, ILEI, INCOME, h) \tag{1.44}
\]
Assume a linear relationship among the explanatory variables. One can estimate (1.44) by

\[ \bar{H} = \alpha_0 + \alpha_1(\Delta SISD) + \alpha_2(M(t_0),\Delta\text{INFLAT}) + \alpha_3(M(t_0),\Delta\text{ILEI}) + \alpha_4(M(t_0),\Delta\text{INCOME}) + \alpha_5(AS_1) + \alpha_6(AS_2) + \varepsilon \]  

(1.45)

where the \( \alpha \)'s are regression coefficients, \( (AS_1) \) and \( (AS_2) \) are indicator variables for the first two state programs in the study period, and \( (\varepsilon) \) is a randomly distributed normal error term. The third state aid program is not included to avoid multicolinearity.

The sign of \( (\alpha_1) \) is ambiguous. Economies of scale predict more students should cause the school district to need fewer dollars per student to provide a given level of services. More students, however, ambiguously effects the community’s desire to spend money on education.

\( (\alpha_2) \) is assumed positive to reflect the need to replenish real expenditures when inflation is increasing. \( (\alpha_3) \) and \( (\alpha_4) \) should be positive from a direct income effect. \( (\alpha_5) \) and \( (\alpha_6) \) estimate the effect of each state program relative to the program instituted in 1982-83. \( (\alpha_5) \) is predicted positive to reflect the incentives of the power equalization formula. \( (\alpha_6) \) is predicted equal to zero since the difference in the programs, a cost of doing business factor, is independent of the local tax effort.

3. Risk Preferences

Risk preferences may effect duration in two ways. First, a risk averse school superintendent may ask for a smaller levy than someone who is more risk neutral at any given time. Enelow and Hinich (1984) claim a risk averse agenda setter may act much like a median
voter bureaucrat. On the other hand, the superintendent may wait longer to propose a given levy. In keeping with the duration model, this study looks at risk in this second context.

A test of risk preferences considers the losing margin \( (LM_{t-1}) \) of the previous levy. As the losing margin goes from zero to one hundred percent, those preferring risk will ask for the same levy sooner, those averse to risk will wait longer, and those who are neutral will not be effected.

\[
R = R(LM_{t-1}) = \{LM_t : LM_t = \%N_t - \%Y_t \text{ for } \%N_t \geq \%Y_t \} \tag{1.46}
\]

where \( \%N_t \) and \( \%Y_t \) are the percentages of votes against and for a given levy, respectively. In estimating this effect on duration, the sample must be restricted to only levies following a defeat. Those proposals following a success will not capture the same effect. The \( (LM_{t-1}) \) coefficient will be negative for a risk preferring superintendent. A positive coefficient estimate indicates a longer wait the worse the prior defeat, and signals risk aversion. An insignificant coefficient indicates risk neutrality.

4. Proposal Costs

While one would think cost minimization means proposing levies only during general elections (i.e. not holding special elections), this notion is misleading. Quite often there are enough other issues on the ballot to make a special election nearly as cost efficient as a general election. A more accurate test of cost minimization, therefore, is whether or not the superintendent groups several issues onto the same ballot. Does she combine operating levies with bond issues to
reduce fixed costs? If she does then the number of other school issues on the ballot with the operating levy should affect duration. The effect, however, is indeterminate. It cannot be said whether the superintendent will postpone or advance the operating levy to combine it with other proposals.

\[ PC = PC(\text{NUMOTHER}) \] (1.47)

Operating levy proposal costs (PC) are a function of the number of other issues (NUMOTHER) being proposed by the school district on the same ballot. As more proposals are put up for a vote on a given ballot, the average cost of each decreases.

5. Levy Renewals

Finite length levies need to be renewed for school districts to continue to receive the tax revenue they generate. In Ohio, the levy may be renewed either during the general election prior to the final year of the levy's term or anytime during the final twelve months. Any fraction up to one hundred percent of a levy may be renewed (Banks-Baldwin 1986).

Renewing an expiring levy is an opportunity for the superintendent to effectively change the reversion rate (Q). An agenda setter ideally would prefer to let the levy expire, reduce (Q), then request a larger levy in the future. As discussed earlier, the reversion effectively changes to the post-expiration spending level 75 days prior to the actual expiration. Inside the 75 day limit the renewal cannot be considered again before the levy's completion. By waiting as long as possible to propose a renewal, and then combining it with an increase,
the superintendent gives voters the choice of approving the renewal and increase, or allowing the levy to expire.

The median voter bureaucrat would simply ask for that percentage of the renewal desired by the community. She would not combine a renewal with an increase as one levy. With the marginal cost of putting an additional issue on the ballot being near zero (the majority of the costs come from promoting the issues and advertising an election is being held), the median superintendent would always give the voters a choice of renewal and/or increase. The agenda setter would always combine the two when trying to get an increase approved. All superintendents are predicted to wait as long as possible if only a partial or complete renewal is being proposed.

Define two indicator variables (RENEWAL) and (COMBO) to represent the three possible types of proposals. (RENEWAL) indicates the proposal is only a renewal. (COMBO) equals one if a renewal and increase are combined. Once again, the third indicator, an indicator for only an increase, must be omitted to avoid colinearity problems.

6. State Aid Formulae

As with predicting proposed millages, the various state aid formulae will have differing impact on the timing of proposals. Each program had its own requirements as detailed above. The mean value of indicator variables ($AS_1$) and ($AS_2$) are used to estimate the effect of the first two programs relative to the third on the time between proposals.
The first program is predicted to reduce the time between proposals relative to the third as a result of the interaction of the power equalization formula and the Property Tax Relief Act. The second program is predicted to result in the same behavior as the third.

7. Inflation

Inflation reduces the real expenditure level for education in Ohio. For the median voter bureaucrat a higher inflation rate over the length of the spell should reduce the time between proposals. Real spending is straying from the median preference that much faster and requires correction that much sooner.

Inflation should have a similar effect on the agenda setter. Higher inflation reduces the reversion rate more quickly. Any proposal requiring a given status quo can be made sooner with a higher inflation rate. Define the term (INFLAT) as the average annual inflation rate over the length of the spell.

8. Estimating the Duration Model

Four duration models will be estimated to capture all the effects discussed in the previous sections. Two sample populations will be used in models without and with fixed effects. The first sample is drawn from all potential proposals as defined below in the data section. The second sample is a subset of the first and includes only those intervals beginning with a defeat. To study the risk preferences of superintendents a term based on the margin of the last
defeat will be considered. Using proposals following a success will not capture this follow-up effect.

The general model without fixed effects considers all school superintendents to be risk neutral. Incorporating the Weibull and exponential assumptions made earlier, the model becomes

\[ Y = Y(\bar{X}, PC, RENEW, h, INFLAT) \]

\[ = \beta_0 + \beta_1(\bar{X}) + \beta_2(NUMOTHER) + \beta_3(RENEW) + \beta_4(COMBO) \]
\[ + \beta_5(AS_1) + \beta_6(AS_2) + \beta_7(INFLAT) + u \]  

(1.48)

From the theoretical discussion, a positive estimate of \( \beta_1 \) indicates superintendents act as Romer and Rosenthal agenda setters. They wait longer to ask for more. The median voter model suggests \( \beta_1 = 0 \), and no correlation exists between timing and proposal size. The third alternative, \( \beta_1 \) is negative, indicates a superintendent proposes a levy sooner the more funds she requests. This strategy contradicts both the median voter and agenda setter models in the one-election framework.

The second regressor, the proxy for proposal costs, has no theoretically predicted sign. An insignificant estimate may indicate the timing of other issues is changed to group them with the operating proposal, rather than vice versa.

The renewal indicator variable \( \beta_3 \) is predicted positively related to duration for both the agenda setter and the median bureaucrat. Only the agenda model predicts a sign for \( \beta_4 \). A combined renewal and increase is predicted positively related to duration. The median model makes no prediction since the median voter bureaucrat would never make such a proposal.
The last three regressors should behave the same for both the median bureaucrat and the agenda setter. \( \beta_5 \) is predicted negatively related to duration as a result of the power equalization formula. \( \beta_6 \) is predicted equal to zero. The cost function incorporated in the third formula should have no effect on the tax effort of the school district. Increased inflation is modeled to have a negative effect on the time between proposals and \( \beta_7 \) is predicted less than zero as a result.

Sampling only spells beginning with a defeat allows a test of risk preferences for the homogeneous group of superintendents. Risk preferences are revealed through the effect the margin of the previous defeat has on the time to the next proposal. Those spells that begin with a success do not capture this follow-up reaction. Add one more term to the general model to estimate the effect of the size of the losing margin in the previous election.

\[
Y = \beta_0 + \beta_1(M) + \beta_2(NUMOTHER) + \beta_3(RENEVAL) + \beta_4(COMBO) \\
+ \beta_5(AS_1) + \beta_6(AS_2) + \beta_7(INFLAT) + \beta_8(LM_{t-1}) + u \tag{1.49}
\]

All coefficients are predicted to behave as in the earlier model. \( \beta_8 \) will be positive if the superintendents as a group are risk averse. They will take more time between proposals the worse the previous defeat. A negative estimated parameter signals risk preference, and \( \beta_8 \) equals zero if the group is risk neutral.

The two fixed effects models attempt to capture varying superintendent behavior across school districts. If behavior is not homogeneous across districts, then assuming it is may yield misleading results. Before continuing note that estimating a fixed effects model
requires a minimum of two observations per school district and thus reduces each sample population by those districts with only one proposal spell. Also, assume in each district the same superintendent was in office throughout the study.

Each district is represented by an indicator variable \((SD_j)\) with the constant assumed equal to zero to avoid multicollinearity. Each \((\beta_{9,j})\) coefficient is interpreted as being the cumulative effect of all school district and superintendent characteristics not included in the vector of explanatory variables. While all demographic variables are held constant over the length of the proposal spells, possible differences in community make-up across districts may influence the timing of tax levies. In both fixed effects models the original coefficients maintain their interpretations. A positive estimate of either \((\beta_{9,j})\) or \((\beta_{10,k})\) indicates a local effect that delays proposing a tax levy. Similarly, a negative coefficient signals a reduction in time between levies.

In the first fixed effects model all superintendents are assumed to be risk neutral. The full sample is used for school districts with at least two spells.

\[
Y = \beta_1(\bar{H}) + \beta_2(NUMOTHER) + \beta_3(RENEWAL) + \beta_4(COMBO) + \beta_5(AS_1) + \beta_6(AS_2) + \beta_7(INFLAT) + \beta_8(LM_{t-1}) + \sum_{j=1}^{374} \beta_{9,j}(SD_j) + u \quad (1.50)
\]

The second fixed effects model is econometrically similar to the first, but incorporates different assumptions. All superintendents are assumed homogeneous in their risk preferences. Only those proposals beginning with a defeat for school districts with at least
two observations will be included. The other coefficients are predicted to behave as in the risk model without fixed effects.

\[
Y = \beta_1(N) + \beta_2(NUMOTHER) + \beta_3(RENEWAL) + \beta_4(COMBO) + \beta_5(AS_1)
+ \beta_6(AS_2) + \beta_7(INFLAT) + \beta_8(LM_{t-1}) + \sum_{k=1}^{240} \beta_{10,k}(SD_k) + u \quad (1.51)
\]

D. The Data

1. The Dependent Variable

The dependent variable in a duration model is the time until the occurrence of an event. Here the event is a tax levy, and the dependent variable is the time until an operating tax levy is proposed.

More specifically, the levy must be for either (1) current operating expenses, (2) emergency operating expenses, (3) avoiding an operating deficit, or (4) preventing school closings. Levies for other purposes including construction and improvements, maintenance and repairs, libraries, and recreation will not be considered. They will only be included when counting the number of other levies being offered at the time of the operating proposal.

The sample size is also limited by censoring. Weibull regression estimation techniques do not allow the inclusion of either left or right censored spells. Each observation, therefore, begins and ends with a proposal. Any spell that is left censored by the starting date of the study (January 1, 1977) is deleted from the sample. Additionally, any spell that is right censored by the end of the study (December 31, 1984) or by a school district boundary change (Education
1987a) must be removed. Boundary changes violate the assumption of constant demographics over the length of each spell.

The exclusion of censored spells may lead one to question the universality of the sample. Are only districts in financial distress being considered? Has the sample selection biased the results? Over three-fourths (476 out of 620) of the Ohio school districts in operation during the study had at least two tax proposals that allowed them to be included in the sample. The Property Tax Relief Law has made it necessary for most all districts to seek local property tax increases at some time. While it is theoretically true that the exclusion of censored spells may bias the coefficient estimates downward, it is felt the sample is large enough and diverse enough to have minimized this problem.

One further restriction also limits the sample. In Ohio, school districts are required to file a proposal with the county auditor at least 75 days before it is to be decided. Occasionally multiple levies are proposed for different dates with the plan being to cancel the follow-up proposals if the first is successful. If the first levy fails, another election can be held in less than 75 days. This plan, fortunately, is rarely used. Assuming school boards take as much time as possible to decide upon a proposal, the duration interval is ended 75 days before the election. The few elections that did occur less than 75 days apart were removed from the study. The levy specifics (date, millage, length, type, renewal and/or increase, and result) were gathered at the Ohio Secretary of State's Office, Department of Elections (Elections).
2. The Independent Variables

**Levy Millage** - Levy millage is assumed to be outside millage, that is it must be approved by the voters. It is also assumed for simplicity that it applies uniformly over the entire tax base (Elections).\(^{13}\)

**Starting Millage** - The millage at the beginning of the spell \((M(t_0))\) used to benchmark the effects of changes in prices, real income, and the index of leading indicators is the millage for education in the year of the last proposal (OPEC).

**Inflation** - The monthly Consumer Price Index (CPI) for all urban consumers is used in both predicting the proposed millage and estimating duration (Labor (a)).

**Income** - The percentage change in real income over the entire proposal spell is computed using the annual average, federally adjusted, gross incomes per tax return for each school district. Constant dollar averages are then computed by deflating the averages by the monthly CPI from the beginning and end of the spell (Taxation, Labor (a)).

**Index of Leading Economic Indicators** - The monthly values of the ILEI are used. This regressor is computed as the percentage change from the last proposal (Labor (b)).

**Student Enrollment** - School district enrollment includes kindergarten through twelfth grades. It does not include ungraded, special education, or joint vocational school students. The percentage change in enrollment over the length of the spell is the statistic used. Using the actual change in enrollment would not capture the
significantly different effect of adding, for example, 100 students to a school district with only 100 students, and adding 100 students to the Cleveland City School District which at one time had over 100,000 students (Education 1987b, OPEC).

State Aid Formulae - The first aid formula was in effect from the start of the study to August 31, 1981. The second formula lasted one year until August 31, 1982. The third was in effect throughout the rest of the study.

Number of Other Issues - All other issues being proposed by a school district concurrent with the operating levy are totalled to compute this regressor (Elections).

Renewals and Combination Levies - A renewal proposed alone regardless of the fraction of the previous levy being renewed is considered a renewal. If it proposed with an increase it is a combined levy (Elections).

Losing Margin - The losing margin is the difference between the percentage of no and yes votes for the previously defeated levy (Elections).

E. Results

1. Ad Hoc Analyses

Table 1.2 contains a breakdown of levy lengths by the average annual inflation rates over the proposal spell. Levies in Ohio can be proposed in yearly increments of up to five years or for an infinite duration. The median voter model predicted school superintendents to
only propose non-expiring levies. Agenda setting bureaucrats are modeled to vary the length of their levies with the rate of inflation and never propose an infinitely lengthed tax increase.

The results show the majority of the levies in the sample are of infinite length. Regardless of the annual inflation rate over the length of the spell, non-renewable levies are most often proposed and indicate median voter bureaucratic behavior.

Another model test proposed comparing the number of times a renewal and an increase were combined in one levy, and how often the two were offered separately. Twenty-five times renewals and rate increases were offered separately on the same ballot as the median model predicts. Only nine times were renewals and increases combined to not allow voters to maintain the status quo as in the agenda model. Once again, the median model tends to be supported.

Lastly, in Ohio voters can organize to propose a tax reduction if the current rate is thought to be too high. Alexander and Bass (1974) considered the possibility of a taxpayer revolt. Given voters can propose tax repeals, they would only do so if the superintendent were behaving as an agenda setter. The median voter bureaucrat is already representing the community's preferences under the threat of being removed from office. From January 1976 to June 1986 only eleven "tax revolts" were put on the ballot. All but one of these issues were defeated indicating overall voter approval of superintendent behavior. Those disenchanted with the local bureaucrats seem to be a strict minority. The median voter model is supported once again.
2. Regression Estimates

Tables 1.3 through 1.6 list the empirical estimations of the four duration models. First, the equation predicting the proposed millage is estimated each time using an Ordinary Least Squares (OLS) technique (Johnston 1972). The estimated coefficients are then used to predict \( \hat{h} \), which in turn is included as an independent regressor in the duration model. (See note 11.) Actual levy proposals cannot be used since they are endogenous with the length of the spells.

While the OLS coefficient estimates are not the primary concern of the study, a quick scan of the results finds all regressors act as predicted when significant at a five percent confidence level. The effect of the Property Tax Relief Law is consistently evident as the coefficient estimate for the inflation term is positive at a five percent confidence level for each sample.

The empirical estimates also find education to be a normal good. The times the percentage change in real income coefficient is significant, it is positively related to the proposed millage. Likewise, though not always significant, the permanent income proxy (\( \Delta ILEI \)) is found to increase the predicted millage when increasing.

The coefficient estimate for the percentage change in enrollment is consistently insignificant. The model is ambiguous in predicting the sign of this parameter.

Though never significant at a five percent level, the first state aid program indicator variable behaved as expected. The positive coefficient estimate reflects the effect of the power equalization formula and the incentive to increase the local tax effort. The second
state indicator is estimated to not be significantly different from zero as predicted in all models, thus signalling no difference in the effect on proposed millage between the second and third programs.

Table 1.3 lists the estimation results for the full sample, no fixed effects model. This specification assumes all superintendents are risk neutral; their behavior is not effected by the outcome of the previous election. It also assumes homogeneous superintendent behavior whether it be that of a median voter bureaucrat or an agenda setter.

The empirical estimates yield results supporting the agenda setter model. Predicted millage is significantly, positively related to the time between proposals indicating the size of the levy increases as the time to the next proposal increases. This finding supports the agenda model as long as superintendent behavior is assumed homogeneous across districts. More will be said about this point while discussing the fixed effects models below.

The other median voter-agenda setter model test regressor ($\beta_4$) examines the handling of combined renewals and increases. The insignificance of the (COMBO) term only suggests these levies do not effect duration as predicted by the agenda model. The mere fact that some of these levies are proposed is contrary to the median voter model.

The other regressors are not tests of the two models, but simply explanatory variables in determining levy timing. The negative significance of the inflation term points to the effect of the Property Tax Relief Law much the same way the inflation term in the predicted millage equation did. As districts are exposed to higher rates of inflation, proposals occur more often.
Levy renewals delay the time to an election as predicted for both models. All superintendents seem to hold off renewing expiring levies. They also seem to delay operating proposals if they can be combined with other issues on the same ballot. Superintendents are modeled to group issues to reduce proposal costs, but the effect on levy timing is theoretically ambiguous. The model cannot determine whether the operating levy would be advanced or delayed, or whether the timing of the other issues would be modified to accommodate the operating proposal.

The state aid indicator variables behave unexpectedly. The first program is predicted to be negatively related to duration relative to the third program. The regressor, however, is estimated as not being significantly different from zero indicating the first and third programs have the same effect on levy timing. The second aid program is predicted to be no different than the third in its effect, yet it is estimated to prolong the time between levies. These regressors may be picking up other time related effects since they are no more than indicator variables. Note that the various programs did effect the proposed millage as anticipated.

The results of estimating superintendent risk preferences as a homogeneous group can be found in Table 1.4. As a group the superintendents are found to be risk averse. As the losing margin of the previous levy increases, they on the average wait longer to make the next proposal.

No longer assuming risk neutrality resulted in only two regressors behaving differently from the general model. The effect of
renewals on duration is now found to be insignificant. Additionally, the first state aid program indicator is now significantly positive. Relative to the third program, the first program prolongs the time between levies. This outcome is once again contrary to the model's predictions.

The two fixed effects models test for variations in bureaucratic behavior across jurisdictions. Both models assume that in each district only one superintendent was in office throughout the length of the study. Since the population is limited to those school districts with at least two spells, the first sample includes 374 of the 620 possible districts. The results of the model that assumes superintendents are risk neutral are in Table 1.5.

As in the general model without fixed effects, $\beta_1$ is estimated significantly positive indicating agenda setting behavior among the school superintendents. The individual school district coefficient estimates can be interpreted as the cumulative effect of district characteristics that have not been included in the general model. Only 35 districts, or less than ten percent of the sample, have negatively estimated coefficients. Of those 35 coefficients, only nine estimates are significant at a five percent confidence level. One hundred and forty of the 339 positively estimated district coefficients are significant. The results indicate the existence of unaccounted for characteristics that delay proposing a levy. More will be said about this possibility later. The other regressors behaved as they did in the model without fixed effects, though the renewal indicator is no longer significant.
The second fixed effects model tests the risk preferences of the group of homogeneous superintendents. The sample is further reduced by requiring two spells that each begin with a defeat for each school district. Two hundred and forty districts are included. The empirical results are reported in Table 1.6.

The coefficient estimate for the losing margin regressor ($\beta_9$) indicates overall risk aversion among the superintendents, just as it did in the model without fixed effects. Of the 240 school district indicator variable coefficients, forty seven have a negative estimate, and only three are significantly negative. Sixty nine of the district coefficients are estimated significantly positive. Overall, the estimates continue to suggest the existence of local characteristics that increase the time between proposals.

Two additional tests were performed to distinguish which school district level characteristics effect the timing of tax levies. First, a Pearson correlation coefficient is estimated to determine the relationship between school district size (i.e. enrollment) and the time between proposals. Perhaps there is a positive correlation signalling larger districts take more time to propose a tax increase. The delay may be the result of greater organizational and proposal costs. The estimate found the two terms to be negatively correlated (-0.03), but insignificantly different from zero even at the twenty percent confidence level. See note 7 for an interpretation of the estimate.

A second test regressed various demographic variables on the school district coefficient estimates from the first fixed effects model ($\beta_{9,j}$) from equation (1.50)). The empirical estimates are
listed in Table 1.7. Two of the seven independent variables used are significant at a five percent confidence level.

Alexander and Bass (1974) found areas with a higher proportion of owner occupied housing were more likely to hold elections. The significantly negative estimated coefficient of the percentage of homeowners term agrees with their result. As the percentage of homeowners increases across districts, the fixed effect coefficient and the time between proposals decreases.

The empirical results also indicate districts with a relatively higher percentage of non-white families take less time between levy proposals. These variables may direct future research on the variability of school superintendent behavior across districts.

F. Conclusions

This study, while attempting to find the determinants to timing a tax increase proposal, also tried to evaluate the behavior of local school superintendents. As a group they were found to be risk averse agenda setters. If this result is correct, Enelow and Hinich (1984) suggest they will behave just as median voter bureaucrats and not abuse their agenda setting monopoly power.

Using a series of fixed effects models, the possibility of heterogeneous superintendent behavior across school districts was examined. These results indicate behavior varies with differing community demographics. Most significantly, superintendents take less time between levies the higher the percentage of homeowners in their
district, and the higher the percentage of non-white families in their district.

The fixed effects models showed grouping all school districts together in a cross section to find the determinants of varying expenditures per pupil may not be appropriate without controlling for the variety of superintendent behavior that is possible. While differing bureaucratic behavior is not related solely to district enrollment, it may be related to other community demographic variables. Future research should allow for these district level factors before attempting to find the "correct" expenditure model.

2. See Barr and Davis (1966), Davis and Haines (1966), Borcherding and Deacon (1972), Bergstrom and Goodman (1973), Denzau and Mackay (1976), Edelson (1976), and Lovell (1978).

3. For a survey of recent empirical results see Denzau (1983).

4. School districts were allowed to propose income tax levies for two years in Ohio. In 1982 and 1983, 439 property tax and only 40 income tax levies for operating expenses were proposed.

5. Moore, Goertz, and Hartle (1983) find federal aid to education targets special services and needs. "In stimulating programs and services, the federal government has generally relied on financial assistance grants coupled with conditions on the use of funds." Examples of federal programs are the Education of All Handicapped Children Act, the Vocation Education Act, Title VI of the Civil Rights Act of 1964, and Section 504 of the Rehabilitation Act of 1973.

6. See Edlefson (1983) for a discussion of the various Ohio aid plans and the level of educational equity achieved by them. Adams and Crampton (1983) discuss the various forms of educational grants made by the state of Ohio and their effect on local educational expenditures.

7. Two tests for relationships between average daily attendance, local property tax revenue per pupil, and superintendent salary were conducted using 1985-86 Ohio school district data. First, Pearson product-moment correlation coefficients were computed. Salary and attendance had an estimated correlation of 0.42 with a less than one percent probability of independence. Zero estimated correlation indicates complete independence, while an estimate of one means one variable can be expressed exactly as a linear function of the other variable. Salary and local property tax revenue per pupil had an estimated coefficient of 0.12 and a less than one percent probability of independence as well. The second test was to regress salary onto attendance and local tax revenue. Each regressor was significantly positive at a one percent level. Salary was estimated to increase 90 cents for each additional pupil in the district, and 91 cents for each additional locally financed dollar per pupil for education.

8. Election costs such as poll workers' salaries are divided equally among those groups with issues on the ballot during a special election, and are paid by the county in Ohio during a general or primary election. Advertising costs to promote the school district's issue(s) are fixed by radio and television stations, and newspapers and are not dependent on the number of issues being proposed. Two or more issues can be promoted as easily as one in the media.
9. Ohio law only allows three special elections per calendar year (Banks-Baldwin, 1986). Three levies, however, may be considered relatively numerous.

10. An example of funding a tax levy comes from the Columbus School District tax levy campaign of May 1986. The over $241,000 budget was funded from three sources. Over $93,000 came from school district employees. Another $125,000 came from the Columbus Chamber of Commerce, and over $23,000 was donated by the public (Garner 1987).

11. The two stage least squares technique (Johnston 1972) is suitable for many models contending with endogeneity. It can be used with a log-duration dependent variable as long as the sample is limited to uncensored spells.

12. The author would like to thank one person in particular for her assistance. She asked to remain anonymous.

13. Note that the discussion has been simplified considerably. For simplicity the state assessment ratio (0.35 in Ohio) will not be considered, nor will the variation among residential, commercial, agricultural, or personal property tax rates be addressed.

14. The seven regressors are defined as follows:
   (1) \( \%\text{NON-WHITE} \) = the number of non-white families in the district from the 1980 census (Education 1987b) / FAMILIES
   (2) \( \%\text{WITHKIDS} \) = the number of families with school age children in the district from the 1980 census (Education 1987b) / FAMILIES
   (3) \( \%\text{POVERTY} \) = the number of families below the poverty line in the district from the 1980 census (Education 1987b) / FAMILIES
   (4) \( \%\text{HOMEOWNERS} \) = the number of families owning a home in the district from the 1980 census (Education 1987b) / FAMILIES
   (5) \( \text{ENROLLMENT} \) = the average school district enrollment from 1975-1984 (Education 1987b, OPEC)
   (6) \( \text{PROPERTY VALUE} \) = the average estimated valuation per pupil based on real, utility, and tangible personal property from 1975-86 (OPEC).
   (7) \( \text{INCOME} \) = the average real income computed using annual average, federally adjusted, gross incomes per tax return for each school district deflated by the June CPI for each year from 1976-84 (Taxation, Labor (a)).

FAMILIES = the number of families in the district from the 1980 census (Education 1987b).
Table 1.1
Sources of public elementary and secondary school revenues

<table>
<thead>
<tr>
<th>SCHOOL YEAR</th>
<th>SOURCES (ALL STATES)</th>
<th>SOURCES (OHIO)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOCAL</td>
<td>STATE</td>
</tr>
<tr>
<td>1919-20</td>
<td>83.2</td>
<td>16.5</td>
</tr>
<tr>
<td>1929-30</td>
<td>82.7</td>
<td>16.9</td>
</tr>
<tr>
<td>1939-40</td>
<td>68.0</td>
<td>30.3</td>
</tr>
<tr>
<td>1949-50</td>
<td>57.3</td>
<td>39.8</td>
</tr>
<tr>
<td>1959-60</td>
<td>56.5</td>
<td>39.1</td>
</tr>
<tr>
<td>1969-70</td>
<td>52.1</td>
<td>39.9</td>
</tr>
<tr>
<td>1975-76</td>
<td>46.5</td>
<td>44.6</td>
</tr>
<tr>
<td>1976-77</td>
<td>47.8</td>
<td>43.4</td>
</tr>
<tr>
<td>1977-78</td>
<td>47.6</td>
<td>43.0</td>
</tr>
<tr>
<td>1978-79</td>
<td>44.5</td>
<td>45.7</td>
</tr>
<tr>
<td>1979-80</td>
<td>43.4</td>
<td>46.8</td>
</tr>
<tr>
<td>1980-81</td>
<td>43.4</td>
<td>47.4</td>
</tr>
<tr>
<td>1981-82</td>
<td>45.0</td>
<td>47.6</td>
</tr>
<tr>
<td>1982-83</td>
<td>44.9</td>
<td>48.0</td>
</tr>
<tr>
<td>1983-84</td>
<td>45.1</td>
<td>48.0</td>
</tr>
<tr>
<td>1984-85</td>
<td>43.7</td>
<td>49.6</td>
</tr>
<tr>
<td>1985-86</td>
<td>43.5</td>
<td>50.1</td>
</tr>
</tbody>
</table>

Table 1.2

Levy duration versus the average annual inflation rate over the proposal spell

<table>
<thead>
<tr>
<th>AVG ANNUAL INFLATION RATE OVER SPELL (P)</th>
<th>1 YEAR</th>
<th>2 YEAR</th>
<th>3 YEAR</th>
<th>4 YEAR</th>
<th>5 YEAR</th>
<th>INFINITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P ≤ 1%</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>1% &lt; P ≤ 2%</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2% &lt; P ≤ 3%</td>
<td>1</td>
<td>5</td>
<td>17</td>
<td>4</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>3% &lt; P ≤ 4%</td>
<td>2</td>
<td>4</td>
<td>16</td>
<td>5</td>
<td>28</td>
<td>58</td>
</tr>
<tr>
<td>4% &lt; P ≤ 5%</td>
<td>1</td>
<td>11</td>
<td>20</td>
<td>1</td>
<td>31</td>
<td>74</td>
</tr>
<tr>
<td>5% &lt; P ≤ 6%</td>
<td>2</td>
<td>13</td>
<td>23</td>
<td>2</td>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td>6% &lt; P ≤ 7%</td>
<td>0</td>
<td>6</td>
<td>11</td>
<td>3</td>
<td>17</td>
<td>89</td>
</tr>
<tr>
<td>7% &lt; P ≤ 8%</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>7</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>8% &lt; P ≤ 9%</td>
<td>2</td>
<td>17</td>
<td>28</td>
<td>1</td>
<td>24</td>
<td>83</td>
</tr>
<tr>
<td>9% &lt; P ≤ 10%</td>
<td>4</td>
<td>12</td>
<td>16</td>
<td>3</td>
<td>17</td>
<td>65</td>
</tr>
<tr>
<td>10% &lt; P ≤ 11%</td>
<td>2</td>
<td>6</td>
<td>14</td>
<td>1</td>
<td>17</td>
<td>66</td>
</tr>
<tr>
<td>11% &lt; P ≤ 12%</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>13</td>
<td>79</td>
</tr>
<tr>
<td>12% &lt; P ≤ 13%</td>
<td>7</td>
<td>10</td>
<td>25</td>
<td>0</td>
<td>31</td>
<td>103</td>
</tr>
<tr>
<td>13% &lt; P ≤ 14%</td>
<td>3</td>
<td>8</td>
<td>14</td>
<td>0</td>
<td>14</td>
<td>52</td>
</tr>
<tr>
<td>14% &lt; P ≤ 15%</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>15% &lt; P ≤ 16%</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>16% &lt; P</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

MEAN INFLATION RATE | 9.9 | 8.2 | 8.0 | 5.9 | 7.5 | 8.5
Table 1.3

Empirical estimates of the homogeneous superintendent behavior model while assuming group risk neutrality

| VARIABLE                  | PARAMETER ESTIMATE | STANDARD ERROR | T FOR HO: PARAMETER=0 | PR > |T| |
|---------------------------|--------------------|----------------|------------------------|-------|
| INTERCEPT                 | 4.307663           | 2.537515       | 1.698                  | 0.0898|
| ΔSISD                     | -6.253420          | 6.067808       | -1.031                 | 0.3029|
| M(t₀),ΔINFLAT             | 3.370216           | 0.244606       | 13.778                 | 0.0001|
| M(t₀),ΔILEI              | 2.478342           | 0.527521       | 4.698                  | 0.0001|
| M(t₀),ΔINCOME            | -1.482450          | 7.203868       | -0.206                 | 0.8370|
| AS₁                      | 4.478435           | 2.585934       | 1.732                  | 0.0835|
| AS₂                      | -1.921420          | 3.159434       | -0.608                 | 0.5432|

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>CHI SQUARE</th>
<th>PR &gt; CHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>6.54147</td>
<td>1.052950</td>
<td>38.5955</td>
<td>0.0001</td>
</tr>
<tr>
<td>PREDICTED MILL</td>
<td>6.59810</td>
<td>0.169890</td>
<td>1508.35</td>
<td>0.0001</td>
</tr>
<tr>
<td>NUMOTHER</td>
<td>2.04448</td>
<td>0.534061</td>
<td>14.655</td>
<td>0.0001</td>
</tr>
<tr>
<td>RENEWAL</td>
<td>2.68731</td>
<td>1.022540</td>
<td>6.90681</td>
<td>0.0086</td>
</tr>
<tr>
<td>COMBO</td>
<td>1.34845</td>
<td>4.406180</td>
<td>0.093658</td>
<td>0.7596</td>
</tr>
<tr>
<td>INFLAT</td>
<td>-3.29210</td>
<td>6.9E-02</td>
<td>2277.98</td>
<td>0.0001</td>
</tr>
<tr>
<td>AS₁</td>
<td>4.47535</td>
<td>10.5928</td>
<td>0.178498</td>
<td>0.6727</td>
</tr>
<tr>
<td>AS₂</td>
<td>6.37433</td>
<td>0.158717</td>
<td>16.1295</td>
<td>0.0001</td>
</tr>
<tr>
<td>σ</td>
<td>0.759606</td>
<td>0.015498</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1516 PROPOSAL INTERVALS
Table 1.4

Empirical estimates of the homogeneous superintendent behavior model while assuming homogeneous risk preferences

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>T FOR HO: PARAMETERS PR &gt;</th>
<th>T</th>
<th>PR &gt;</th>
<th>CHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>-3.354740</td>
<td>2.242922</td>
<td>-1.496</td>
<td>0.1351</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>ASISD</td>
<td>4.323769</td>
<td>46.81027</td>
<td>0.092</td>
<td>0.9264</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔINFLAT</td>
<td>2.061513</td>
<td>0.386872</td>
<td>5.329</td>
<td>0.0001</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔLEI</td>
<td>8.776107</td>
<td>6.840274</td>
<td>1.283</td>
<td>0.1998</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔINCOME</td>
<td>2.594683</td>
<td>0.814728</td>
<td>3.185</td>
<td>0.0015</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>AS₁</td>
<td>3.645410</td>
<td>2.301684</td>
<td>1.584</td>
<td>0.1136</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>AS₂</td>
<td>3.19251</td>
<td>3.035900</td>
<td>-0.393</td>
<td>0.6946</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>CHI SQUARE</th>
<th>PR &gt; CHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>6.28853</td>
<td>1.351020</td>
<td>21.6658</td>
<td>0.0001</td>
</tr>
<tr>
<td>PREDICTED MILL</td>
<td>1.49967</td>
<td>0.764737</td>
<td>384.561</td>
<td>0.0001</td>
</tr>
<tr>
<td>NUMOTHER</td>
<td>2.43564</td>
<td>0.925002</td>
<td>6.9333</td>
<td>0.0085</td>
</tr>
<tr>
<td>RENEWAL</td>
<td>3.65659</td>
<td>2.902420</td>
<td>1.5872</td>
<td>0.2077</td>
</tr>
<tr>
<td>COMBO</td>
<td>3.54763</td>
<td>9.446200</td>
<td>0.14105</td>
<td>0.7072</td>
</tr>
<tr>
<td>INFLAT</td>
<td>-3.30890</td>
<td>9.0E-02</td>
<td>1345.04</td>
<td>0.0001</td>
</tr>
<tr>
<td>AS₁</td>
<td>3.31141</td>
<td>1.35593</td>
<td>5.96418</td>
<td>0.0146</td>
</tr>
<tr>
<td>AS₂</td>
<td>9.48785</td>
<td>1.82839</td>
<td>26.9275</td>
<td>0.0001</td>
</tr>
<tr>
<td>LMₜ₋₁</td>
<td>7.74643</td>
<td>2.60860</td>
<td>8.81821</td>
<td>0.0030</td>
</tr>
<tr>
<td>σ</td>
<td>0.942509</td>
<td>0.022941</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

916 PROPOSAL INTERVALS
Table 1.5

Empirical estimates of the heterogeneous superintendent behavior model using fixed effects while assuming group risk neutrality

| VARIABLE | PARAMETER ESTIMATE | STANDARD ERROR | T FOR HO: PARAMETER=0 | PR > |T| |
|----------|-------------------|----------------|----------------------|-------|---|
| INTERCEPT | 4.076118 | 2.584749 | 1.577 | 0.1150 |
| ΔSISD | -5.482240 | 6.135294 | -0.894 | 0.3717 |
| M(t₀),ΔINFLAT | 3.516594 | 0.268658 | 13.089 | 0.0001 |
| M(t₀),ΔILEI | 2.603578 | 0.546149 | 4.767 | 0.0001 |
| M(t₀),ΔINCOME | -1.557960 | 7.735574 | -0.201 | 0.8404 |
| AS₁ | 3.703142 | 2.646940 | 1.399 | 0.1620 |
| AS₂ | -9.174650 | 32.73389 | -0.280 | 0.7793 |

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>CHI SQUARE</th>
<th>PR &gt; CHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>0.</td>
<td>0.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PREDICTED MILL</td>
<td>6.66739</td>
<td>0.154360</td>
<td>1865.7</td>
<td>0.0001</td>
</tr>
<tr>
<td>NUMOTHER</td>
<td>1.62070</td>
<td>0.562719</td>
<td>8.29511</td>
<td>0.0040</td>
</tr>
<tr>
<td>RENEWAL</td>
<td>1.60987</td>
<td>1.082290</td>
<td>2.21256</td>
<td>0.1369</td>
</tr>
<tr>
<td>COMBO</td>
<td>-1.37751</td>
<td>4.295240</td>
<td>0.102852</td>
<td>0.7484</td>
</tr>
<tr>
<td>INFLAT</td>
<td>-3.70232</td>
<td>0.110870</td>
<td>1115.14</td>
<td>0.0001</td>
</tr>
<tr>
<td>AS₁</td>
<td>1.42796</td>
<td>11.30420</td>
<td>0.01596</td>
<td>0.8995</td>
</tr>
<tr>
<td>AS₂</td>
<td>5.12705</td>
<td>1.470630</td>
<td>12.1543</td>
<td>0.0005</td>
</tr>
<tr>
<td>ESD_j (374)</td>
<td>-</td>
<td>-</td>
<td>818.013</td>
<td>0.0001</td>
</tr>
<tr>
<td>σ</td>
<td>0.60099</td>
<td>0.013438</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1414 PROPOSAL INTERVALS
### Table 1.6

**Empirical estimates of the heterogeneous superintendent behavior model using fixed effects while assuming homogeneous group risk behavior**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>T FOR HO: PARAMETER=0</th>
<th>PR &gt;</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>-3.799540</td>
<td>2.443933</td>
<td>-1.555</td>
<td>0.1204</td>
<td></td>
</tr>
<tr>
<td>ΔSISD</td>
<td>1.180275</td>
<td>4.859255</td>
<td>0.243</td>
<td>0.8082</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔINFLAT</td>
<td>2.167053</td>
<td>0.455621</td>
<td>4.756</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔILEI</td>
<td>1.111170</td>
<td>0.754142</td>
<td>1.473</td>
<td>0.1410</td>
<td></td>
</tr>
<tr>
<td>M(t₀),ΔINCOME</td>
<td>2.385612</td>
<td>0.913236</td>
<td>2.612</td>
<td>0.0092</td>
<td></td>
</tr>
<tr>
<td>AS₁</td>
<td>3.788793</td>
<td>2.510200</td>
<td>1.509</td>
<td>0.1316</td>
<td></td>
</tr>
<tr>
<td>AS₂</td>
<td>3.000170</td>
<td>34.07141</td>
<td>0.088</td>
<td>0.9299</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>CHI SQUARE</th>
<th>PR &gt; CHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>0.</td>
<td>0.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PREDICTED MILL</td>
<td>1.67565</td>
<td>0.866452</td>
<td>374.007</td>
<td>0.0001</td>
</tr>
<tr>
<td>NUMOTHER</td>
<td>2.17745</td>
<td>10.15710</td>
<td>0.04596</td>
<td>0.8303</td>
</tr>
<tr>
<td>RENEWAL</td>
<td>3.80451</td>
<td>3.058330</td>
<td>1.5475</td>
<td>0.2135</td>
</tr>
<tr>
<td>COMBO</td>
<td>1.45410</td>
<td>9.424460</td>
<td>0.02381</td>
<td>0.8774</td>
</tr>
<tr>
<td>INFLAT</td>
<td>-3.33535</td>
<td>0.129440</td>
<td>663.951</td>
<td>0.0001</td>
</tr>
<tr>
<td>AS₁</td>
<td>3.22285</td>
<td>1.517880</td>
<td>4.50823</td>
<td>0.0337</td>
</tr>
<tr>
<td>AS₂</td>
<td>7.79770</td>
<td>1.761250</td>
<td>19.6017</td>
<td>0.0001</td>
</tr>
<tr>
<td>LMₜ₋₁</td>
<td>1.31603</td>
<td>0.319590</td>
<td>16.9568</td>
<td>0.0001</td>
</tr>
<tr>
<td>ΕSDₖ (240)</td>
<td>-</td>
<td>-</td>
<td>613.347</td>
<td>0.0001</td>
</tr>
<tr>
<td>σ</td>
<td>0.66485</td>
<td>0.019825</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

793 PROPOSAL INTERVALS
Table 1.7

Estimating the effects of school district demographics on an index of school district superintendent behavior

| VARIABLE       | PARAMETER ESTIMATE | STANDARD ERROR | T FOR HO: PARAMETER=0 | PR > |T| |
|----------------|--------------------|----------------|-----------------------|-------|---|
| INTERCEPT      | 1.111822           | 0.388493       | 2.862                 | 0.0045|
| %NON-WHITE     | -6.905940          | 3.262469       | -2.117                | 0.0350|
| %WITHKIDS      | -1.317680          | 4.825641       | -0.273                | 0.7850|
| %POVERTY       | 1.598017           | 0.925710       | 1.726                 | 0.0852|
| %HOMEOWNERS    | -7.725650          | 2.518808       | -3.067                | 0.0023|
| ENROLLMENT     | 9.243800           | 39.73290       | 0.233                 | 0.8162|
| PROPERTY VALUE | 1.997972           | 2.217396       | 0.901                 | 0.3682|
| INCOME         | 1.923368           | 30.02313       | 0.064                 | 0.9490|
REFERENCES


Inman, Robert P. "Testing Political Economy's 'As If' Proposition: Is the Median Income Voter Really Decisive?" Public Choice 33 (Winter 1978)


A. Introduction

Paul Samuelson (1954) originally claimed that no "market type" solution exists to determine public good expenditure levels. Charles Tiebout (1956) responded by proposing that under certain conditions local governments can provide services both optimally and efficiently. Perfectly informed, self-interested individuals, choosing from numerous communities with differing tax-public service plans, will choose that area most suited to their tastes and budgets. If everyone can costlessly relocate, inefficient service provision will be eliminated.

Thirty years later economists are still debating the validity of Tiebout's assumptions, and how the world operates under less than these ideal conditions. Tiebout supposes people with knowledge of many local fiscal packages, and complete mobility, will locate in areas providing their preferred expenditure level. Local communities will be homogeneous in public service preferences. Free rider and public good provision problems will be eliminated as consumers reveal their preferences through residency. Additionally, interjurisdictional competition will assure efficiency through minimum cost service provision.
As Tiebout's assumptions are relaxed, his conclusion of perfectly homogeneous communities becomes unrealistic. Minimum size community constraints reduce locational choices. Less than complete knowledge and mobility, along with a limited number of available locations, force households into heterogeneous communities.

House values, according to the income approach to property valuation and the theory of tax capitalization (Bloom, Ladd, and Yinger 1983), reflect the less than Tiebout-like real world. The value of a house equals the discounted present value of its before-tax rental stream minus the discounted present value of its capitalized tax stream assuming no depreciation. A house providing \( H \) units of housing services per year, with a before-tax rent of \( R \) dollars per unit per year, and a net of benefits tax payment of \( T \) dollars per year, will have value \( V \) for a given annual discount rate \( r \) and capitalization rate \( \beta \).

\[
V = \frac{RH}{r} - \beta \frac{T}{r} \tag{2.1}
\]

If the housing market corrects for public sector imperfections through tax capitalization, tax payment-service differentials will appear in property values.

Epple, Zelenitz, and Visscher (1978) discuss tax capitalization as a test of the Tiebout hypothesis. In a model with movable jurisdictional boundaries, the authors conclude "as long as individuals are free to bid for land - and thus reformulate community boundaries by annexation... - the price of the land itself (i.e. net of tax) will be the same regardless of the taxes imposed or fiscal packages provided by the communities." "As long as a price differential - net of tax - existed, there would always be this incentive toward equalization."
Their critical assumption is jurisdictional boundaries are movable. They conclude by claiming with movable boundaries tax capitalization cannot occur.

Epple and Zelenitz in a later paper (1981) study tax capitalization in a fixed boundaries model. With fixed boundaries they find the hypotheses of Oates (1969) and other capitalization advocates are correct. Differences in tax rates or public service levels are capitalized into housing prices when boundaries are exogenously fixed.

Many authors have estimated the degree of capitalization \( (\beta) \) occurring in the housing market.\(^1\) This study does not estimate \( \beta \), but simply allows for capitalization by assuming

\[
0 \leq \beta \leq 1.
\]  
(2.2)

Any degree up to full capitalization may take place.

This essay pursues whether or not voters consider boundaries movable by setting a deannexation precedent. In Ohio, the state in which the deannexation referendum under study took place, detachment and annexation are legally possible (Banks-Baldwin 1986). A subdivision of Columbus (Olentangy Highlands) attempted to redraw jurisdictional boundaries through deannexation and annexing into neighboring higher income, more Tiebout-like, Worthington in 1983.\(^2\) The procedure to redistrict, however, is not costless, and to be successful they needed to receive majority approval of all Columbus voters.

In an Epple, Zelenitz, and Visscher (1978), and an Epple and Zelenitz (1981) framework, if the probability of successfully deannexing is small, then the tax capitalization model is more suited to Ohio. On the other hand, the degree of capitalization may vary inversely with
this probability, and may account for estimates of less than full capitalization.

Below, one and two period models of how voters perceived the issue are developed. In the third part an empirical model is formulated to test the propositions of the theories. A discussion of the data, study results, and conclusions complete the text.

B. The Theoretical Model

1. Fiscal Subsidies and Deannexation

Deannexation involves two jurisdictions. First divide the central city (CC) into two parts, the deannexing area (D) and the remainder (0).

\[
CC = \{\text{All persons in the central city}\} \quad (2.3)
\]

\[
D = \{\text{All persons in the deannexing area}\} \quad (2.4)
\]

\[
0 = \{\text{All persons in the central city not deannexing}\} \quad (2.5)
\]

Second, define (A) as

\[
A = \{\text{All persons in the annexing jurisdiction}\}. \quad (2.6)
\]

Note that A is the empty set if D wishes to start its own municipality.

Budget balancing requires

\[
\sum_i \sum_j E_{ij}(CC) = \sum_i \sum_j T_{ij}(CC) \quad (2.7)
\]

and

\[
\sum_i \sum_j E_{ij}(A) = \sum_i \sum_j T_{ij}(A). \quad (2.8)
\]

Expenditures on services by the central city and the annexing area for each property j, owned by each person i, must equal the respective sums of property taxes collected. Assume all other revenue sources are
insignificant. Note that pure public goods (Samuelson 1954) are not considered in this study. It is assumed these goods are financed and provided by a separate regional authority.

If one assumes constant returns to scale in providing public services, then a subset of the population that pays more in taxes to its community than is spent on them for services subsidize the remainder of the community. If $D$ is subsidized by $[\text{subsidizes}]$ $0$, $0$ subsidizes $[\text{is subsidized by}]$ $D$. Similarly, if $D$ is subsidized by $[\text{subsidizes}]$ the rest of $A$ after annexation, $A$ will subsidize $[\text{be subsidized by}]$ $D$.

$$\sum_{i \in D} E_i^\text{(CC)} - \sum_{i \in D} T_i^\text{(CC)} > 0 \quad \sum_{i \in \emptyset} E_i^\text{(CC)} - \sum_{i \in \emptyset} T_i^\text{(CC)} < 0 \quad (2.9)$$

$$\sum_{i \in D} E_i^\text{(DUA)} - \sum_{i \in D} T_i^\text{(DUA)} > 0 \quad \sum_{i \in A} E_i^\text{(DUA)} - \sum_{i \in A} T_i^\text{DUA} < 0 \quad (2.10)$$

where "DUA" is the union of sets $D$ and $A$, $E_i = \sum_{j \in A} E_{ij}$, and $T_i = \sum_{j \in A} T_{ij}$ for all properties $j$ owned by $i$ in the relevant areas. (2.9) and (2.10) result from the balanced budget assumptions of (2.7) and (2.8).

Acting in their own best interest, $A$ will only annex $D$ if it benefits, or at least does not lose. The model implies

$$\sum_{i \in A} E_i^\text{(DUA)} - \sum_{i \in A} T_i^\text{(DUA)} \geq 0. \quad (2.11)$$

$D$ will only seek annexation while knowing it will subsidize $A$ (equations 2.10 and 2.11) if

$$\sum_{i \in D} E_i^\text{(CC)} - \sum_{i \in D} T_i^\text{(CC)} \leq \sum_{i \in D} E_i^\text{(DUA)} - \sum_{i \in D} T_i^\text{(DUA)} \leq 0 \quad (2.12)$$

is true. $D$ will only deannex if it is already subsidizing the central city and can reduce its subsidizations. Equation (2.12) ultimately suggests that $D$ will always create its own jurisdiction. If $A$ is the empty set, then
\[ \sum_{i \in D} E_i(DUA) - \sum_{i \in D} T_i(DUA) = 0 \quad (2.13) \]

is guaranteed by the balanced budget constraint. The model permits a test of whether voters believe the efficient allocation of public services requires a minimum sized jurisdiction (Tiebout 1956). If D is thought to be too small to provide its own services, and user fees on public services provided by CC or A for non-residents are prohibitive, D may find subsidizing A its best alternative. For simplicity assume all established jurisdictions are equally efficient in the supply of services. Note that a group being subsidized will never attempt annexation since no one else will want to support them, and they cannot do any better on their own.

2. Individual Voting Behavior

The simultaneous voting behavior model (Barkume 1976) requires an individual to determine concurrently whether she should participate in an election, and which issue alternative to select. The model is appropriate for one-issue, special elections. Modeling this decision process requires a system of simultaneous equations. Alternatively, the sequential model of Haurin (1980) allows a voter to determine whether she will turnout before deciding how to vote. The sequential model is more suited to the analysis of a single issue in a general election. "When a referendum issue is one of many on the ballot, it may be expected that preference on a particular issue is unrelated to the participation decision." (Barkume 1976) Treating voter turnout as exogenous to the model also simplifies the econometrics by removing the need for a set of simultaneous equations.
Consider a single issue that is part of a general election. Consistent with the sequential model, assume eligible voter i has already decided to turnout. For a two-alternative issue j that is part of a general election, let $B_{ijk}$ equal the net benefits measured in dollars to i given alternative k.

$$B_{ijk} = \Delta b_{ijk} - \Delta c_{ijk}, \ k = 1,2$$

(2.14)

where $\Delta b_{ijk}$ and $\Delta c_{ijk}$ are the perceived changes from the status quo in benefits and costs, respectively, to i.

If

$$B_{ij1} > B_{ij2}$$

(2.15)

then i selects alternative 1. Similarly,

$$B_{ij1} < B_{ij2}$$

(2.16)

results in i choosing 2, and

$$B_{ij1} = B_{ij2}$$

(2.17)

implies indifference.

Consider next how those deannexing (D) and those remaining (O) will vote. It is assumed A is legally ineligible to vote on the referendum. For consistency, allow indifference to generate an affirmative vote.

Assume that an individual i, who participates in the deannexation referendum, votes to maximize utility ($U_i$).

$$U_i = U_i(C_i, \sum_{j} EPFS_{ij}, \sum_{j} EPV_{ij})$$

(2.18)

Utility is a separable function of the consumption of a composite good ($C_i$), the sum of i's personal fiscal surpluses ($\sum_{j} EPFS_{ij}$) over each property j, and indirectly a function of the market values of i's properties ($\sum_{j} EPV_{ij}$). $PFS_i$ is the difference between what i would pay
for the publicly provided private services and goods (referred to here as simply "public services") available from owning \( j \), and the corresponding property tax bill.

\[
\frac{\partial u_i}{\partial \text{PFS}_{ij}} > 0
\]  

(2.19)

for all \( i \) and \( j \).

Utility for \( i \) is also an indirect function of the value of the properties she owns \( (\Sigma PV_{ij}) \). If tax capitalization occurs, then the value of \( j \) is a non-decreasing monotonic function of its market fiscal surplus \( (\text{MFS}_j) \). \( \text{MFS}_j \) equals the market value of the public services \( (\text{MV}_j) \) available with the property less the property taxes \( (T_j) \). Assume an increasing monotonic function \( (h) \) exists such that

\[
\text{MFS}_j = h(\text{E}_j) - T_j
\]  

(2.20)

where

\[
\text{MV}_j = h(\text{E}_j)
\]  

(2.21)

\[
\frac{\partial PV}{\partial \text{MFS}} = \beta , \ 0 \leq \beta \leq 1
\]  

(2.22)

and

\[
\frac{\partial u_i}{\partial \text{PV}_{ij}} > 0
\]  

(2.23)

for all \( i \) and \( j \).

3. The Deannexing Voter's Model

Just as if each deannexing, property owning (homeowner or landlord) voter \( i \) were considering moving to \( A \), each must weigh relocation benefits against costs. His choices are (1) vote for deannexation and continue to own \( j \), (2) vote for deannexation and sell, or (3) vote against deannexation.
Define

\[ dPFS(D_{ij}) = PFS(D_{ij} \mid DUA) - PFS(D_{ij}) \]  
(2.24)

and

\[ dPV(D_{ij}) = PV(D_{ij} \mid DUA) - PV(D_{ij}) \]  
(2.25)

as the changes in personal fiscal surplus and property value, respectively, to \( i \) from the deannexation of property \( j \). Note that (2.12) does not imply (2.25) is positive for all properties in \( D \). Possibly heterogeneous properties receiving uniform services will be re-evaluated differently by the housing market.

Let \( RC(D_{ij}) \) equal \( i \)'s relocation costs, the costs of selling property \( j \). Typical relocation costs include realtor and financing fees, and search costs in the form of time and money. If selling \( j \) implies buying another property (e.g. selling a home and buying another one), then any losses from receiving a less preferred service-tax package elsewhere should also be included. From (2.24) and (2.25), property owner \( D_i \) will vote for deannexation if

\[ \sum_{j} \max\{[dPFS(D_{ij}) + dPV(D_{ij})], [dPV(D_{ij}) - RC(D_{ij})]\} > 0. \]  
(2.26)

Equation (2.26) claims \( i \) will vote for deannexation if the total change in his property values, along with either the changes in his PFS's, or his relocation costs, are non-negative. If \( D \) successfully deannexes, those properties with

\[ [dPFS(D_{ij}) + dPV(D_{ij})] \geq [dPV(D_{ij}) - RC(D_{ij})] \]  
(2.27)

will be kept, while the rest will be sold. If

\[ \sum_{j} \max\{[dPFS(D_{ij}) + dPV(D_{ij})], [dPV(D_{ij}) - RC(D_{ij})]\} < 0. \]  
(2.28)

property owner \( D_i \) will oppose deannexation.
One more voter, renter $D_i$, needs to be considered. Deannexing renter $i$ resides on property $j$ similar to homeowner $D_i$, but does not own it. For renter $D_i$, $dMFS(D_{ij}) = 0$. She does not directly benefit from any changes in property values. As opposed to homeowners and landlords, renters must consider the change in rental rates from deannexation. Assume that rental rates ($R_j$) are directly related to property values (Stiglitz 1983).

$$\frac{dR}{dpv} = \gamma \geq 0 \quad (2.29)$$

A renter must weigh the change in her personal fiscal surplus against any change in rental rates. Allow $T_{ij}$ to equal zero for the renter computing her $dPFS$; she makes no direct property tax payments. She only considers her valuation of service changes, and changes in rental rates. Renter $D_i$ will favor deannexation if

$$dPFS(D_{ij}) - \gamma R_j \geq 0 \quad (2.30)$$

and otherwise will oppose it.

4. The Remaining Voter's Model

Each property owning voter must weigh redistricting benefits against costs. It has been deduced that only a service subsidizer will attempt deannexation. If the net lost subsidy from the boundary change is taken from all properties through either an equal reduction in all services or a flat rate tax increase, the change in PFS and the change in property values through capitalization will be negative. In the one period model all homeowners and landlords will oppose the proposed deannexation. Renters will weigh their valuation of the change in
services against the reduction in their rental rate resulting from lower property values.

The value of setting a deannexation precedent must be considered in the two-period model. Voters must determine if given a chance will their neighborhood attempt deannexation next period, and whether such a move would be personally beneficial. Assuming information is not costless (Stigler 1961), individuals use their votes on the current deannexation proposal as signals of either support for or opposition to setting this precedent.

Decompose \( O \) into the smallest geographical regions capable of deannexing (e.g. neighborhoods or census tracts). Arrange these \( M \) groups in descending order of their perceived gains from their own deannexation. Each group only considers the effect of their own deannexation since they cannot legally force another group to leave, and do not know how the other groups will behave in the future. For simplicity assume each group is homogeneous.

If \( T_0 = D \) is the group attempting deannexation, \( T_1 \) may wish to join them but currently cannot. \( T_1 \) must anticipate how \( T_2, \ldots, T_M \) will vote in the next election while deciding on \( T_0 \). An affirmative vote in this election may only help set a precedent that boundaries can be moved, while it allows a deannexation advocate (\( T_0 \)) to leave the pool of eligible voters.

Iterating forward in a sequential process, \( T_M \) places zero, or even negative value on setting a precedent since, by definition, it is least desirous to deannex. \( T_M \) will oppose all deannexations, since
allowing the other \((M-1)\) groups to escape is equivalent to \(T_M\) establishing its own jurisdiction. Temporarily assuming equal sized voting groups means \(T_M\) will never allow \(T_{M-1}\) to escape. Without the possibility of deannexing, \(T_{M-1}\) can only lose if it allows any service subsidizers to leave, and will also vote against \(T_0, \ldots, T_{M-2}\). Iterating backward, this sequential coalition process predicts all groups, except \(D\), will oppose \(D\)'s deannexation.

Removing the assumption of equal sized groups allows \(T_{M-1}\) to deannex if it is larger than \(T_M\). Similarly, \(T_i\) could deannex if

\[
T_i > \sum_{j=2}^{M} T_j.
\]  

(2.31)

In general, any \(T_k\) set of groups can deannex if

\[
T_k > \sum_{j=1}^{M} T_j
\]

(2.32)

has enough support internally to overcome outside opposition.

The current decision of the non-deannexing voters depends on this future deannexation coalition, or the belief that jurisdictional boundaries can actually be moved. Let the superscripted, two period notation \(0^D\) denote a voter who lives in an area he thinks will coalesce to deannex next period. Otherwise he lives in \(0^-\).

Voter \(0^D_i\)'s choices now become similar to those of deannexing voter \(D_i\). Each voter maximizes utility given potential changes in services and taxes. Those voters anticipating deannexation next period \((0^D)\) must simply include the changes resulting from this period's deannexation along with the changes from their own shift next period. Homeowners, landlords, and renters will vote for or against the
proposal depending upon changes in property values, personal fiscal surpluses, and rental rates.

\( O^{-1}_i \), by definition, does not anticipate her neighborhood coalescing to deannex next period. If the net lost subsidy from deannexation is taken from all properties through an equal reduction in all services or a flat rate tax increase, the change in her property value and personal fiscal surplus will be negative. If a property owner does not believe her area is a candidate for deannexation, she will oppose the attempts of others.

Renter \( O^{-1}_i \) has to consider the effect of movable boundaries on rental rates and his personal fiscal surplus. Once again, if \( dPV(O^{-1}_i) < 0 \) is always true, then rents for all \( O^{-1}_j \) will fall. Renter \( O^{-1}_i \) benefits from deannexation if his lower rental payments cover the losses from the new service-tax package. If

\[
dPFS(O^{-1}_j) - \gamma R(O^{-1}_j) \geq 0
\]

he supports deannexation. Otherwise, he favors the status quo.

C. The Empirical Model

1. The Logit Model

Define a voter choice random variable \( X \) such that

\[
f_X(x;p) = p^x(1-p)^{1-x} \quad \text{for } x=0 \text{ or } 1
\]

\[= 0 \quad \text{otherwise.} \]

In a two alternative election, let \( x=1 \) denote a positive vote with probability \( 0 \leq p \leq 1 \), while \( x=0 \) depicts a negative vote. \( X \) is distributed with the Bernoulli probability density function \( f_X \).
Consider the conditional probability \( p \) of voting yes given an individual voter's characteristics. Unfortunately, restricting \( p \) to the closed interval zero to one makes a regression analysis over different voters inappropriate. The finite range of \( p \) problem can be avoided by defining \( p \) by the logistic cumulative distribution function \( P(Z) \),

\[
P(Z) = \frac{1}{1+e^{-G(Z)}}.
\]  

(2.35)

\( Z \) is a vector of voter characteristics related by a yet unspecified function \( G \). From (2.35), and the Bernoulli restriction of only two alternatives, define the cumulative probability of voting no as

\[
1 - P(Z) = \frac{e^{-G(Z)}}{1+e^{-G(Z)}}.
\]  

(2.36)

Combining (2.35) and (2.36) and taking the natural logarithm completes the transformation of \( p \),

\[
\ln \left( \frac{P(Z)}{1-P(Z)} \right) = G(Z).
\]  

(2.37)

Now the dependent variable is defined over the entire \((-\infty, +\infty)\) interval. The left side of (2.37) is known as the logit of an affirmative vote.

2. The Voter Characteristics Vector

The elements of \( Z \) include the voter's current tenure choice and factors that would lead the voter to think her area would or would not attempt deannexation next period. Among these factors are location and the desirability of the potential annexing area. Additionally, the voter must determine whether her neighborhood is desirable to another jurisdiction, or would they have to start their own municipality after leaving the central city.
Location includes the distance to the nearest potentially annexing community. Community contiguity is required for annexation in Ohio. As a result, the closer an area is to another jurisdiction, the easier it will be to move boundaries. Define the distance (DIST) to the nearest potentially annexing jurisdiction as a proxy for location. This covariate should be negatively related to the likelihood of supporting deannexation.

Another aspect of location is the voter's local school district. In Ohio, the switching of political jurisdictions does not effect school district boundaries since each is a separate entity. In the early 1980s (this deannexation referendum took place in 1983) central city neighborhoods in suburban school districts were being considered for annexation into their own municipality's school system. If it is assumed suburban schools are preferred to central city schools, then these voters should favor deannexation to guarantee access to the better schools. Furthermore, an area may be more readily received by the annexing jurisdiction if it is already in their school district. An indicator variable (SD) equaling zero if a majority of the tract is in the Columbus school district, and one if it is in another district, was computed. This coefficient is predicted positive.

Thirdly, if all property values are linearly effected by deannexation, then owners of more expensive homes are nominally more effected. As property values increase, those who are able to deannex have more to gain, while others with similarly valued properties who cannot have more to lose. An interaction term (HV(O),D) of the median
home value of the tract and the distance to the nearest potentially annexing area was used to capture this effect. A positive correlation with supporting deannexation is predicted for this term, as well.

Unless voters consider all communities identical, some jurisdictions should be preferred over others. Assume subsidies made by those to be annexed will be smaller as the new community's property values are relatively greater. All other things equal, voters should increasingly prefer switching jurisdictions the more prosperous the potentially annexing community. The median home value \((HV(A))\) in the annexing area was used to represent the attractiveness of the new community, and is predicted positively correlated with an affirmative vote.

Another consideration is how desirable is the voter's neighborhood to other communities. Does detachment mean starting a new jurisdiction, or is another municipality eager to include them? Two variables were used to capture this factor. First an indicator variable \((HVO-HVA)\) was computed to equal one if the detaching area's median home value \((HV(O))\) was higher than that of the annexing area \((HV(A))\), and zero otherwise. This regressor is predicted positive using the subsidization argument made earlier. Another element of acceptance is race. Blacks may not feel welcomed into the deannexation coalition or into some of the white majority annexing communities. Racial prejudice, or the poverty and undesirable characteristics some people associate with blacks, may cause them to find boundaries less movable than whites. The coefficient of the percentage of non-white residents \((RACE)\) in a tract is predicted negative.
To compute the effect of personal fiscal surpluses on voter choices, one would want to develop public service demand equations. Determining specific individual public service valuations, however, is beyond the scope of this paper. It is, therefore, unrealistic to predict how the service-tax combination of the annexing area, relative to the current package, effects voter choices. For a given tax payment, though, the level of public services (PS) currently received should be negatively related to supporting the movement of municipal boundaries. A police protection proxy variable for measuring public services was computed and will be discussed in more detail in the next section.

Renters are unique in this model, since they are the only group to lose when property values increase. Renters must weigh potential rental rate changes against any changes in their public service package. Any changes that increase the value of their rental property may also increase their rental payments. Thus, this group may vote for a property value reducing alternative if rent reductions are greater than the losses from reduced public services. On the other hand, renters may vote to increase property values if the potential rent increases are less than their evaluation of gains from increased public services. The sign on this regressor is ambiguous.

Before continuing, some assumptions about $G$ must be made to allow the empirical estimation of (2.37). For simplicity, assume a linear relationship among the elements of $Z$. 

$$\ln \left[ \frac{P(Z)}{1-P(Z)} \right] = Z' \beta + \epsilon \quad (2.38)$$
with a parameter vector $\beta$, and $\varepsilon$, an independent logistically distributed error term.

D. The Data

1. The Election

The residents of Olentangy Highlands decided Columbus, Ohio, is not a Tiebout community. Instead of moving and selling their homes at a capitalized negative market fiscal surplus price, they proposed a referendum to detach and annex into Worthington, a higher income, more Tiebout-like community.

The Ohio Revised Code (Banks-Baldwin 1986) requires an area seeking detachment to initiate a petition stating this intention, and obtain a majority of the area's registered voters' signatures. The area may either choose to start a new township, or annex into an existing contiguous community. The proposal must then receive a majority of votes from the entire original jurisdiction. This procedure has been in effect since before the revision of the Ohio General Code in 1953. Detachment is rarely attempted, however, since free rider problems make organization difficult, and the expected outcome is usually failure.

Table 2.1 summarizes the election results. The referendum was on the ballot along with a close mayoral contest, and an issue to raise the state minimum drinking age to 21 years. Voter turnout as a result was relatively high. The election fits the sequential voting behavior model, since voters primarily turned out to support other issues.
to decide on deannexation. Once at the polls, 76.5% of the participants did vote on the Olentangy Highlands proposal. The issue was defeated by a 10.2% margin.

2. The Units of Observation

Since individual voting data are not available, census tracts are the units of observation.

\[
\ln \left[ \frac{Y_j}{N_j} \right] = Z_j'\beta + \epsilon_j^* \tag{2.39}
\]

\(Y_j\) is the number of yes votes, \(N_j\) the number of no votes, and \(Z_j\) the characteristic vector of tract \(j\). The \(\epsilon_j^*\) error terms are independent with logistic distributions.

3. The Dependent Variable

Actual voting results were obtained from the Franklin County (Ohio) Board of Elections (Franklin 1983). Voting precincts were mapped into the Columbus SMSA census tracts assuming a uniform voter distribution. The tract containing Olentangy Highlands was excluded since these voters are not part of the two period model. Assuming no ballot tampering occurred, 22 of the 200 tracts were removed from the sample when the mapping led to more voters in a tract than residents. Table 2.2 lists the mean characteristics of all 200 tracts, and the 178 tracts used in the analysis.

4. The Independent Variables

**Distance (DIST).** The distance between the nearest edges of the census tract and the closest potentially annexing city as defined by
the State of Ohio (Ohio 1980) or Dublin Village was measured. Measurements were done by hand and rounded to the nearest quarter mile.

**Home Value (HV)**. The home value for each tract (HV(0)) or neighboring municipality (HV(A)) is the median owner's estimate of how much the property (house and lot) would sell for if it were for sale. The sample is limited to one-family homes on less than ten acres without a commercial establishment or medical office on the property (Commerce 1980).

**Home Value X Distance (HV(0),DIST)**. This interaction term is HV(0) multiplied by DIST as defined above.

**School District (SD)**. An indicator variable equaling zero if a majority of the tract is in the Columbus school district, and one if it is in another district, was computed.

**Public Services (PS)**. Public services for a municipality include police and fire protection, sanitation, snow removal, and other less significant functions. Police and fire consume the largest budget shares. Many police functions such as vice squads, narcotics investigations, and jail maintenance are provided uniformly for the city. The major variable city-wide service is the number of cruisers patrolling each district. The number of officers on duty daily per 1000 residents in each tract was computed based on information received from the Columbus Public Safety Department. Only mobile officers were included since foot patrol data for the University and Near East Side areas were not available. Including these officers would probably enhance the subsidization argument since both neighborhoods are low
income, low property value areas. Mapping was necessary with residents assumed uniformly distributed in each tract.

Columbus and its neighboring communities have agreed the nearest fire station will answer a call regardless of political jurisdiction. Assuming no communities free ride, no change in fire protection will occur after deannexation (Columbus 1982). Since other service expenditures are comparatively small, the public services regressor is based solely on police protection.

Race (RA). The percentage of non-white persons in each tract was used for voter race (Commerce 1980).

Renters (%RENT). The percentage of renters in a tract is one minus the ratio of owner occupied housing units to households. If the owner or co-owner lives in the housing unit it is "owner occupied." Ownership is implied even if the unit is mortgaged or not fully paid (Commerce 1980).

Industrial Property Value. Median industrial property values to be used along with median residential values are currently not available.

Relocation Costs. Relocation costs vary significantly across individuals. The many factors included in moving make any statistic inaccurate enough to warrant its exclusion from the regression estimate.
E. Results

Tax rates vary among municipalities causing identically valued properties to generate different tax payments. Relocating to a higher income, more Tiebout-like community to obtain a more preferred services and tax combination will not necessarily result in smaller tax payments; relocation only allows individuals to enjoy a higher services to tax dollar ratio. If public services and tax payments are capitalized into housing prices, then an area by deannexing (Olentangy Highlands in this study) would receive windfall profits through higher property values.

As the model predicts the annexing district's (Worthington) residents would increase their tax base and also improve their fiscal surpluses through deannexation. The median home value for Olentangy Highlands is $115,000 (Issue 5 to Decide, 1983) as compared to $74,700 for Worthington (Commerce, 1980). Since the median home value in Columbus (the central city) is only $41,300 (Commerce 1980), Olentangy Highlands would subsidize public services to a smaller degree given services are uniformly distributed. Only Columbus would lose as some of its fiscal subsidies would be removed.

Incorporating the discussion of the voter characteristic vector $Z$, the data specifications, and the linearity assumption of (2.38), the estimated model is

$$
\ln \left[ \frac{y_{ij}}{n_{ij}} \right] = \beta_0 + \beta_1(DIST) + \beta_2(SD) + \beta_3(HV(0), D) + \beta_4(HV(A)) + \beta_5(HVO-HVA) + \beta_6(RACE) + \beta_7(\%RENT) + \beta_8(PS) + \epsilon_j. \quad \text{(2.40)}
$$
Coefficients $\beta_2$, $\beta_3$, $\beta_4$, and $\beta_5$ are predicted to be positive. $\beta_1$, $\beta_6$, and $\beta_8$ are predicted negative, and $\beta_7$ is ambiguous.

Since the variances of the individual $\epsilon_j^*$ cannot be assumed equal, the model is estimated using generalized least squares (GLS). $\sigma_j^2$ is approximated by $S_j^2$ (Kmenta 1971) such that

$$S_j^2 = \frac{Y_jN_j^2 + N_jY_j^2}{(Y_j + N_j - 1)(Y_j + N_j)^2}.$$ (2.41)

$S_j^2$ is an unbiased estimator of $\sigma_j^2$ since the expected value of $S_j^2 = \sigma_j^2$. Using $S_j^2$ and a GLS procedure to estimate (2.40) yields a best linear unbiased estimate (BLUE) of the $\beta$ parameter vector.

The model parameter estimates are presented in Table 2.2. If favoring Olentangy Highlands' deannexation can be interpreted as desiring to set a deannexation precedent, then voters in non-Columbus school districts wish to do just that. The significantly positive coefficient estimate for the school district variable (SD) implies individuals value the opportunity to attend suburban schools, and would choose deannexation as a way to protect it.

$HV(A)$ is a measure of the desirability of the potentially annexing community. The positive significance of this estimated coefficient indicates voters consider not just whether they can detach or not, but to where they can annex, as well. Communities with higher median property values are preferred for annexation over other communities.

An insignificant coefficient for $HV(A)$ would have meant voters wish to deannex merely to get out of the central city. Possibly they would have then set up their own community. This result, however,
supports the Tiebout minimum size jurisdiction condition for the efficient supply of public services. Voters do not consider starting their own community a viable alternative. More will be said below about whether voters also consider the ease of annexation a variable across communities.

The negative significance of the distance variable (DIST) reflects the legal requirements of contiguity for annexation. It further signifies voters consider annexation a necessary part of moving boundaries. The results seem to indicate once again that voters do not consider starting a new jurisdiction optimal, rather, they agree with Tiebout's (1956) minimum feasible jurisdictional size hypothesis.

Since it appears that voters consider detachment and annexation together, the desirability of their neighborhood to another community should be important to their voting decisions. The positive significance of the subsidization indicator variable (HVO-HVA) further confirms voters do not consider a new jurisdiction feasible. Only if voters think they will be accepted elsewhere will they support the current, precedent setting effort.

The large t-ratio for the race coefficient (-15.6) suggests a strong difference in how the races perceive redistricting. Non-whites prefer more stationary boundaries. Had the combined coefficient estimates of the distance variable (DIST), the subsidization indicator (HVO-HVA), and the annexing area median home value (HV(A)) variables proven insignificant, then the race coefficient would only have captured the perceived ability to detach. Voters would have been looking to start new jurisdictions rather than annexing into existing ones.
Since the perceived attitudes of the potentially annexing areas appear important, blacks may fear the racial prejudices discussed earlier. Chow (1960) tests to be discussed below were done in an attempt to further determine the reasons behind this overwhelming result.

The percentage of renters (RENT) coefficient is significantly positive. Those renters anticipating deannexation may recognize a more preferred public service package is available elsewhere, and believe it is worth any potential rent increases. Other renters may be hoping for rent reductions to offset any service losses.

The interaction of home value and distance (HV(0),D) is insignificant. Perhaps the magnitude of gains and losses from deannexation cannot be captured. Likewise, the public services (PS) regressor is insignificant. Possibly the differing amounts of police protection are transparent to voters across jurisdictions.¹⁴

The heterogeneity of the annexing communities leads to the second estimated equation. Instead of using home values to capture the desirability of joining each suburb, an indicator variable was defined for each potentially annexing city. This regressor will also pick up any variance across communities in voter perceptions of being annexed. The indicator for the city with the lowest median home value (Whitehall), is not included to avoid multicollinearity. The coefficient estimates are reported in Table 2.3.

These additional results further confirm the predictions of the model. The four areas with positive, significant coefficient estimates (Upper Arlington, Worthington, Westerville and Gahanna) are among the top five cities in median property value considered in the study. See
Table 2.4. Dublin is completely contained in one census tract and had to be removed from the second model to avoid collinearity problems. Furthermore, the two areas with negative, though insignificant, estimated coefficients (Grove City and Reynoldsburg) comprise two of the bottom three positions in the table. Remember a coefficient for the area with the lowest median home value is not estimated.

The predominately black neighborhoods surrounding an affluent, white majority city may not consider their chances of annexation very promising. Racial attitudes, as discussed earlier, may have resulted in the estimated coefficient for Bexley to be insignificant.

To determine whether predominately non-white census tracts have a different relationship among the explanatory factors than the overall sample, a complete set of racial interaction terms (a Chow test) was added to the model. An indicator variable equaling one if the tract is greater than seventy percent non-white was used. The results of the estimation of the two modified models are listed in Table 2.5.

None of the interaction terms were significant in either model. The joint F-test of these racial interaction terms, however, yielded conflicting results. The set of additional regressors is significantly different from zero at a five percent confidence level in the first model. F equals 2.09. This result suggests the two sub-samples do not come from the same general population. The group of regressors, however, are insignificant at a four percent level. In the second model the regressors are not significant at even a twenty-five percent confidence level. F equals 1.24.
F. Conclusions

A model and empirical test of whether or not voters wish to set a deannexation precedent to move jurisdictional boundaries has been presented. Though boundary lines are legally adjustable, the process is costly and does not guarantee success. If tax differentials are capitalized into property values, then those property owners who successfully deannex may receive windfall profits. Even without capitalization, utility gains are available from receiving a more preferred tax-service package.

The analysis in one respect indicates some voters would prefer to move boundaries. A landslide defeat of the proposal would have indicated otherwise. Conversely, the improbability of successfully deannexing, and the free rider problems of organizing an attempt, are pointed out by the rarity of such proposals. If only a minority will ever find moving boundaries beneficial, all attempts will be defeated. As a result of these problems, voters may consider boundaries fixed.

Overall, deannexation seems unlikely. If Epple and Zelenitz (1981) are correct, then the fixity of boundaries will result in tax capitalization. Voters, like lottery players, however, do seem willing to "invest" a little for the slim hope of a big payoff.
ENDNOTES


2. The referendum as it appeared on the November 8, 1983, ballot read:

PROPOSED TRANSFER OF TERRITORY FROM THE CITY OF COLUMBUS TO THE CITY OF WORTHINGTON

City of Columbus

Shall "Olentangy Highlands", a subdivision, and other small adjoining parcels of the City of Columbus situated in the State of Ohio, County of Franklin, City of Columbus, being 165.20 acres of land, more or less, located generally west of the Olentangy River and Stratford Road, south of Snouffer Road, east of Linworth Road, and north of Dublin-Granville Road, be detached from the City of Columbus and annexed to the City of Worthington, for corporate municipal purposes only, on the following two conditions?:

(1) On the date the annexation becomes effective, ownership of all public owned facilities and property within the area shall be transferred from the City of Columbus to the City of Worthington, and

(2) Any real property tax related to the area shall be apportioned between the City of Columbus and the City of Worthington so that any such tax attributable to any period prior to the date of annexation becomes effective, but collected for, or received by, the City of Worthington subsequent to said date shall be forwarded to the City of Columbus.

3. Worthington City Manager David Elder said providing services to the subdivision (Olentangy Highlands) - if it were annexed - would add some costs to Worthington, but it "wouldn't be a burden. The costs would be offset by tax revenues. The best way to explain it is that it would be just about a wash." (Issue 5 to Decide, 1983).

4. Gary Glecker, the chairman of the annexation movement, indicated the reason for the change was "the (Worthington) subdivisions around us get better service than we do." (Issue 5 to Decide, 1983). "We can do better with Worthington," Glecker said. (City Misled, 1983).

5. See Downs (1957), Tullock (1968), Riker and Ordeshook (1968), Palfrey and Rosenthal (1983), and Owen and Grofman (1984) for discussions of this aspect of the process.
6. Since choices over time are being discussed here, one should speak of the present value of each of the terms involved. However, as a simplification consider the time between elections, or to relocation, to be so short that discounting future benefits is unnecessary.

7. It is the deannexation concept that drives the two period model. Setting "a bad precedent and eroding the tax base" were major concerns of the Columbus bureaucracy. Columbus Service Director Robert C. Parkinson said, "It (the deannexation attempt) could very well be the start of a chain reaction. If other areas were dissatisfied with city operations, they'd want out." (Issue 5 to Decide, 1983). Parkinson also stated, "we are aware of other areas interested in deannexing." (City Misled, 1983). Columbus Development Department officials also opposed the transfer saying it would set a bad precedent. (Issue Asks De-annexation, 1983). Other Columbus officials urged residents to vote against the transfer as a bad precedent and erosion of the tax base. (Highlands Transfer, 1983).

8. See Cox (1970), Deacon and Shapiro (1975), and Barkume (1976) for more detailed discussions and applications of this transformation.

9. Only one other deannexation has been attempted in Franklin County since 1971. On June 5, 1979, a 143-home subdivision, Pipers Glen, was successfully transferred from Columbus to the City of Gahanna (Yes - 32,069, No - 21,629). "Columbus and Gahanna officials favored the land transfer because the subdivision already is practically surrounded by Gahanna. Service to the area can be provided more easily by Gahanna." (Voters, 1979). Quite possibly Columbus was ridding itself of a service subsidizee, while Gahanna was gaining a subsidizer. Service provision efficiencies, however, are beyond the scope of this paper. An additional note, Pipers Glen was already part of the Gahanna school system.

10. Dublin, although only a village, is included in the survey to correct any effects its extremely high property values had on the rest of the cities. Specifically, the effect Dublin has on Hilliard, the nearest city. Unfortunately, Dublin is completely contained in one census tract (62) and has to be removed from the second model to avoid collinearity problems.

11. Columbus (1984). The three largest public service expenditures in 1983 for Columbus were police ($61,127,255), fire ($33,448,996), and sanitation ($16,818,217).

12. The author thanks Officer Thomas Fischer of the Columbus Police Division for providing data and information on police allocation throughout the city (Fischer 1985).

13. Gary Glecker, chairman of the deannexation movement, said "our taxes will go up by $350 per home with this move," referring to Worthington's higher tax rates. "We are not trying to get something for nothing." (Issue 5 to Decide, 1983).
TABLE 2.1

Election results for the Olentangy Highlands deannexation referendum

<table>
<thead>
<tr>
<th></th>
<th>Yes Votes</th>
<th>No Votes</th>
<th>%Yes</th>
<th>%No</th>
<th>Yes/No Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>68,619</td>
<td>84,344</td>
<td>44.9</td>
<td>55.1</td>
<td>0.814</td>
</tr>
<tr>
<td>Olentangy Highlands</td>
<td>370</td>
<td>81</td>
<td>82.0</td>
<td>18.0</td>
<td>4.556</td>
</tr>
<tr>
<td>Outside Olentangy Highlands</td>
<td>68,249</td>
<td>84,263</td>
<td>44.7</td>
<td>55.3</td>
<td>0.810</td>
</tr>
<tr>
<td>Adjacent Dummy = 1</td>
<td>24,201</td>
<td>21,968</td>
<td>52.4</td>
<td>47.6</td>
<td>1.102</td>
</tr>
<tr>
<td>Adjacent Dummy = 0</td>
<td>44,418</td>
<td>62,376</td>
<td>41.6</td>
<td>58.4</td>
<td>0.712</td>
</tr>
<tr>
<td>School District Dummy = 1</td>
<td>18,358</td>
<td>15,218</td>
<td>54.7</td>
<td>45.3</td>
<td>1.206</td>
</tr>
<tr>
<td>School District Dummy = 0</td>
<td>50,261</td>
<td>69,126</td>
<td>42.1</td>
<td>57.9</td>
<td>0.727</td>
</tr>
</tbody>
</table>

Number of Eligible Voters: 316,765
Number of Actual Voters: 199,963
Number That Voted on Deannexation Issue: 152,963
TABLE 2.2

Characteristic means of all the Columbus SMSA census tracts and only those used in the study

<table>
<thead>
<tr>
<th></th>
<th>MEAN (200 OBS.)</th>
<th>MEAN (178 OBS.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>1.000</td>
<td>1.013</td>
</tr>
<tr>
<td>School District Indicator</td>
<td>0.305</td>
<td>0.247</td>
</tr>
<tr>
<td>Home Value(0)</td>
<td>$43,991</td>
<td>$43,679</td>
</tr>
<tr>
<td>Home Value(0) X Distance</td>
<td>37,242</td>
<td>37,343</td>
</tr>
<tr>
<td>Home Value(A)</td>
<td>$63,300</td>
<td>$63,951</td>
</tr>
<tr>
<td>Subsidization Indicator</td>
<td>0.185</td>
<td>0.180</td>
</tr>
<tr>
<td>Race</td>
<td>22.20</td>
<td>23.60</td>
</tr>
<tr>
<td>%Renters</td>
<td>47.93</td>
<td>48.75</td>
</tr>
<tr>
<td>Public Services</td>
<td>6.725</td>
<td>6.643</td>
</tr>
<tr>
<td>Bexley</td>
<td>0.225</td>
<td>0.247</td>
</tr>
<tr>
<td>Grandview Heights</td>
<td>0.160</td>
<td>0.163</td>
</tr>
<tr>
<td>Grove City</td>
<td>0.095</td>
<td>0.090</td>
</tr>
<tr>
<td>Gahanna</td>
<td>0.070</td>
<td>0.056</td>
</tr>
<tr>
<td>Hilliard</td>
<td>0.020</td>
<td>0.011</td>
</tr>
<tr>
<td>Worthington</td>
<td>0.120</td>
<td>0.118</td>
</tr>
<tr>
<td>Reynoldsburg</td>
<td>0.050</td>
<td>0.039</td>
</tr>
<tr>
<td>Upper Arlington</td>
<td>0.145</td>
<td>0.163</td>
</tr>
<tr>
<td>Westerville</td>
<td>0.035</td>
<td>0.034</td>
</tr>
<tr>
<td>Dublin</td>
<td>0.005</td>
<td>0.000</td>
</tr>
<tr>
<td>Whitehall</td>
<td>0.075</td>
<td>0.079</td>
</tr>
<tr>
<td>Yes/No Ratio</td>
<td>0.850</td>
<td>0.819</td>
</tr>
<tr>
<td>Ln (Yes/No Ratio)</td>
<td>-0.291</td>
<td>-0.325</td>
</tr>
</tbody>
</table>
**TABLE 2.3**

Empirical estimates of the voting logit using the median home value of the potentially annexing area and an indicator variable for each potentially annexing area as regressors

<table>
<thead>
<tr>
<th></th>
<th>LN (YES/NO)</th>
<th>LN (YES/NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.98 (-14.55)</td>
<td>-1.30 (-11.34)</td>
</tr>
<tr>
<td>Distance</td>
<td>-1.64 (-3.03)</td>
<td>-1.03 (-1.94)</td>
</tr>
<tr>
<td>School District Indicator</td>
<td>3.00 (6.02)</td>
<td>2.81 (5.04)</td>
</tr>
<tr>
<td>Home Value(O) X Distance</td>
<td>6.90 (0.48)</td>
<td>-3.59 (-0.25)</td>
</tr>
<tr>
<td>Home Value(A)</td>
<td>1.28 (7.95)</td>
<td>-</td>
</tr>
<tr>
<td>Subsidization Indicator (HVO-HVA)</td>
<td>1.89 (3.03)</td>
<td>1.56 (2.52)</td>
</tr>
<tr>
<td>Race</td>
<td>-1.05 (-15.64)</td>
<td>-0.95 (-11.41)</td>
</tr>
<tr>
<td>%Renters</td>
<td>1.69 (2.30)</td>
<td>1.30 (1.82)</td>
</tr>
<tr>
<td>Public Services</td>
<td>-1.29 (-0.27)</td>
<td>3.41 (0.70)</td>
</tr>
<tr>
<td>Bexley</td>
<td>-</td>
<td>1.33 (1.47)</td>
</tr>
<tr>
<td>Gahanna</td>
<td>-</td>
<td>2.36 (2.16)</td>
</tr>
<tr>
<td>Grandview Heights</td>
<td>-</td>
<td>1.74 (0.18)</td>
</tr>
<tr>
<td>Grove City</td>
<td>-</td>
<td>-9.88 (-0.97)</td>
</tr>
<tr>
<td>Hilliard</td>
<td>-</td>
<td>3.31 (1.81)</td>
</tr>
<tr>
<td>Reynoldsburg</td>
<td>-</td>
<td>-1.18 (-0.10)</td>
</tr>
<tr>
<td>Upper Arlington</td>
<td>-</td>
<td>4.59 (5.09)</td>
</tr>
<tr>
<td>Westerville</td>
<td>-</td>
<td>4.35 (3.41)</td>
</tr>
<tr>
<td>Worthington</td>
<td>-</td>
<td>4.70 (5.11)</td>
</tr>
<tr>
<td>(R^2)</td>
<td>.77</td>
<td>.80</td>
</tr>
</tbody>
</table>

<sup>a</sup> T-values are given in parentheses.
### TABLE 2.4

**Median home values for all potentially annexing areas and Columbus**

<table>
<thead>
<tr>
<th>Area</th>
<th>Median Home Value $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin</td>
<td>98,000</td>
</tr>
<tr>
<td>Upper Arlington</td>
<td>83,300</td>
</tr>
<tr>
<td>Worthington</td>
<td>74,700</td>
</tr>
<tr>
<td>Bexley</td>
<td>69,800</td>
</tr>
<tr>
<td>Westerville</td>
<td>68,400</td>
</tr>
<tr>
<td>Gahanna</td>
<td>56,600</td>
</tr>
<tr>
<td>Grandview Heights</td>
<td>53,900</td>
</tr>
<tr>
<td>Reynoldsburg</td>
<td>51,800</td>
</tr>
<tr>
<td>Grove City</td>
<td>49,500</td>
</tr>
<tr>
<td>Hilliard</td>
<td>42,500</td>
</tr>
<tr>
<td>Whitehall</td>
<td>39,100</td>
</tr>
<tr>
<td>Columbus</td>
<td>41,300</td>
</tr>
</tbody>
</table>

*Source: Commerce (1980).*
TABLE 2.5

Chow tests of the non-white census tracts using both logit models

<table>
<thead>
<tr>
<th></th>
<th>LN (YES/NO)</th>
<th>LN (YES/NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercept</strong></td>
<td>-1.88 (-11.46)</td>
<td>-1.32 (-8.16)</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>-2.24 (-3.82)</td>
<td>-1.58 (-2.70)</td>
</tr>
<tr>
<td><strong>School District Indicator</strong></td>
<td>2.96 (5.94)</td>
<td>2.95 (5.18)</td>
</tr>
<tr>
<td><strong>Home Value(0) X Distance</strong></td>
<td>1.68 (1.12)</td>
<td>0.59 (0.39)</td>
</tr>
<tr>
<td><strong>Home Value(A)</strong></td>
<td>1.25 (7.77)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Subsidization Indicator (HVO-HVA)</strong></td>
<td>1.65 (2.66)</td>
<td>1.39 (2.22)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td>-1.03 (-7.86)</td>
<td>-1.01 (-6.71)</td>
</tr>
<tr>
<td><strong>%Renters</strong></td>
<td>1.78 (2.35)</td>
<td>1.41 (1.87)</td>
</tr>
<tr>
<td><strong>Public Services</strong></td>
<td>-9.23 (-1.43)</td>
<td>-2.08 (-0.30)</td>
</tr>
<tr>
<td><strong>Bexley</strong></td>
<td>-</td>
<td>1.58 (1.70)</td>
</tr>
<tr>
<td><strong>Gahanna</strong></td>
<td>-</td>
<td>3.04 (2.56)</td>
</tr>
<tr>
<td><strong>Grandview Heights</strong></td>
<td>-</td>
<td>3.35 (0.34)</td>
</tr>
<tr>
<td><strong>Grove City</strong></td>
<td>-</td>
<td>-8.31 (-0.80)</td>
</tr>
<tr>
<td><strong>Hilliard</strong></td>
<td>-</td>
<td>3.17 (1.73)</td>
</tr>
<tr>
<td><strong>Reynoldsburg</strong></td>
<td>-</td>
<td>-2.27 (-0.23)</td>
</tr>
<tr>
<td><strong>Upper Arlington</strong></td>
<td>-</td>
<td>4.63 (5.11)</td>
</tr>
<tr>
<td><strong>Westerville</strong></td>
<td>-</td>
<td>4.22 (3.30)</td>
</tr>
<tr>
<td><strong>Worthington</strong></td>
<td>-</td>
<td>4.51 (4.88)</td>
</tr>
<tr>
<td><strong>Non-White X Distance</strong></td>
<td>-2.24 (-3.82)</td>
<td>1.99 (0.64)</td>
</tr>
<tr>
<td><strong>Non-White X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>School District Indicator</strong></td>
<td>2.96 (5.94)</td>
<td>-2.82 (-0.94)</td>
</tr>
<tr>
<td><strong>Non-White X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Home Value(0) X Distance</strong></td>
<td>1.68 (1.12)</td>
<td>-2.79 (-0.24)</td>
</tr>
<tr>
<td><strong>Non-White X Home Value(A)</strong></td>
<td>1.25 (7.77)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subsidization Ind. (HVO-HVA)</strong></td>
<td>1.65 (2.66)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Race</strong></td>
<td>-1.03 (-7.86)</td>
<td>0.32 (0.47)</td>
</tr>
<tr>
<td><strong>Non-White X %Renters</strong></td>
<td>1.78 (2.35)</td>
<td>-0.99 (-0.26)</td>
</tr>
<tr>
<td><strong>Non-White X Public Services</strong></td>
<td>-9.23 (-1.43)</td>
<td>11.93 (1.01)</td>
</tr>
<tr>
<td><strong>Non-White X Bexley</strong></td>
<td>-</td>
<td>-1.55 (-0.60)</td>
</tr>
<tr>
<td><strong>Non-White X Gahanna</strong></td>
<td>-</td>
<td>-1.82 (-0.58)</td>
</tr>
<tr>
<td><strong>Non-White X Grandview Heights</strong></td>
<td>-</td>
<td>-10.9 (-0.33)</td>
</tr>
<tr>
<td><strong>Non-White X Grove City</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Hilliard</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Reynoldsburg</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Upper Arlington</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Westerville</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non-White X Worthington</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\[ R^2 = .78 \quad \text{F Value for racial interaction terms} = 2.09 \]

\[ R^2 = .81 \quad \text{F Value for racial interaction terms} = 1.24 \]

- **a** T-values are given in parentheses.
- **b** No variations in the data to permit a coefficient estimation.
REFERENCES


Fischer, Thomas. City of Columbus, Public Safety Department, Police Division, Research and Development Section. Personal Correspondence, 30 January 1985.


"Highlands Transfer Thwarted," Columbus Dispatch 9 November 1983.

"Issue Asks De-annexation," Columbus Dispatch 6 November 1983.

"Issue 5 to Decide Home for Olentangy Highlands Subdivision Residents," Columbus Citizen's Journal 5 November 1983.


CONCLUSIONS

This dissertation examined two aspects of determining public goods expenditure levels. The first essay contrasted hypotheses of local bureaucratic behavior using two models derived from the Public Finance literature. The first expenditure theory states public officials will provide that level of services preferred by the median voter. Any other level may result in a coalition offering the median preference removing the incumbents from office.

A second model proposed by Romer and Rosenthal (1978, 1979a, 1979b, 1982) incorporates the bureaucrat's power over setting the voting agenda. Seldom do voters get to choose the spending level they prefer. More often they are offered a choice of two alternatives. Either voters can approve a tax increase, or accept the reversion rate if the measure is defeated. Romer and Rosenthal suggest voters may approve spending levels higher than the median preference if their alternative spending level is sufficiently low. The empirical results of the first essay suggest that researchers should be careful not to assume all bureaucrats behave identically while trying to determine which model is "correct."

One way for voters to change the public service-tax package they receive is via the voting booth. Another possibility is for them to relocate to a jurisdiction offering a more preferred level of
services and taxes. The second essay examined the election results of a neighborhood attempting to change jurisdictions through deannexation.

Using a two-period voting behavior model, the essay analyzed the reasoning of central city voters who nearly permitted a public service subsidizer to leave the community. Allowing voters to value the precedent setting aspect of a successful deannexation explained the support received from various subgroups of the voting population.

The results indicated that given a chance many central city residents would approve redrawing jurisdictional boundaries. The procedure for deannexation in Ohio, however, is not costless and does not guarantee success. The rarity of the proposals may not be a signal of approval of the current situation, but may simply be a product of the free rider incentives inherent in the legal process.
REFERENCES


---


---


Fischer, Thomas. City of Columbus, Public Safety Department, Police Division, Research and Development Section. Personal Correspondence, 30 January 1985.


"Highlands Transfer Thwarted," Columbus Dispatch 9 November 1983.


Inman, Robert P. "Testing Political Economy's 'As If' Proposition: Is the Median Income Voter Really Decisive?" *Public Choice* 33 (Winter 1978)

"Issue Asks De-annexation," Columbus Dispatch 6 November 1983.

"Issue 5 to Decide Home for Olentangy Highlands Subdivision Residents," Columbus Citizen's Journal 5 November 1983.


