



Determinants of community support for rural hospitals : evidence from voting on hospital referenda
by Rodney Douglas Fort

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Applied Economics

Montana State University

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Abstract:

The purpose of this thesis is to identify factors influencing community support for rural hospitals, and to discuss the implications of these factors for health planners and policymakers. The first two chapters provide a background and rationale for the research. In the third, a theoretical model of voting decisions by individuals, as they are revealed in hospital referenda, is developed and utilized to predict potentially important determinants of community support for rural hospitals. Multiple regression analysis is used to relate voting outcomes in county level hospital referenda to the explanatory variables suggested by the theoretical model. The policy significance of the empirical results is discussed in a concluding section.

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Rodney D. Fort

Date

June 2, 1980

DEDICATION

This thesis is dedicated to my wife, Leslie Fort, without whose unfailing patience, endless sacrifice, constant moral support, and love this thesis would not have been completed.

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by

RODNEY DOUGLAS FORT

A thesis submitted in partial fulfillment
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Approved:


Chairperson, Graduate Committee


Head, Major Department


Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

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Finally, my parents are deserving of special attention for their support and encouragement.

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ABSTRACT

The purpose of this thesis is to identify factors influencing community support for rural hospitals, and to discuss the implications of these factors for health planners and policymakers. The first two chapters provide a background and rationale for the research. In the third, a theoretical model of voting decisions by individuals, as they are revealed in hospital referenda, is developed and utilized to predict potentially important determinants of community support for rural hospitals. Multiple regression analysis is used to relate voting outcomes in county level hospital referenda to the explanatory variables suggested by the theoretical model. The policy significance of the empirical results is discussed in a concluding section.

CHAPTER 1

INTRODUCTION AND OBJECTIVES

The purpose of this thesis is to identify factors influencing community support for rural hospitals. The evidence is drawn from actual voting outcomes on rural hospital referenda. Studying the behavior of voters revealed in rural hospital referenda is important for two reasons.

First, it contributes to an evolving theory of "public economics" [Buchanan 1975, p. 383] and to the empirical verification of the theory. In particular, within the literature of public economics, a question recently has been raised concerning the ability of the setter of referenda expenditure levels to have a significant impact upon the outcome of such elections [Romer and Rosenthal 1978, 1979 (a), 1979 (b), 1979 (c)]. A test of voter behavior under the setter hypothesis provides information on this current topic.

The second reason that the study undertaken in this thesis is important is that the results are useful for policy purposes. The rural health care arena has recently become a volatile one. Confrontations between health planners and local residents occur frequently and can be expected to continue in the future. The following section provides background on the current state of rural hospitals. It is followed by a brief outline of the procedure employed in the thesis.

Background

Recent occurrences in health care have forced the confrontations mentioned between health planners and rural residents. Rising costs of health care have focused legislative attention on the health care delivery system in the United States with rural hospitals distinguished as high cost facilities. The National Guidelines for Health Planning (August, 1977) recommended a maximum four beds per thousand people and an eighty percent occupancy rate [Zwick 1978]. Since rural hospitals often violate these guidelines, they have been carefully scrutinized as an area for lowering health care costs. The most cost-effective method of meeting the guidelines is often closure of a facility [McClure 1976]. It is when implementation of a closure plan is attempted that the confrontations occur.

It should be expected that if a concentrated group benefits from provision of a public service then considerable resistance will confront plans to eliminate provision of that service. Arguments offered against closure by rural residents include the importance of the hospital to the local economy, the contribution of the hospital to keeping and attracting physicians, and the willingness of communities to finance hospital construction with county tax money and bond issues.¹ Hence, benefits are concentrated locally while costs are dispersed at least partially (for example, through increased health insurance rates among the pool of insured individuals).

The effects of the distribution of rural hospital costs and benefits upon support for hospitals in rural areas can be examined through analysis of voting on rural hospital referenda. These referenda typically arise in the following manner. The desire for a facility is made known to policy-makers (for example, county commissioners) by a local health contingency (such as physicians, health administrators, or concerned elements of the general population). The policy-maker then sets the level of the referendum. The level chosen appears dependent upon referendum-specific factors such as projected costs as well as upon the preferences of the policy-maker. The final stage of the referendum process is the actual vote.

Procedure

The thesis proceeds in three parts. First, in the literature review, background on the problem of identifying and estimating individual demands for collectively provided goods and a rationale for investigation is presented. Second, in Chapter 3, a theory of voting is developed to predict variables that are important in explaining the outcomes of rural hospital referenda. Third, in Chapter 4, multiple regression analysis is used to test the theory on observed voting outcomes and implications of the results are discussed.

CHAPTER 2

REVIEW OF THE LITERATURE

The goals of this chapter are threefold. First, the historical development of the economics subdiscipline of "public economics" is discussed. Second, its relevance to the present research is developed. This relevance involves contributions in the theoretical development of individual behavior and in the referenda voting setting. Third, by describing previous work done under the rubric of "public economics," the contributions of previous authors to the prominent topics approached in this thesis are acknowledged. The review organizes the literature into important topics, describes why these topics are important, and then acknowledges individual works where they have contributed significantly to the topics.

The Evolution of Public Economics

The frequently stated logic for collective provision of certain goods and services distinguishes public goods from private goods. Public goods exhibit two characteristics [Samuelson 1954, Musgrave 1959, and Head 1962]. First, consumption of a public good by one individual does not preclude simultaneous consumption by another individual. This characteristic is often referred to as jointness of consumption. Second, it is prohibitively expensive to exclude (by price) any individual from enjoying the benefits of a public good, once it has been purchased by another. This characteristic is often

referred to as non-excludability. Private goods, on the other hand, are both non-joint and excludable.

Generally, it is concluded that public goods left to production by private individuals will be under-supplied, if supplied at all [Pigou 1932, Olson 1965]. The reason is that, in the case of a large number of consumers, the individual's share of the total cost of the good is small and the individual enjoys the benefits of consumption once the good is produced, whether he contributes or not. If left to private action, it is expected that little voluntary payment will be forthcoming from individuals. They have the incentive to become free-riders. Even though added social benefits of public good provision would be greater than added costs, it is entirely possible that, if all individuals attempt to become free-riders, the public good will not be produced at all. Hence, due to the free-rider incentive, the justification is made for the provision of public goods under some collective mechanism.

Oviously, not all goods lie at the polar extremes of purely private or purely public. Depending upon the mix of the two criteria, excludability and jointness, goods may lie closer to one extreme than to the other. For example, the good examined in this thesis, hospital services, may exhibit both private and public characteristics. The following characterization of contingency value is an attempt to reveal how the complex nature of hospital services, not a purely public good,

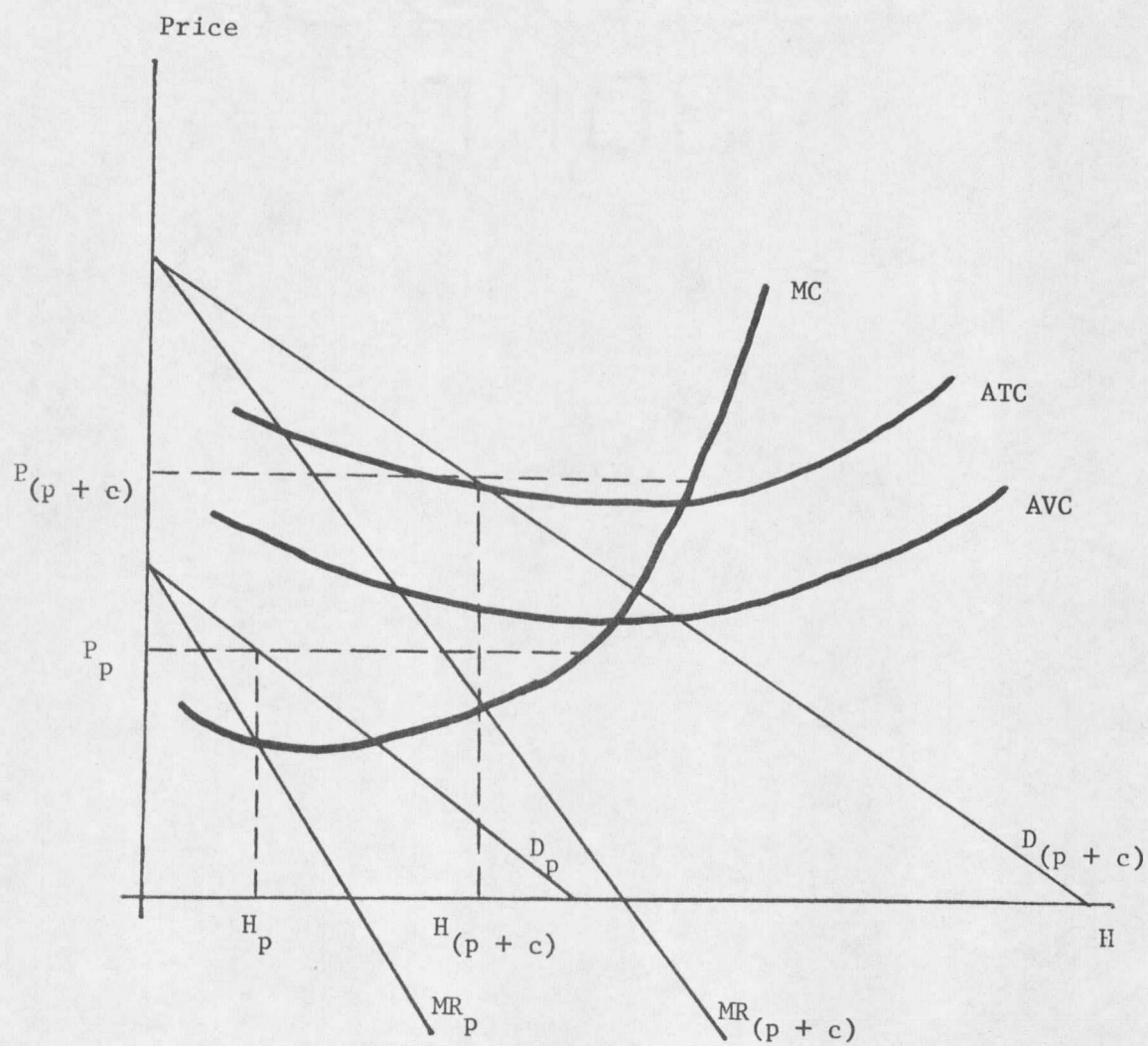
may nonetheless lead to the conclusion that some collective action in its provision is justified.²

Provision of rural hospital services actually satisfies two types of demand. First, demands of users in the present time period are satisfied. Second, as a costless by-product, the demands of potential future users are satisfied. Even if such potential future users never actually use the services, the satisfaction of their contingency demands represents an external benefit. In other words, contingency demanders experience a jointness in consumption with users in the present time period.

The relevant question concerning the economic efficiency of opening, or keeping open, a hospital in the presence of contingency demands becomes: are the summed values that contingency demanders place on the hospital services, plus the value that users in the present time period place on the hospital services greater than the social cost of providing the services? From this perspective, contingency demands may exist in varying degrees for different goods and greatly complicate this calculation of net social value since there may be no viable mechanism for attaching market values to contingency demands. Weisbrod argues that this complication allows for the possibility of inefficient outcomes if provision is left entirely to the private sector [Weisbrod 1964, p. 473].

This outcome can be represented by Figure 1.³ D_p and MR_p

Figure 1. The Effect of Contingency Demands on Production of Hospital Services.



represent the demand and marginal revenue curves associated with users in the present time period, respectively. The average total cost (ATC), average variable cost (AVC), and marginal cost (MC) curves refer to provision of hospital services, H . Equating MR_p to MC and charging what the market will bear results in the price-output combination (P_p, H_p) . At this price-output combination, the producer would choose not to stay in business, even in the short run, since even variable costs are not covered. However, if contingency demands could be ascertained and their value collected, the relevant demand and marginal revenue curves might be $D_{(p+c)}$ and $MR_{(p+c)}$ in Figure 1. Now, equating $MR_{(p+c)}$ to MC yields the price-output combination $(P_{(p+c)}, H_{(p+c)})$. At this combination, both variable and fixed costs are covered and the producer would choose to stay in business.

In a social sense, then, private production can result in an under supply of hospitals in the presence of contingency demands due to the absence of an enforceable payment mechanism.⁴ This is closely akin to the free-rider problem present in pure public goods. Although a hospital may be privately non-viable, summed marginal social benefits may outweigh social costs of provision. As with pure public goods, if contingency demands are significant and a strictly private hospital closes, collective means of provision may be called for on efficiency grounds.⁵

In observing the presently volatile rural hospital arena, it

can be concluded that rural hospitals are highly desired by rural residents. In cases where the costs of rural hospital provision predictably would not be met by revenues from consumers, county governments are sometimes called upon to finance capital costs with county tax revenues. Such decisions are important voting issues for county residents and often times are decided by referenda. In light of the single issue nature of these elections, the voting outcome provides important information relevant to the demands of rural communities for the collectively provided hospital.

However, the question still remains: how are individual demands for collectively provided goods discovered by the providers? Individuals can neither bid for a given supply nor decide what quantity to purchase at a given price as they do in the marketplace. Further, suppliers of collectively provided goods do not offer goods directly to consumers but rather make governmental budget decisions that influence the quantity supplied.⁶

Precisely estimating the demands of citizens for goods which are collectively provided is a difficult task for government decision-makers, as well as for those interested in the economics of such provision. For example, basing expenditure levels on individually reported demands may not produce socially desirable outcomes because individuals lack incentives to truthfully reveal their preferred levels of expenditure under most financing schemes [Deacon 1977, p. 372]. Since

any particular individual may have "above average" or "below average" demands, it is in that individual's interest to misrepresent expected benefits in an attempt to influence provision toward his private optimum. Discovering the upward or downward bias of this incentive to misrepresent has involved the design of reward mechanisms of "ungodly cunning" [Sen 1977]⁷ but limited practical usefulness.

Due to the difficulty of determining demand, analyses of designs intended to ameliorate the free-rider problem and the related incentive to misrepresent have largely confined themselves to identifying allocative effects and estimating tax burdens [Buchanan 1975, pp. 383-4]. In studies during the pre-1930s (and even in many present studies), the influence of collective choice institutions on expenditure levels is taken as given [Deacon 1977, p. 371, Buchanan 1975, p. 384]. Further, such analyses were not undertaken in the context of an explicit behavioral theory [Deacon 1977, p. 371]. These shortcomings - neglect of the influence of collective institutions and absence of an explicit behavioral theory - remained at least until the late 1930s and the 1940s.⁸

Central ideas in the voluntary exchange theory of public finance, the forerunner of modern public economics, were developed by Richard Musgrave [1938], Howard Bowen [1943], and James Buchanan [1949]. Then during the 1950s and 1960s, these central ideas were rapidly expanded into what Buchanan has named "public economics" [Buchanan 1975,

p. 383]. Public economics, as an emerging subdiscipline in economics, is distinguished from traditional public finance in two ways: 1) an explicit behavioral theory of public expenditure has evolved and 2) modeling of public expenditure issues has included existing institutional arrangements explicitly rather than handling them as exogenous. The next section of this chapter describes these distinguishing characteristics in more detail and gives examples of their use.

Public Economics: Characteristics and Examples

The first characteristic of public economics is the emergence of an explicit behavioral theory of individual choice regarding collectively provided goods. This behavioral theory is developed by assuming that individuals have well-defined preferences for collectively provided goods and services just as they do for privately provided goods. Therefore, the basic premise of public economics is that support or opposition for any public sector action is functionally related to perceived magnitudes of expected costs, expected benefits, and the distribution of these costs and benefits under existing fiscal choice institutions [Bartlett 1973, Breton 1974, Buchanan and Tullock 1962, Commons 1940, Downs 1957].

Proceeding from the base of the individual decision process (i.e. how individuals weigh benefits and costs at the margin) many authors utilize the traditional concept of utility maximization

(examples of utility functions maximized with respect to budget constraints are found in Appendix A). Other researchers bypass rigorous development of the individual optimization strategy and begin by specifying a demand function outright [Borcherding and Deacon 1972, Birdsall 1965, Peterson 1975]. Since the first approach is used in this thesis, it is important to note that the difference between the utility maximization framework for public goods and traditional utility maximization involving only private goods is the inclusion of a budget constraint imposed by the public sector. In this way, the individual is forced to account for the marginal benefits and marginal costs of collectively provided goods just as with privately provided goods.

The second characteristic that distinguishes public economics from traditional public finance is that public economics models have attempted to include the effects of existing institutional arrangements, rather than treating them as given. Two methods of incorporating institutional effects are prevalent. These are 1) the analysis of expenditure levels to determine actual individual demands for collectively provided goods and 2) the analysis of voting outcomes which is indicative of individual demands only when individual voting data are available. If only aggregated voting data are available, the analysis of voting approach allows only general inferences about the disposition of the population to be made. Since this thesis uses the second

approach, with aggregated data, the analysis of expenditure approach will receive only brief mention.

Analyses of expenditure levels typically rely on the theory of the median voter. While Harold Hotelling [1929] discussed the tendency for politicians to choose "middle of the road" platforms, more rigorous development of what is called the median voter theory was begun by Howard Bowen [1943] and actually formalized by Duncan Black [1948, 1958]. According to the median voter theory, 1) if a simple majority rule prevails, 2) if a full range of alternative expenditure levels appears on the ballot and 3) if individual preferences between the alternatives are single-peaked (i.e. not V-shaped), then 4) the voters who prefer the median expenditure level will see their preferences realized in the collective choice [Black 1958, pp. 14-24, Musgrave and Musgrave 1976, pp. 104-5]. The theory tends to support the conclusion that, with brisk political competition, non-median strategies invite defeat. Hence, politicians have incentives to search for and adopt the median position. This suggests that actual politically derived expenditure levels will approximate the median demand in the jurisdiction and, hence, analysis will pertain to a particular individuals' demands.

In order to transform this analytical method into an operational empirical framework, it is usually assumed that the median voter possesses the median explanatory characteristics in the jurisdiction; the

median voter pays the median tax share and occupies the median position in the income distribution. Complete specifications of the median voter model can be found in Barr and Davis [1966], Bergstrom and Goodman [1973], and Borcharding and Deacon [1972]. Other assumptions also are necessary to apply the model but they are of lesser importance for a general understanding of the model.⁹

The basic median voter model just described has been used to estimate individual demands for many local collectively provided goods [Barlow 1970, Bergstrom and Goodman 1973, Borcharding and Deacon 1972, Pommerehne and Frey 1976]. The successfulness of these attempts is described by Robert Deacon [Deacon 1977, p. 378]:

Despite differences in specification, the results of these studies show a degree of qualitative consistency; negative price elasticities and positive income elasticities, that are generally statistically significant, have been observed. A measure of agreement appears to be emerging regarding the general shape of public service demand functions. In most cases, demands appear to be price inelastic and estimated income elasticities are positive though less than unity.

Despite the reasonableness of the empirical results obtained from the median voter model, criticism of the model has surfaced. The criticism arises from a basic institutional question. What if it is not assured that a full range of alternative expenditure levels will appear on the ballot? In other words, perhaps lack of political competition in some areas does not allow the preferred level of the median voter to even appear on the ballot.¹⁰ Thomas Romer and Howard

Rosenthal take this position. In a series of papers, they argue that in many cases the alternative levels of expenditure that appear on a ballot are under the control of a setter [Romer and Rosenthal 1978, 1979(a), 1979(b), 1979 (c)]. This setter may be a bureaucrat or an elected official acting according to his own preference function. Following William Niskanen [1971], Romer and Rosenthal postulate the setter's preferences as expenditure maximization subject to the constraint of staying in office [Romer and Rosenthal 1979(a)]. Further, they argue that the constraint is weak due to entry barriers inherent to the political arena [Romer and Rosenthal 1979(a)]. Their conclusion is that deviations from the preferences of the median voter seem likely to occur. The setter's preferred expenditure level need not coincide with that preferred by the median voter.¹¹

Two aspects of the analysis of rural hospital voting undertaken in this thesis are worthy of particular notice. First, individual voting data were not available. Aggregated secret ballot data do not allow one to identify how any single individual voter actually cast his ballot. As a result, the type of available voting data affect the interpretation of empirical results. These results do not pertain to individual behavior and demands. Rather, interpretation of empirical results pertains to an abstract representation of community behavior. Second, the presence of Romer's and Rosenthal's setter appears pervasive in rural hospital elections. The hospital referenda studied in this thesis

are of three types: 1) funds for building new hospitals where none existed previously, 2) funds for building hospitals to replace existing ones, and 3) funds for remodeling or expanding existing hospitals. Typically, these referenda can be characterized as all-or-nothing propositions. For the first category, new hospitals, the threat is that physicians will leave the rural community (or, never enter the area to begin with) unless the facility is built. For the remaining categories, replacement hospitals and expansion/remodeling, the threat is that physicians will leave unless they get what they want and/or that lost federal Medicare/Medicaid accreditation due to deficient facilities will force the existing facility to close. In any event, the all-or-nothing threat is the complete absence of doctors and hospitals.

The ability of the setter to confront voters with all-or-nothing propositions is of current interest in the public choice literature [Romer and Rosenthal 1978, 1979(a), 1979(b), 1979(c)] because it seriously undermines the assumption of brisk political competition that is so crucial to the median voter model.¹² While this thesis is not an application of the median voter approach, a test of voter behavior under the power of the setter, developed in Chapter 3 and performed in Chapter 4, pertains directly to this current topic. The remainder of this section is devoted to the method of voting analysis.

The simplest voting choices that individuals face are local elections where finance levels for various collectively provided goods are

decided by popular referendum.¹³ Issues are typically stated in terms of alternative property tax rates and only a single service is involved. Hence, tax liabilities are easily computed and there is little uncertainty as to where funds will be spent. The explicit behavioral theory that evolved within public economics, based upon utility maximizing behavior involving both private and collectively provided goods, indicates that the voting decision will be reached by weighing costs and benefits of ballot alternatives. In other words, the individual comes to a decision by comparing the utility levels associated with passage of the referendum and defeat of the referendum and then chooses the alternative that yields highest utility. In this manner, by including the institution of voting in public decisions, public economics makes its second contribution to the research at hand.

As in traditional private goods demand theory, the inclusion of collectively provided goods into the individual decision calculus suggests variables which might help explain demands for collectively provided goods. The theory suggests that price and income effects will be important factors in the demand for collectively provided goods, just as they are for privately provided goods. The price effect for collectively provided goods demand can be identified relative to the individual's assessed taxable property value since the good is financed from property taxes [Barr and Davis 1966, p. 152]. Income effects can be identified by 1) absolute levels of jurisdiction income

such as median county income and 2) specifying groups within the population that are expected to experience changes in income due to changes in public policy, a priori. Aside from price and income effects, the theory suggests that tastes and preferences will influence demand. An operational method to account for the presence of tastes and preferences is to identify groups within the population that can be expected, again a priori, to exhibit similarities in tastes and preferences. For example, Deacon and Shapiro [1975, p. 948] use voter party affiliation as an ideology proxy. In this way, estimating demands for a collectively provided good requires one to identify a relationship between the probability of a yes vote and variables that economic theory suggests will influence that probability. The general form of the probability density function for yes votes must be specified beforehand.

In an example of the analysis of voting approach, Daniel Rubinfeld [1977] found supporting evidence for the basic explanatory variables suggested by economic behavioral theory. In a cross-sectional analysis of the precinct vote on a Troy, Michigan school mill election, using individual voting data, Rubinfeld found that 1) ceteris paribus, the probability of a yes vote was inversely related to the tax-price of schooling, 2) as income rose, the probability of a yes vote increased, 3) the probability of a yes vote was positively related to the number of children in a given household that attended public schools, 4) the greater the number of years a person resided in the jurisdiction, the

lower was the probability of a yes vote, and 5) the probability of a yes vote increased if the voter was employed as a teacher. Other variables were used but only the statistically significant ones have been listed here. While the designs of other studies vary in detail, they are consistent in specifying demands for collectively provided goods to depend upon tax-price, income, and socioeconomic characteristics [Barkume 1976 and 1977, Deacon and Shapiro 1975, Levy 1975, Märotti 1978, Mikesell and Blair 1974, Neufeld 1977, Peterson 1975, Schroeder and Sjoquist 1978].

Summary

This literature review has pursued three goals. First, historical background on the development of the public economics framework used for analysis in this thesis was provided. The characteristics that distinguish public economics from its public finance heritage are 1) the evolution of an explicit behavioral theory of public expenditure rooted in familiar utility maximizing demand theory and 2) the development of models that operate within the institutional voting setting. In short, public economics operates under the premise that society is a collection of individuals with the same motives driving the demand for collectively provided goods as drive the demand for privately provided goods. Further, it offers an approach to the analysis of collective outcomes that incorporates institutions in their contemporary forms.

While new sets of institutions are of interest and their pursuit important, analysis under existing institutions is important to the extent that the objective is examining immediate policy questions.

The second goal was to show the relevance of public economics to the analysis of local support for rural hospitals. This goal was met by identifying two public economics approaches to estimating the demand for collectively provided goods, one involving the median voter approach and another analyzing actual voting outcomes. Also, it was shown why the second method was adopted for use in this thesis: the type of data available and the prevalence of the setter. It is expected that the evidence of the setter's influence provided by this thesis will add to the growing information base used to evaluate the usefulness of the median voter approach.

The remainder of this thesis develops and estimates an explanatory model of local community support for rural hospitals based upon the voting outcomes of referenda elections for rural hospital construction projects. The explanatory variables will stress the effects that individually perceived expected costs, expected benefits, and their distribution have upon voting behavior. The works of other authors, outlined in this literature review, provide the basis and justification for the model.

CHAPTER THREE

A MODEL OF HOSPITAL REFERENDA VOTING

The preceding literature review suggests important criteria for a model of hospital referenda voting. First, the demands for collectively provided goods must be developed at the individual level. Second, a theory that unifies the individual's behavioral strategy and the institutional voting setting must be advanced. The purpose of this chapter is to satisfy these criteria and to specify the variables that are expected to influence the individual's voting decision.

The Individual and the Collectively Provided Good

The behavioral assumption in this theory development is rational utility maximization. When individuals are faced with a range of alternatives, their decisions are based on a ranking of the alternatives according to well-defined preferences. Rationality, in this sense, dictates that the highest ranked alternative is chosen. To simplify presentation of the theory, a utility function is specified which incorporates only two arguments: collectively provided hospital services and a privately provided good representing all other goods and services. Let the continuous, quasi-concave utility function for individual i be

$$(1) \quad u^i = u(q, x)$$

where the i superscript denotes individual i , q = collectively provided hospital services, and x = the privately provided good.

Hospital services are a function of capital and labor inputs in a production function sense. Hence,

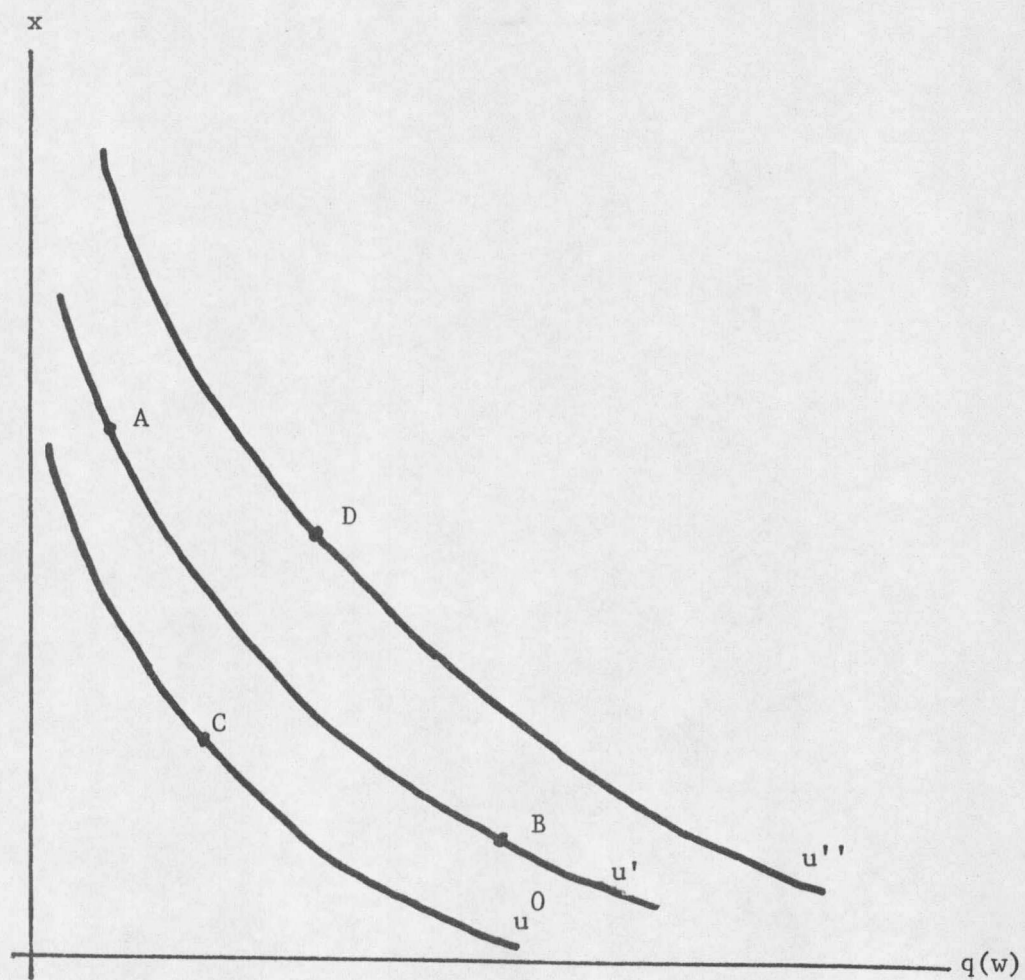
$$(2) \quad q = Q(w, \ell)$$

where w is hospital capital characterized by size, availability, and age. Labor inputs are represented by ℓ . It is assumed that, once the desired level of collectively provided hospital capital is determined, a unique level of labor is required to accompany it.¹⁴ In this simplified manner, hospital services can be treated as a variable affected by adjustments in capital only, since the level of labor is deterministic. Hence, the utility function becomes:

$$(1') \quad u^i = u(q(w), x).$$

Let A be one bundle of quantities of a privately provided good, x , and the collectively provided good, $q(w)$. Let B represent another bundle with different quantities of the two goods. According to the individual's preferences for the privately and collectively provided goods, either A is preferred to B , B is preferred to A , or the individual is indifferent between A and B . Bundles that all provide the same level of satisfaction, or utility, can be graphed as indifference curves. Curve u' in Figure 2 represents bundles, such as A and B , that provide one level of utility while curve u'' represents bundles, such as

Figure 2. Indifference Curves for x and $q(w)$.



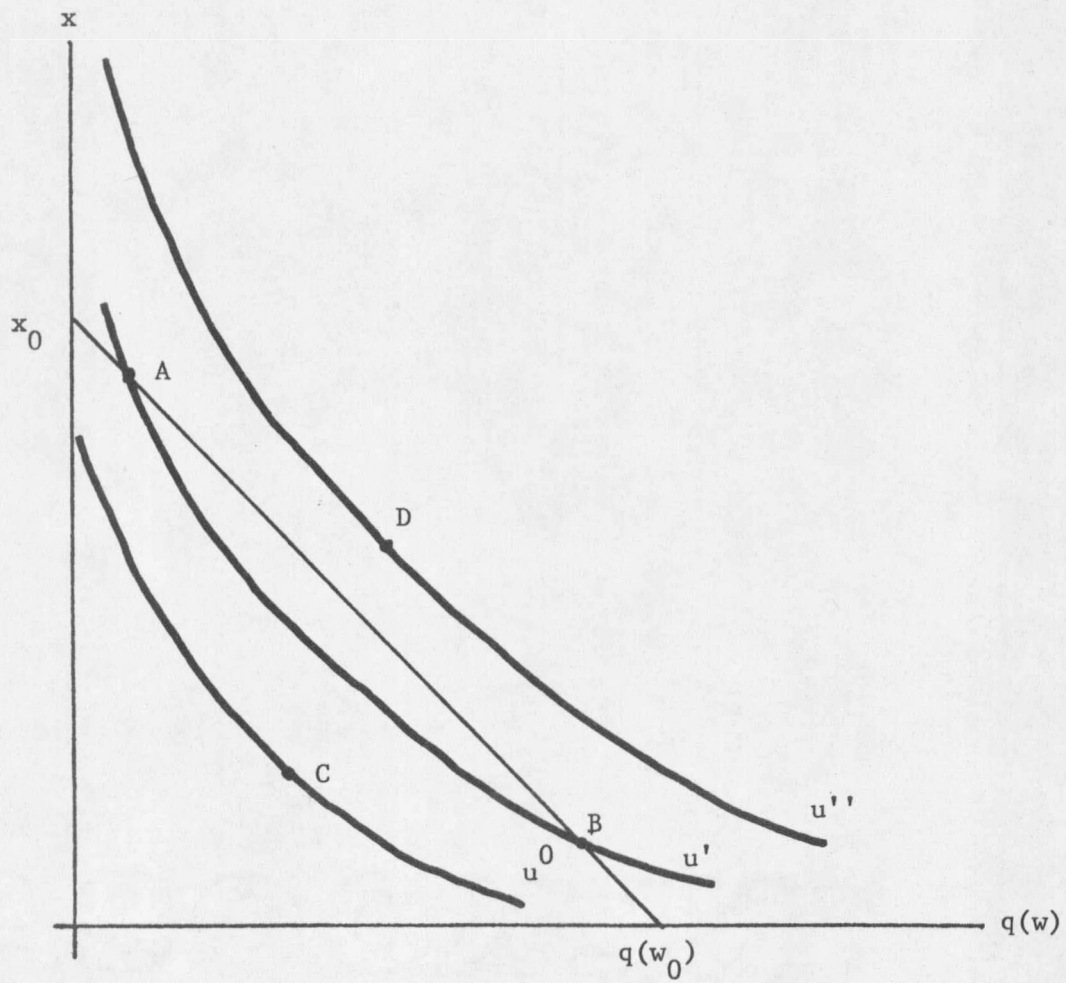
D, that provide a higher level of utility. It is important to note that while indifferent between bundles that lie on a single indifference curve, the individual is not indifferent between bundles located on separate indifference curves. Bundle D provides a higher level of utility than bundles A and B while A and B, in turn, provide a higher utility level than bundle C on curve u^0 . Indifference curves 1) are convex due to diminishing marginal utility, 2) cover the entire region between the axes, and 3) cannot intersect when consumer preferences are assumed transitive.

The consumer is constrained in his consumption by the level of his income. The consumer's budget line represents the combinations of privately and collectively provided goods that his income can purchase. If no units of x are purchased, the consumer can purchase some level of $q(w)$, say $q(w_0)$. Conversely, if no units of $q(w)$ are purchased, the consumer could purchase some level of the privately provided good, say x_0 . In Figure 3, the straight line connecting $q(w_0)$ and x_0 shows all different combinations of the two goods that can be purchased with a given level of income.

Utility maximization dictates that all income be allocated to utility producing consumption. In this simple two-good world, the budget line is of the form:

$$(3) I^i = px^i + rv^i$$

Figure 3. Indifference Curves and the Consumer's Budget Line.



where I^i = income of the i^{th} individual, p = price of one unit of the privately provided good, x^i = actual number of units of the privately provided good consumed by the i^{th} individual, r = the mill rate levied to cover the cost of collectively provided hospital capital, and v^i = assessed value of taxable property possessed by the i^{th} individual.

The mill rate is assumed to be determined by the collective taxing authority from the balanced budget constraint

$$(4) \quad h(q(\bar{w})) = G(q(\bar{w}), I^c) + rV$$

where $h(q(\bar{w}))$ = the cost of a given level of collectively provided hospital capital, $\bar{w}$, and V represents the total assessed value of all community taxable property.

The specification of G in expression (4) represents intergovernmental grants. The most dominant form of intergovernmental grant that historically affected rural hospital capital stock was money distributed by the federal government under the Hill-Burton Program. The amount of these grants was directly related to the proposed amount of hospital construction. However, amounts paid under the Hill-Burton Program were adjusted for relative community income levels (i.e. richer communities were expected to pay a greater proportion than poorer ones) [Lave and Lave 1974] and, hence, the specification in (4) of $G(q(w), I^c)$ where I^c = the community income level.

Solving (4) for the mill rate, $r(q(\bar{w}))$, substituting into (3), and rearranging terms yields the consumer's reduced private-social budget constraint:

$$(5) \quad I^i = px^i + \frac{y^i}{V} (h(q(\bar{w})) - G(q(\bar{w}), I^C)).$$

The second term on the right-hand side of (5) can be thought of as the "price" to consumer i of one dollar's worth of collective expenditure on $q(w)$ multiplied by the actual number of dollars that the community spends on $q(w)$. This price term, y^i/V , is the consumer's portion of the total assessed value of all community taxable property, i.e. the share that consumer i is deemed to be responsible for.

If available income is spent in such a manner that no combination of expenditures at the same level, or a lower level, would yield greater utility than the actual chosen expenditures, then the consumer has maximized utility, or satisfaction, and is said to be in equilibrium.

The highest attainable level of individual utility occurs where $q(I')$ is maximized subject to constraint (5). If the individual was free to choose personally optimal consumption levels of $q(w)$ and x , the following Lagrangean represents the optimization problem:

$$(6) \quad L = u(q(w), x) + \lambda (I^i - \frac{y^i}{V} (h(q(w)) - G(q(w), I^C) - px^i)$$

where the Lagrangean multiplier, λ , represents the marginal value of

income. Partially differentiating (5) with respect to w , x^i , and λ yields:

$$(7) \quad \frac{\partial L}{\partial w} = \frac{\partial u}{\partial q} \frac{\partial q}{\partial w} - \lambda \frac{v^i}{V} \left(\frac{\partial h}{\partial q} \frac{\partial q}{\partial w} - \frac{\partial G}{\partial q} \frac{\partial q}{\partial w} \right)$$

$$(8) \quad \frac{\partial L}{\partial x^i} = \frac{\partial u}{\partial x^i} - \lambda p$$

$$(9) \quad \frac{\partial L}{\partial \lambda} = I^i - \frac{v^i}{V} (h(q(w)) - G(q(w), I^C)) - px^i.$$

Setting (7), (8), and (9) equal to zero to satisfy first order conditions for maximization of a function results in:

$$(7') \quad \frac{\partial u}{\partial q} \frac{\partial q}{\partial w} = \lambda \frac{v^i}{V} \left(\frac{\partial h}{\partial q} \frac{\partial q}{\partial w} - \frac{\partial G}{\partial q} \frac{\partial q}{\partial w} \right)$$

$$(8') \quad \frac{\partial u}{\partial x^i} = \lambda p$$

$$(9') \quad I^i - \frac{v^i}{V} (h(q(w)) - G(q(w), I^C)) - px^i = 0.$$

Solving (7') and (8') for λ and then setting the two expressions equal to each other yields the optimality condition:

$$(10) \quad \frac{\frac{\partial u}{\partial q} \frac{\partial q}{\partial w}}{\frac{\partial u}{\partial x^i}} = \frac{\frac{v^i}{V} \left(\frac{\partial h}{\partial q} \frac{\partial q}{\partial w} - \frac{\partial G}{\partial q} \frac{\partial q}{\partial w} \right)}{p}$$

The left-hand-side ratio of the partial derivatives of u with respect to w and with respect to x^i can be interpreted as the ratio of

the marginal utilities with respect to w and x . The numerator of the right-hand-side of (10) can be interpreted as the marginal cost of a change in w while the denominator is the marginal cost of a change in x (equal to the price of x under competitive assumptions). Under these interpretations, (10) becomes

$$(10') \quad \frac{MU_w}{MU_{xi}} = \frac{MC_w}{MC_x^i}$$

where MU denotes marginal utility and MC denotes marginal cost. Expression (10') is the familiar condition that the slope of the indifference curve must equal the slope of the budget line for the consumer to be in equilibrium. Further, condition (10') implies that when the consumer is in equilibrium,

$$(11) \quad \frac{MU_w}{MC_w} = \frac{MU_x^i}{MC_x^i}$$

or that the marginal utility per dollar allocated to expenditure on the two goods should be equal. If expenditure levels were not chosen in this manner, then an additional increment in one type of expenditure would yield higher marginal utility gains than an additional increment of the other type of expenditure. The consumer would not be in equilibrium and, accordingly, expenditures would be reallocated.

First order condition (7') helps explain the consumer's move toward optimality in a very basic manner. Rearranging (7') yields:

$$(7'') \quad \left(\frac{1}{\lambda}\right) \frac{\partial u}{\partial q} \frac{\partial q}{\partial w} = \frac{v^i}{V} \left(\frac{\partial h}{\partial q} \frac{\partial q}{\partial w} - \frac{\partial G}{\partial q} \frac{\partial q}{\partial w} \right).$$

This conclusion can be interpreted as follows. The right-hand-side is the added cost to individual i of an increase in hospital capital stock. The left-hand-side expresses the individual's dollar valuation of the utility increase resulting from the increase in hospital capital stock. Thus, (7'') shows that the consumer is in equilibrium when the consumer's valuation of the additional utility derived from changes in w just equals the consumer's additional cost resulting from changes in w .

The first criterion for a hospital referenda voting model has been met. Under the behavioral assumption of utility maximization, a condition for optimal individual consumption has been derived. However, the individual is not free to obtain the personal optimum level of w , since the level of collectively provided hospital capital is a non-incremental, collective decision. Hence, a theory that unifies this individual strategy and the institution of voting is required. This is the second criterion for a model of hospital referendum voting set forth in the introduction to this chapter.

The Individual and the Collective Institution: A Unifying Theory of Voting

Robert Deacon and Perry Shapiro [1975] develop a theory that

unifies the individual's utility maximizing strategy with the institution of voting. Their theory is adopted for the purpose of identifying important explanatory variables for rural hospital referenda.

Assuming that constraint equation (5) is satisfied, the solution to the maximization problem embodied in equation (6) can be solved for an optimal level of private consumption in terms of price, disposable income, and a predetermined level of collectively provided hospital capital. The highest attainable level of utility can be written in the general form

$$(12) \max_{x^i} u^i = U_k^i(p_k, q(w_k), I_k^i - \frac{v^i}{V} (h(q(w)) - G(q(w), I^c))_k).$$

A change in public policy toward hospital capital stock can affect those variables with the k subscript. In turn, the changes will affect induced utility, U^i ("induced utility" since the decision concerning the level of hospital capital is a collective one and, hence, not necessarily individually optimal). Since v^i/V is in part choice-determined, its inclusion as a parametric variable on the right-hand-side of (11) is not strictly valid, but does simplify exposition.¹⁵

A referendum confronts the voter with a choice between two alternative outcomes and, hence, two possible utility levels. Let $k = 0$

denote the outcome if the referendum fails to pass (the reversion) and let $k = 1$ denote the outcome if the referendum does pass. The highest attainable utility levels associated with each outcome are U_0^i and U_1^i , respectively:

$$(13) \quad U_0^i = U^i(p_0, q(w_0), I_0^i - \frac{v^i}{V} (h - G)_0)$$

$$(14) \quad U_1^i = U^i(p_1, q(w_1), I_1^i - \frac{v^i}{V} (h - G)_1).$$

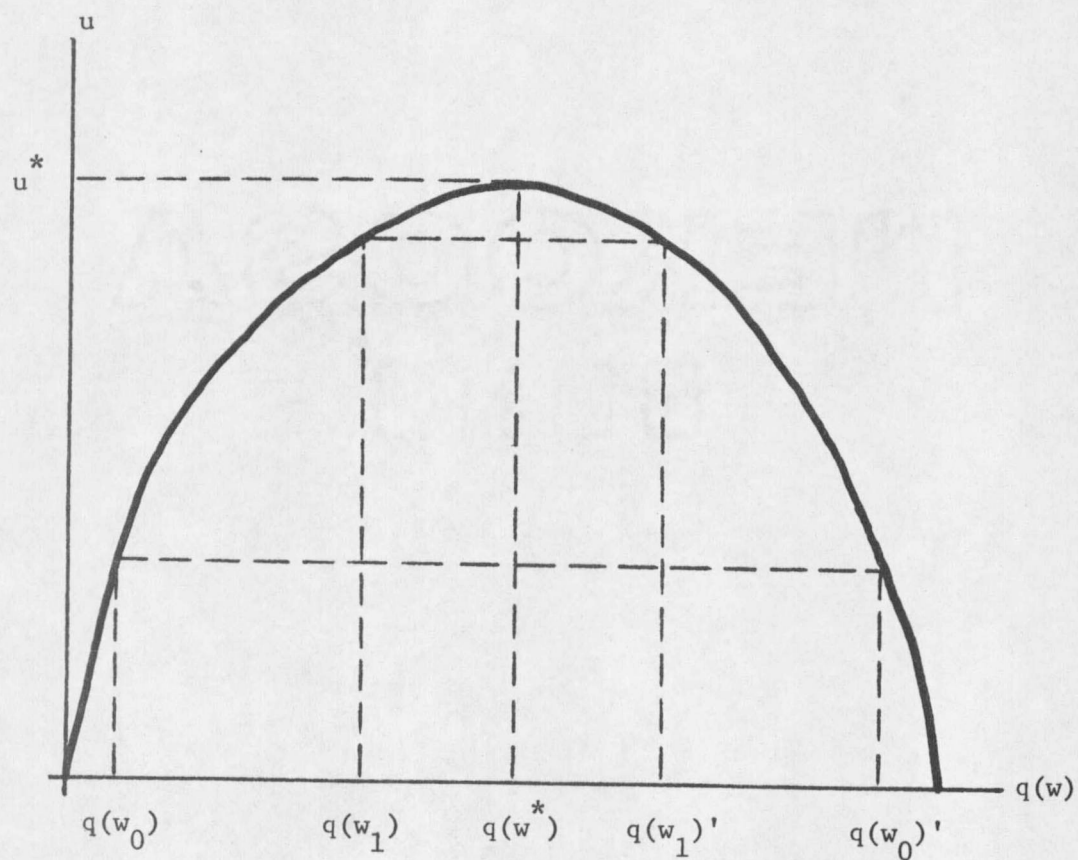
The unifying voting rule consistent with utility maximization is:

vote YES if $U_1^i > U_0^i$, otherwise vote NO.¹⁶

If all attainable utility points from Figure 3 are graphed, the result is Figure 4. This graph shows the different levels of utility that can be induced by different levels of collectively provided hospital capital stock. If the individual could choose a single level of collectively provided hospital capital, it would be $q(w^*)$ since the utility level associated with that output is the highest attainable.

It is important to note, however, that the individual does not have the opportunity to choose his personal, but collectively provided, optimum. That actual level of hospital stock is decided, instead, by all individuals who vote. Further, as pointed out in the literature review, the alternatives that actually confront voters may be restricted by an individual whom Romer and Rosenthal [1978, 1979(a), 1979(b), 1979(c)] have dubbed the "setter". If the setter possesses

Figure 4. The Setter's Influence on the Level of the Referendum and the Importance of the Reversion.



the ability to confront voters with an all-or-nothing proposition, then considerable variation around the preferences of a theoretically pivotal voter can be expected in the presence of the setter. Figure 4 also reveals the crucial nature of the power of the setter.

In Figure 4, the range of referendum alternatives that will receive a YES vote under the unifying rule is between $q(w_0)$, the all-or-nothing reversion, and $q(w_0)'$. Levels of proposed expenditure within this range will receive a YES vote since the utility levels associated with such expenditures are always greater than the level of utility associated with the reversion. Hence, a setter capable of all-or-nothing propositions who operates according to the dictates of his own self-interest, for example the maximization of collective expenditures, has leeway to propose expenditures up to $q(w_0)'$.

The degree of the setter's leeway is tied directly to the reversion. Recall that the "reversion" is the level of hospital capital that will exist if the referendum fails. For example, if the reversion is $q(w_1)$ instead of $q(w_0)$ in Figure 4, then the setter is constrained to $q(w_1)'$ as his maximum position rather than $q(w_0)'$. Any proposition beyond $q(w_1)'$, under reversion $q(w_1)$, would fail since the utility level associated with such a proposed expenditure is lower than the utility level associated with $q(w_1)$. Under such a circumstance, the voter would choose the reversion, $q(w_1)$, vote NO, and accept the reversion level of hospital capital.

It is hypothesized in this analysis that the hospital referenda arena is predominated by the "setter" and that the reversion level of hospital services is important in explaining actual election outcomes as a result of this predominance.¹⁷ Whether the all-or-nothing reversion is important to voters, in an empirical sense, depends upon whether or not voters discount the setter's threats. This suggests that two alternatives should be tested for their relative explanatory powers, the setter's threat versus voter discounting of such threats. Such a test is developed in the next section of this chapter.

It is implicit in the above decision rule that voters rationally calculate benefits and costs. However, it is often argued that voters do not make such calculations. Due to the high cost of becoming informed, voters remain "rationally ignorant." Pommerehne and Schneider [1978] argue that the incentive to become informed is higher in popular referendum votes than in other types of votes, such as votes for representatives. This observation is based upon the explicit unidimensionality of such issues as hospital referenda. Voters are not asked to decide between two platform "lumps" as when choosing candidates for office. This factor alone lowers the cost of being informed. In the case of hospital referenda, the nature of the debate leading to the vote is vigorous and occurs among small populations. Further, an examination of sample ballots shows them to be

clearly stated. Hence, there is little uncertainty about how and where funds will be spent. Benefit and cost calculations under these circumstances are less complicated than for other types of elections and the incentives to be "rationally ignorant" are reduced.

Explanatory Variables Suggested by the Model

Explanatory variables expected to influence the individual's voting decision can be conveniently identified in terms of the difference in potential utilities under the reversion and referendum alternatives.¹⁸ This difference in potential utilities can be written in "change notation" as

$$(15) \quad U_1^i - U_0^i = \Delta U^i(\Delta p, q(\Delta w), \Delta I^i - \frac{v^i}{V} \Delta(h(q(w) - G(q(w), I^C)))$$

where Δp , Δw , ΔI^i , and $\frac{v^i}{V} \Delta(h - G)$ are differences in private prices, hospital capital, income, and tax bill under referendum passage or failure.

Due to the nature of the aggregated voting data available for rural hospital referenda, the explanatory variables that will be used explain a representative concept of "community support." Therefore, price and income effects, for example, can be thought of as representing the effects on a representative individual within the community.

Such an individual may be described by "mean" or "median" characteristics in an analysis of actual voting outcomes (as distinguished from analysis of expenditures where the theory of the median voter is prevalent). It remains a task for empirical investigation to discover the relative explanatory powers of different descriptions of the "representative individual."

The variables selected for empirical analysis are 1) the level of hospital capital that will prevail under passage of the referendum, w_1 , 2) the reversion level of hospital capital (i.e. the level associated with referendum failure), w_0 , 3) individual income, I^i , justified on the basis of the constrained utility maximization framework, 4) expected income changes due to passage or failure of the referendum, ΔI^i , 5) variations in the price of collectively provided hospital capital to the representative county resident in each county, v^i/V and 6) intergovernmental grants, G . In addition, operational methods of controlling for variation in other factors are discussed.

Unfortunately, data limitations often require that the explanatory variables actually used in empirical estimation are not the ones that theory would dictate as ideal. Thus, while individual income is observable, the potential differences in income under alternative referendum outcomes are not. Also, while a representative individual price for the collectively provided good can be derived for the

representative individual in each county, alternative tax bills under alternative referendum outcomes, i.e.

$$(16) \quad \frac{v^i}{y} \Delta (h(q(w)) - G(q(w), I^C)),$$

cannot be. In such cases, proxy measures are used.

With respect to w_1 , the variables that characterize the level of potential hospital capital if the referendum passes, typically the voter knows only the number of beds involved with passage of the referendum. For this reason, let the expenditure level specified in the referendum stand as a proxy for the level of hospital capital associated with passage of the referendum. Further, voter-perceived hospital capital quality will depend to some extent upon the number of persons with access to the proposed capital stock. Hence, the level of hospital capital associated with passage of the referendum can be specified as:¹⁹

$$(17) \quad w_1 = f(H, n)$$

where H = proposed expenditure on hospital capital and n = the number of persons receiving services from the added capital. For empirical work, expenditure per capita is chosen to represent (17), overall.

It was mentioned that the reversion level of hospital services, w_0 , is an important explanatory variable, due to the existence of the "setter." If a setter with the power to confront voters with an all-

or-nothing proposition exists, then deviation from the preferences of a theoretically pivotal voter can occur. The existence of a setter appears to be important in the hospital referenda arena. Threats of closed facilities and of emigration of physicians are common in the political debate concerning hospital referenda. Do voters believe these threats or do they discount them? In order to test whether voters believe the setter's threat, two alternative explanations of the reversion, or referendum failure, levels of hospital capital stock are included in the analysis. If the voter expects to lose the facility in the event of referendum failure, then it is assumed that the voter also expects the level of hospital capital stock associated with the next best alternative facility to be available. The reversion which best describes the level of hospital stock available if the referendum fails, under the setter's threat, is assumed to be the facility nearest the one threatened with closure. This reversion will be referred to as the alternative reversion. On the other hand, if voters do not believe the setter's threat, the reversion that should explain voter behavior is the status quo level of hospital capital. In this case, voters go to the polls believing that the status quo will remain even if the referendum fails. This reversion will be referred to as the status quo reversion.

The variables chosen to reflect hospital capital stock levels under each reversion are: 1) the size of the hospital, measured by

number of beds (larger hospitals typically have broader service mixes), 2) the percent occupancy rate, indicating average availability of access, 3) age of the building, indicating quality of the facility itself, and 4) distance to the nearest alternative to the status quo, indicating response time and travel costs. Under this specification, the models which describe the alternative and status quo reversions can be stated as:

$$(18) \quad q_0 = w_0(S, 0, D, a)$$

$$(19) \quad q'_0 = w'_0(S', 0', a')$$

where S = size (number of beds), 0 = percent occupancy, D = distance to the alternative to the status quo, a = age of the building, and the "prime" superscript denotes the status quo. Under these specifications of the two reversions and the referendum level of hospital capital, individual decisions are not restricted to purely expenditure related quantitative interpretation. Additional information on qualitative perceptions is allowed to supplement the interpretation and enhance its meaningfulness.

In economic studies of voting behavior, price and income effects have proven to be theoretically and empirically important variables in explaining individual decisions. Since hospital referenda votes involve changes in the property tax rate, the specific price of

additions to hospital capital depends on the assessed value of an individual's taxable property. The fact that the property tax is a selective tax on a certain type of consumption (e.g. owned housing) means that there will be both an income effect and a relative price (or substitution) effect not found in expenditure decisions financed by general taxes such as sales or income taxes [Musgrave and Musgrave 1976, pp. 463-465].

The explanatory price variable that the model suggests is:

$$(20) \quad p_q^i = \frac{v^i}{V}$$

where, to restate, v^i = assessed value of taxable property possessed by the i^{th} individual and V represents total community assessed taxable property value. The price term, p_q^i , represents the i^{th} individual's share of the total community taxable property value, which equals the individual's price per dollar of collective expenditure on hospital capital.

The focus of this thesis is on support for rural hospitals at the community level, defined to be the county. Given two counties subscripted A and B, if V_A equals V_B while at the same time the chosen representative $(v^i)_A$ is greater than $(v^i)_B$, then the representative voter in county A would desire a lower level of collectively provided hospital capital than would the voter in county B [Barr and Davis

1966, p. 152]. In short, when

$$(21) \quad (p_q^i)_A > (p_q^i)_B$$

under the stated assumptions,²⁰ the implication is that desired levels of collective hospital capital are greater in county B than in county A.

Income variables suggested by the model involve the level of chosen representative income at the time of the referendum, I^i , and expected changes in income under passage and failure of the referendum, ΔI^i . For purposes of estimation, the first explanatory income variable is observable as median county income. Expected changes in income can be represented with data on groups within the population that can be expected, a priori, to experience changes in income due to changes in hospital output. The proxies used for empirical analysis are 1) the percentage of the county population which is employed full-time in the status quo facility and 2) the percentage of the county population which is employed in retail and wholesale establishments. The latter is expected to account for changes in business activity due to changes in hospital expenditures and the expenditures of hospital visitors.

The model also suggests that intergovernmental grants will affect the voter's decision. Intergovernmental grants for rural hospitals historically involved Hill-Burton Program money. Data were available on 1) the expenditures specified in the sample referenda and 2) which

hospitals in the sample received Hill-Burton funds. Unfortunately, it was not possible to ascertain whether the expenditures specified in the referenda typically covered the balance of total project cost minus Hill-Burton grants. Hence, a precise estimate of the effect of Hill-Burton money on net county cost ($h(q(w)) - G(q(w), I^C)$, in equation (15)) was unobtainable. However, the dates of both the elections and Hill-Burton grant approval were available. The technique of binary variables was used to account for the effect of Hill-Burton grants on the voting outcome. Binary variables for 1) Hill-Burton funding within eight years prior to the election and 2) within eight years after the election were used. The omitted category was "no Hill-Burton funding."

The model developed in this chapter is static in nature. It assumes tastes and preferences are constant. Empirically, this is not necessarily the case. One operational method that accounts for differences in tastes and preferences within the sample is to assume that such variations will be similar among certain subsets of the population. The variables used to account for relatively high demanders of hospital capital are: 1) the percentage of the county population that is over sixty-five years of age and 2) birth rate per thousand population in the county.

In addition to the variables described above, several variables

were added to the empirical analysis as controls. First, the year of the referendum was included to control for institutional changes over time.²¹ Second, two binary variables were added to control for the affect of the type of referendum issue on voting behavior. Data on the three types of referendum issues were employed in the analysis: new hospitals where none previously existed, replacement of existing hospitals, and additions to existing hospitals. Two binary variables for replacements and additions were chosen and the omitted category was new hospitals.

The equation to be estimated is:

$$(22) \text{ YES} = f(\text{PRICE, INCOME, EXPCAP, RETLWHS, HOSP, OVER65, BIRTHRT, } D_1\text{HBPRE, } D_2\text{HBPOST, } D_3\text{ADDS, } D_4\text{REPLACE, REFYEAR, } q_0(\text{BEDS, PCNTOCC, AGE, DISTANCE}), q'_0(\text{BEDS}', \text{PCNTOCC}', \text{AGE}'))$$

where variable definitions and data sources are described in Table 1.

As stated in Table 1, values of some variables were determined from a ten-state survey of county clerks concerning hospital referenda in their counties. All 542 counties from the following states were surveyed in August 1979: Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, North Dakota, South Dakota, Utah and Wyoming. The states were chosen as characteristically "rural" in nature. From a follow-up survey based on an initial seventy percent response by county clerks, 152 health care referenda were discovered. These included elections

TABLE 1

DATA SOURCES AND DEFINITIONS

<u>Variable</u>	<u>Definition</u>	<u>Source*</u>
PRICE: $\frac{v^i}{V}$ (0.0614)**	The i^{th} voter's share of total county taxable property value: the proportion of the cost of hospital capital that voter i is responsible for.	v^i : median county housing value from <u>County and City Data Book</u> . V: <u>Census of Government, Taxable Property Values in the U.S.</u>
INCOME: I^i (\$5715.60)	The level of representative county income at the time of the referendum, adjusted to 1967 dollars, using Table 779, "Purchasing Power of the Dollar," <u>Statistical Abstract</u> , U.S. Bureau of the Census 1979, p. 474.	Median county income from <u>County and City Data Book</u> .
EXCAP: H/n (\$76.20)	Expenditure per capita derived from the referendum specified amount (H) and total county population (n), adjusted to 1967 dollars, as in EXCAP above.	H: from a 10-state, by county, survey of county clerks concerning referenda in their counties. n: <u>County and City Data Book</u> .
RETLWHLSL (5.87%)	Percent of the county population employed in retail and wholesale establishments.	<u>County Business Patterns</u> .
HOSP (0.51%)	Percent of the county population employed as full-time hospital personnel at the <u>status quo</u> facility.	<u>Guide to the Health Care Field</u> and from hospital administrators.
OVER65 (11.96%)	Percent of the county population over 65 years of age.	<u>County and City Data Book</u> .
BIRTHRT (20.01 births)	Births per thousand county population.	<u>Vital Statistics of the U.S.</u>
D ₁ HBPPE	Binary variable equal to one if there was approved Hill-Burton funding within eight years prior to the election.	<u>Hill-Burton Project Register</u> .
D ₂ HEPOST	Binary variable equal to one if there was approved Hill-Burton funding within eight years after the election.	<u>Hill-Burton Project Register</u> .

Table 1 (continued)

D ₃ ADDS	Binary variable equal to one if the referendum was for additions to an existing facility.	Type of referendum was asked on the 10-state survey of county clerks.
D ₄ REPLACE	Binary variable equal to one if the referendum was for a replacement hospital.	Type of referendum was asked on the 10-state survey of county clerks.
REFYEAR	The year in which the referendum occurred.	The date on which the vote occurred was asked on the 10-state survey.
BEDS (77.20 beds)	Number of hospital beds at the facility nearest the referendum hospital.	<u>Guide to the Health Care Field</u> and from hospital administrators.
PCNTOCC (67.41%)	Occupancy rate percentage at the facility nearest the referendum hospital.	<u>Guide to the Health Care Field</u> and from hospital administrators.
AGE (15.29 years)	Age of the facility nearest the referendum hospital.	Telephone conversations with hospital administrators and their staff.
DISTANCE (32.38 miles)	Distance to the facility nearest the referendum hospital.	Official highway road maps.
BEDS' (51.36 beds)	Number of hospital beds at the referendum hospital.	<u>Guide to the Health Care Field</u> and from hospital administrators..
PNCTOCC' (65.54%)	Occupancy rate at the referendum hospital.	<u>Guide to the Health Care Field</u> and from hospital administrators.
AGE' (22.13 years)	Age of the referendum hospital.	Telephone conversations with hospital administrators and their staff.

*Linear interpolation was used, where necessary, to construct data for specific years.

** Values in parentheses are the means of the variables.

for nursing care facilities, medical clinics, combined nursing care/hospitals, and hospitals. Of these 152 health care referenda, the sixty-nine elections relating only to hospitals were chosen for analysis. Auxiliary data limitations further reduced the usable subset to fifty-five. Among this usable subset, seven elections involved new hospitals where none existed previously, eighteen elections involved additions to existing facilities, and thirty elections involved replacement of existing hospitals. The fifty-five elections occurred within the years 1946-1978. To permit empirical application of the model, three assumptions were made. First, since voting outcome data were available only in an aggregate form, it was assumed that summary values for the explanatory variables can be used in place of individual values. Second, since data from actual voting outcomes were used as the variable to be explained and census data on the explanatory variables cover the general population (not just voters), it was assumed that the characteristics of voters coincide with the characteristics of the general population. Third, it was assumed that application of five- and ten-year period aggregated census data to observations within the period and to subsets within the census population is meaningful. Where necessary, linear interpolation was used to derive data entries for particular years.

In conclusion, a framework for estimating aggregate community responses to proposed changes in hospital service levels has been

developed in this chapter. While secret ballot voting procedures preclude estimation of any particular individual's demand, the existence of known voting outcomes for small geographic areas does allow inferences to be made about community preferences from aggregate behavior. The result, in the words of William Birdsall, is an "abstract representative individual who has a preference with respect to fiscal change . . . which can be compared to . . . another abstract individual . . ." [Birdsall 1965, p. 290].

CHAPTER FOUR

EMPIRICAL RESULTS AND IMPLICATIONS

In this final chapter, four topics are covered. First, the empirical methodology is discussed. Second, the empirical estimation technique is presented. Third, empirical results are discussed. Finally, some conclusions are drawn concerning the theoretical implications of this study.

Empirical Methodology

One objective of this thesis is to compare the explanatory power of the setter's all-or-nothing reversion with the explanatory power of the status quo reversion. Unfortunately, limited statistical tests exist for comparing two models such as:²²

$$(23) \quad Y = \alpha + \beta x + \theta s + \epsilon$$

$$(24) \quad Y = \alpha' + \beta'x + \gamma t + \epsilon'$$

where s is the set of characteristics for alternative reversion, t is the set of characteristics for the status quo reversion, x is a vector containing all other variables, Y represents voting behavior, and ϵ is the error term. The coefficients α , β , θ , and γ are to be estimated. Due to this lack of formal testing, a methodology must be developed that allows testing in a nonrigorous manner.

The methodology adopted here can be summarized as follows. A basic "no reversion capital" model can be written:

$$(25) \quad Y = \alpha + \beta x + \epsilon.$$

Then an F-test can be employed to discover the explanatory significance of each set of reversion characteristics added separately to the equation. The possible outcomes under this approach are shown in Table 2. Outcomes I and III are ambiguous in terms of identifying

TABLE 2
POTENTIAL OUTCOMES
Alternative Reversion

	Alternative Reversion	
	significant	not significant
Status Quo	significant I	IV
Reversion	not significant II	III

which reversion explains "better" under a specified confidence level. In these cases, significance levels of the F-values computed for each reversion model can be compared. Then, judgement as to which reversion explains "better" can be made on the basis of which significance level is higher.

Empirical Estimation Technique

Empirical estimation of voting decisions assumes that individuals are faced with two alternatives. The logit model assumes that the probability of voting yes is logistically distributed [Pindyck and Rubinfeld 1976, p. 247]:

$$(26) \quad \text{Pr}(Y) = f(\underline{X}) = (1 + e^{-\underline{X}})^{-1} = (1 + e^{-(\alpha + \underline{\beta X})})^{-1}$$

where $\text{Pr}(Y)$ is the probability of a yes vote given the characteristics vector $\underline{X}$ and coefficients as previously specified. Rewriting and taking the natural logarithm of both sides of the equation yields [Pindyck and Rubinfeld 1976, p. 248]:

$$(27) \quad \log \left(\frac{\text{Pr}(Y)}{1 - \text{Pr}(Y)} \right) = \alpha + \underline{\beta X}.$$

With repeated sample observations for each value of the explanatory variables, $\text{Pr}(Y)$ is approximated by [Pindyck and Rubinfeld 1976, p. 249]:

$$(28) \quad \text{Pr}(Y)^* = \frac{Y_i}{(Y + N)_i}$$

where Y_i = the number of yes votes cast in election i and $(Y + N)_i$ = the total number of votes cast in election i . The logit model can now be estimated in the form:

$$(29) \quad \log \left(\frac{Y}{N} \right) = \alpha + \underline{\beta X}.$$

Cox [1970, pp. 33-34] suggests that the following amended model is more appropriate for estimation using small samples:

$$(30) \quad \log \left(\frac{Y + \frac{1}{2}}{N + \frac{1}{2}} \right) = \alpha + \underline{\beta X}.$$

Further, since the logit model (30) is characteristically heteroskedastic [Kmenta 1971, p. 426], with variance of the dependent variable equal to [Cox 1970, p. 33-34]

$$(31) \quad V = \frac{(Y + N + 1)(Y + N + 2)}{(Y + N)(Y + 1)(N + 1)},$$

weighted least squares is the preferred estimation procedure. The weights applied to both sides of (30) are the inverses of the square roots of the variances described in (31) [Intriligator 1978, pp. 165-173]. These weights attach greater importance to observations where a large number of individuals vote as well as to observations where the number of yes and no votes are nearly equal.

The basic logit model as described in (30), to which the different specifications of the reversion will be applied, is:

$$(32) \quad w \log \left(\frac{Y + \frac{1}{2}}{N + \frac{1}{2}} \right) = w\alpha + w\beta_1 \text{ PRICE} + w\beta_2 \text{ INCOME} \\ + w\beta_3 \text{ EXPCAP} + w\beta_4 \text{ RETLWHLs} \\ + w\beta_5 \text{ HOSP} + w\beta_6 \text{ OVER65} + w\beta_7 \text{ BIRTHRT} \\ + w\beta_8 D_1 \text{ HBPRES} + w\beta_9 D_2 \text{ HBPOST} \\ + w\beta_{10} D_3 \text{ ADDS} + w\beta_{11} D_4 \text{ REPLACE} \\ + w\beta_{12} \text{ REYEAR}$$

where w = the weighting factor derived from (31) and all other variables are as stated previously.

The two reversion specifications to be added to the basic model (32) in order to test their relative explanatory powers are:

$$(33) \text{ alternative reversion: } w\theta_1 \text{ BEDS} + w\theta_2 \text{ PCNTOCC} \\ + w\theta_3 \text{ AGE} + w\theta_4 \text{ DISTANCE}$$

$$(34) \text{ status quo reversion: } w\gamma_1 \text{ BEDS}' + w\gamma_2 \text{ PCNTOCC}' \\ + w\gamma_3 \text{ AGE}'.$$

Empirical Results

Evidence concerning the explanatory power of the two reversions is revealed in three ways. First, none of the characteristics chosen to represent either reversion level is significant individually at even the eighty percent confidence level. Second, a formal F-test (Appendix B) reveals that these characteristics, taken together, do not contribute significantly to the explanation of the probability of a yes vote for either reversion specification. Finally, taking the F-testing one step further, all reversion characteristics taken together (i.e. all characteristics pertaining to both the alternative reversion and the status quo reversion, combined) do not contribute significantly to the explanation of the probability of a yes vote. These results indicate that the reversion level of hospital capital, as one element in the voter's consideration of utility levels associated with passage or failure of a referendum, is not an empirically

significant explainer of the rural hospital voting outcomes analyzed in this study.

Much has been said concerning what the two reversion do not do. In a more positive fashion, what can be said for the relative explanatory power of the two reversion? Referring back to Table 2, the analysis thus far has revealed that neither reversion is significant at a specified significance level (Quadrant III). Such an outcome is ambiguous in terms of identifying which reversion explains the probability of a yes vote "better." However, comparison of the actual significance levels attained by the computed F-value for each reversion can aid in identifying which reversion is the better explainer.

The F-value for the alternative reversion set of characteristics is significant at the 77.7 percent level while the F-value for the status quo reversion characteristics is significant at the 76.8 percent level (see Appendix B). This small difference does not allow for a definitive selection between the two reversion specifications.²³

Checking whether multicollinearity problems might render all F-tests uninteresting, the variables listed in equation (32) were added to each reversion specification. The results of F-testing on this type of inclusion revealed that, in both cases, the set of explanatory variables in the basic model was significant in explaining the probability of a yes vote.

The results of estimation appear in Tables 3 and 4. Table 3 lists the results of estimating the basic, alternative, and status quo models with data unadjusted for heteroskedasticity while the results in Table 4 come from adjusted data. The following discussion of regression coefficients is based on Table 4. In the basic model the following results are consistent with the a priori expectations developed in Chapter Three (significance levels are in parentheses): 1) the probability of a yes vote decreases with a relatively higher representative price of collectively provided hospital capital (99%) 2) the greater the proportion of residents who stand to gain in terms of increased business interplay with the hospital and its visitors, the more probable is a yes vote (99%), 3) the probability of a yes vote increases if Hill-Burton funds were approved within eight years prior to the election relative to the omitted category, "no Hill-Burton funds" (80%), and 4) changing preferences and institutional arrangements over time have increased the probability of a yes vote (80%).

Two other significant empirical results deserve special attention. First, with respect to referenda for new hospitals where none existed previously, referenda for replacement hospitals increase the probability of a yes vote (99%). Apparently, rural communities which have experienced the benefits of a local hospital exhibit stronger support in elections than communities where no hospital exists. This

TABLE 3

REGRESSION RESULTS FOR MODELS
NOT ADJUSTED FOR HETEROSKEDASTICITY

<u>Variable</u>	<u>1. Basic Model</u>	<u>2. Alternative Reversion</u>	<u>3. Status Quo Reversion</u>
a. Price	-.50142 (1.7277)*	-.54369 (1.8505)	-.50549 (1.5383)
b. Income	.00003 (.1797)	.00005 (.3381)	-.00003 (.1490)
c. Exp./Capita	-8.0154 (2.8925)	-10.429 (3.3295)	-8.5163 (2.9573)
d. Retail-Whls. Employment	9.2143 (1.3464)	14.05 (2.1205)	10.225 (1.4185)
e. Hospital Employment	20.451 (.2939)	72.910 (1.0883)	15.245 (.2126)
f. Over 65	-1.4319 (.2926)	-1.1636 (.2425)	-2.6815 (.4876)
g. Birthrate	.02268 (.8150)	.01196 (.4371)	.02432 (.8395)
h. HB Before	.46657 (.8847)	.47212 (.9076)	.58413 (1.0510)
i. HB After	-.18818 (.4301)	-.33249 (.7782)	.17585 (.3924)
j. Additions	-.19912 (.3394)	-.79968 (1.3672)	-.14081 (.2280)
k. Replacement	.69210 (1.4803)	.35475 (.7578)	.63254 (1.0934)
l. Referendum Year	.00412 (.1342)	-.03052 (1.0279)	.01246 (.3544)
<u>Alternative Reversion</u>			
a. Number of Beds		.00246 (1.4820)	
b. Occupancy Rate		-.00467 (.6515)	
c. Age of Building		-.00571 (.6094)	
d. Distance		.02524 (2.1837)	
<u>Status Quo Reversion</u>			
a. Number of Beds			-.00226 (.7154)
b. Occupancy Rate			.00749 (.6755)
c. Age of Building			.01070 (.8755)

	<u>R²</u>	<u>Adj. R²</u>	<u>DF</u>	<u>Sample Size</u>	<u>Overall F-value</u>	<u>Significance Levels</u>
1.	.3372	.1479	42	55	1.7809	.01 = 2.567
2.	.4905	.2760	38	55	2.2868	.05 = 1.960
3.	.3601	.1140	39	55	1.4633	.10 = 1.645

* t-statistics are given in parentheses.

TABLE 4

EMPIRICAL RESULTS

<u>Variables</u>	<u>1. Basic Model</u>	<u>2. Alternative Reversion</u>	<u>3. Status Quo Reversion</u>
a. Price	-1.5118(5.9465)*	-1.3379(4.3032)	-1.348(5.1344)
b. Income	.00001(.1058)	-.00012(.8050)	-.00001(.0806)
c. Exp./Capita	-7.2195(5.1716)	-6.9766(3.4463)	-7.3074(4.8568)
d. Retail-Whls. Employment	13.004(2.8476)	17.883(3.3532)	12.017(2.5468)
e. Hospital Employment	-1.0357(.0173)	61.133(.8523)	38.948(.5615)
f. Over 65	-7.8210(1.2199)	-7.3865(1.1102)	-9.1334(1.3382)
g. Birthrate	.00936(.3378)	.00079(.0245)	.00739(.2319)
h. HB before	.76316(1.9261)	.99060(2.0911)	.64292(1.6051)
i. HB after	-.03994(.1118)	-.10924(.2860)	-.29542(.7876)
j. Addition	.28624(.5371)	-.23907(.3974)	-.01284(.0224)
k. Replacement	.13016(2.9542)	.76034(1.5682)	1.0601(1.9493)
l. Referendum Year	.04845(1.5089)	.04481(1.2119)	.04450(1.3410)
<u>Alternative Reversion</u>			
a. Number of Beds		.00163(1.1441)	
b. Occupancy Rate		-.00370(.5200)	
c. Age of Building		.00957(.9343)	
d. Distance		.01586(1.0803)	
<u>Status Quo Reversion</u>			
a. Number of Beds			.00198(.6117)
b. Occupancy Rate			.00776(.8778)
c. Age of Building			.01407(1.1409)

	<u>R²</u>	<u>Adj. R²</u>	<u>DF</u>	<u>Sample Size</u>	<u>Overall F-Value</u>	<u>Significance Levels</u>
1.	.97689	.97029	42	55	147.9675	.01 = 2.576
2.	.97933	.97138	38	55	117.4666	.05 = 1.960
3.	.98018	.97184	39	55	123.1992	.10 = 1.645

* t-values are given in parentheses.

may indicate that the setter's imposed threat of losing the local hospital is stronger in counties which already have hospitals.

The second significant result must be considered in more detail. Among rural counties, the probability of a yes vote is inversely related to expenditure per capita levels.²⁴ Recall that the voter is hypothesized to make a decision by comparing the utility levels associated with passage or failure of the referendum. Under utility maximization, any element of the referendum proposal that decreases utility will have an adverse effect on the probability of a yes vote. The empirical result that higher relative expenditure per capita levels decrease the probability of a yes vote implies that the representative voter is at or beyond the ideal expenditure per capita level. Any proposed expenditure per capita increase detracts from the current utility level. Hence, rural residents could have more expenditure per capita at the same price but do not desire it. A conclusion that can be drawn is that rural counties are debt averse.

At first glance, this empirical observation on expenditure per capita is at odds with the fact, observed in the survey of hospital referenda, that rural hospital elections pass with few exceptions. One explanation for this apparent nonconformity is based upon the distribution of benefits and costs from the provision of rural hospital services. The empirical results reveal that voters involved in retail and wholesale trade are likely to be supporters of rural

hospital referenda. This outcome is consistent with the hypothesis that the group represents individuals who will experience income gains due to the provision of rural hospital services. These voters, and other groups like them, represent concentrated and perhaps well-organized beneficiaries. Conversely, the costs associated with an aversion to collective debt are likely to be diffused across all voters. It is expected that those voters who stand to gain substantially are more likely to vote than are other rural residents. Further, the goals of these potential gainers are in accordance with the hypothesized public expenditure maximization goal of the setter. Hence, to the extent that the utility positions of potentially decisive voting groups are enhanced, the setter can act to increase expenditure per capita levels and still be confident of referendum passage because of the concentrated position of gainers and the dispersed position of losers. It is important to note that, while this explanation carries intuitive appeal, the aggregated nature of the voting data analyzed does not permit careful examination of whether such groups are actually decisive. Therefore, it would be desirable for future research into rural referenda voting to employ individual data in order to explore in detail explanations such as the one offered here.

Two unexpected empirical results also deserve discussion. First, the variable for representative county income is insignificant and

its sign changes under the two reversion specifications. This outcome appears to be the result of multicollinearity problems in the data. Regression results indicate that 99.7 percent of the variation in income can be explained by variation in the other independent variables. This problem also plagues the variables for hospital employment ($R^2 = .958$), percent of the population over sixty-five years of age ($R^2 = .990$), and birthrate ($R^2 = .982$).

The second unexpected result concerns the variable for percent of the population over sixty-five years of age. While it is nearly significant at the eighty percent level, it is of unexpected sign. It was hypothesized that the elderly would be characteristically high demanders of hospital capital. An explanation for the unexpected result may be that the elderly are averse to paying in the present for capital investments yielding long run benefits which they may never capture.

Conclusions: Implications for Policy and Theory

Two conclusions pertaining to public policy towards rural hospitals arise from the results of this study. One implication for policy-makers is that increases in expenditure per capita levels will not enhance the probability of referendum passage, all else remaining equal. This tends to indicate dissatisfaction with the level of public expenditures specified in the elections studied. However, the

elections generally pass despite this dissatisfaction. One explanation of this outcome focuses on the nature of concentrated benefits and dispersed costs from rural hospital provision. Further empirical work using individual voting data would yield important contributions to the explanation of political influence in rural referenda.

The second important conclusion is that the role of a traditional explanation concerning collective rural hospital decisions is not supported by the study results. The existing level of hospital capital, represented by the setter's alternative reversion and the status quo reversion, was not a significant contributor to the explanation of the probability of a yes vote. Instead, price, expenditure per capita, and a proxy variable for the distributional aspects concerning gainers and losers represented by the retail-wholesale employment variable, are all significant and consistent with a priori hypotheses derived from the theory of public economics. Support for rural hospital referenda can be expected to be strongest for replacement hospitals that received Hill-Burton money prior to the election in counties with strong business sectors and relatively lower personal taxable property shares. Similarly, based on the results of this study, opposition to hospital closures can be expected to be strongest in communities with relatively higher proportions of persons who gain from business interaction with the hospital and its visitors.

APPENDIX A

EXAMPLES OF THE EXPLICIT BEHAVIORAL THEORY OF PUBLIC ECONOMICS;
UTILITY MAXIMIZATION IN THE LITERATURE

I. Mikesell and Blair [1974].

A. utility function

$$U = G(e, a)$$

where: G = a concave downward function
 e = quality of education
 a = vector of private goods

B. private budget constraint

$$I = aP_a + C$$

where: I = total income
 P_a = vector of private good prices
 C = the individual's cost of education

C. collectively imposed budget constraint

$$C = \frac{r}{R}(P_b)b$$

where: r = individual's taxable property
 R = total community taxable income
 P_b = price per school building
 b = number of school buildings

D. strategy

$$\max U \text{ subject to } I = aP_a + \frac{r}{R}(P_b)b$$

II. Neufeld [1977].

A. utility function

$$U = U(q_{i1}, \dots, q_{ij}, V_i, E, x_1, \dots, x_m, z_{i1}, \dots, z_{ik})$$

where: q = vector of private goods other than housing

V_i = level of housing consumed by individual i

E = per pupil expenditure level

x = vector of public goods other than education

z = vector of socioeconomic variables

B. private budget constraint

$$Y_i = \sum_{j=1}^k p_i q_{ij} + r_E V_i + r_N V_i + t_i$$

where: p_i = price of the i^{th} private good

r_E = educational property tax rate

r_N = non-educational property tax rate

t_i = level of all other taxes

Y_i = total income of individual i

C. collectively imposed budget constraint

$$c(E, s, a) = G + r_E V_B + \sum_{i=1}^k r_E V_i$$

where: c = cost of education

s = vector of factor cost conditions

a = number of pupils

G = non-matching intergovernmental grants

V_B = total non-resident taxable property, i.e. business property

D. strategy

$$\max U \text{ subject to } Y_i = \sum_{j=1}^k p_{ij} q_{ij} + \frac{c(E, s, a) - G}{V_B + \sum V_i} (V_i) + r_N V_i + t_i$$

III. Rubinfeld [1977].

A. utility function

$$u = U(c, h, E, X, \varepsilon)$$

where: c = units of non-housing consumption
 h = units of housing services consumed
 E = dollars of educational expenditure per pupil
 X = vector of non-income attributes of individuals and households
 ε = random error, accounting for missing and misspecified elements of X

B. private budget constraint

$$Y = c + ph + t(phD) = c + p(1 + tD)h$$

where: p = annual rental price per unit of housing services
 t = ad valorem effective school tax rate
 D = constant, defined so that phD equal capitalized value of an individual's house
 Y = income

C. collectively imposed budget constraint

$$E = tV$$

where: V = value of taxable property per pupil in the school district

D. strategy

$$\max U \text{ subject to } Y = c + p(1 + \frac{E}{V} D)h$$

APPENDIX B

F-TESTS FOR EXPLANATORY SIGNIFICANCE OF THE ALTERNATIVE REVERSION
AND THE STATUS QUO REVERSION

I. Formal statistical test for the explanatory signifiance of the Alternative Reversion.

A. Hypothesis:

$$H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$$

$$H_A: H_0 \text{ is not true.}$$

B. Calculated F-value for the Alternative Reversion:

$$\begin{aligned} & \frac{(.98018 - .97689)/4}{(1 - .98018)/(52-14-1)} \\ = & \frac{(.00329)/4}{.01982/37} = \frac{.00082}{.00054} = 1.51852 \end{aligned}$$

C. Critical value from tables of $F_{4,37,.05} = 2.6250$

D. Conclusion: Fail to reject H_0 . The Alternative Reversion does not contribute significantly to the explanation.

E. From a table of the percentiles of the F-distribution, the calculated F-value for the Alternative Reversion of 1.51852 is significant at the .777 level, however.

II. Formal statistical test for the explanatory signifiance of the Status Quo Reversion.

A. Hypothesis:

$$H_0: \gamma_1 = \gamma_2 = \gamma_3 = 0.$$

$$H_A: H_0 \text{ is not true.}$$

- B. Calculated F-value for the Status Quo reversion:

$$\frac{(.97933 - .97689)/3}{(1-.97933)/(52-13-1)}$$

$$= \frac{.00244/3}{.02067/38} = \frac{.00081}{.00054} = 1.50617$$

- C. Critical F-value from tables of $F_{3,38,.05} = 2.850$
- D. Conclusion: Fail to reject H_0 . The Status Quo Reversion does not contribute significantly to the explanation.
- E. From a table of the percentiles of the F-distribution, the calculated F-value for the Status Quo Reversion of 1.50617 is significant at the .768 level, however.

III. Formal statistical test for the explanatory significance of both Alternative Reversion and Status Quo Reversion, combined.

- A. Hypothesis:

$$H_0: \theta_1 = \dots = \theta_4 = \gamma_1 = \dots = \gamma_3 = 0.$$

$$H_A: H_0 \text{ is not true.}$$

- B. Calculated F-value = 1.2222
- C. Critical value from tables of $F_{7,34,.05} = 2.30$.
- D. Conclusion: Fail to reject H_0 . Both Reversions, combined, do not contribute significantly to the explanation.

FOOTNOTES

1. See "Rural Health Care Plan Disapproved," Billings Gazette, December 11, 1978 and "Health Plan Agency Favors Lakefield Hospital Project," Minneapolis Tribune, April 28, 1978.
2. The characterization of contingency value adopts Burton Weisbrod's [1964] discussion of option demand.
3. Weisbrod [1964] used no diagram in his original analysis.
4. Inefficiency due to the "price-searching" behavior of hospital providers is also present in this diagram, but not of interest in this discussion.
5. As Weisbrod states [1964, pp. 476-477], "Consequently there appears to be an a priori case for at least consideration of public operation or subsidy when a producer of an infrequently-purchased, nonstorable commodity with sharply-rising short-period marginal costs contemplates closing or cutting service because of unprofitable operations. Of course, if the sum of user charges and the value of option-demand falls short of costs (on a present-value basis), then efficient resource allocation would require that operations be halted or curtailed and resources shifted to alternative uses."
6. See the discussion by Birdsall [1965, p. 237] about political disintermediation.
7. Examples of such mechanisms can be found in Böhm [1971 and 1972], Clarke [1971], Groves and Ledyard [1977], and Loeb [1977].
8. Buchanan [1975, p. 385] traces the development of similar breakthroughs that occurred much earlier in the European tradition of public finance but points out that the transformation from public finance to public economics in America did not spring full-blown from rediscovering this European tradition.
9. For a more detailed description, see Deacon [1977], pp. 376-380.
10. Deacon [1977] describes the crucial role of political competition in the median voter approach on p. 379.

11. There are only two tests of the median voter hypothesis to be found in the literature. Werner Pommerehne and Friedrich Schneider [1978] test the power of the median voter model under different political institutions - direct democracy by referenda, representative democracy with referenda, and representative democracy with no referenda - using data on Swiss Cantons. Their hypothesis is as follows [Pommerehne and Schneider 1978, pp. 395-396]:

. . . the amount of leeway a rationally behaving government (rational in the sense of acting in the narrow self-interest of the government's members under the reelection constraint) has to deviate from the median voter's wishes will correlate to the particular type of collective decision-making institution present. This includes the different possibilities available to the government under each system to use strategies that create positive spending benefit illusions, i.e. those that are favorable to the government.

Their results indicate that the latitude for deviation from the preferences of the median voter is a function of the institutional setting. Their results "give strong evidence that governments in direct democracies have little latitude for deviating from the voters' preferences" [Pommerehne and Schneider 1978, p. 398]. Pommerehne's and Schneider's results tend to support use of the median voter model for analysis of public expenditures covered by referenda but less so in cases of representative voting.

Further evidence for use of the median voter model is offered by William McEachern [1978]. In a comparison of localities in states with no referendum requirement for bonded indebtedness versus localities in states requiring a simple majority referendum, he finds no significant difference in debt levels. If indeed there was more opportunity for government to deviate from median voter preferences as referendum requirements are relaxed, then a difference in debt levels would be expected in localities with referendum requirements versus localities without referendum requirements. Since McEachern found no difference, he takes this as evidence that political decisions are indeed forced toward the median voter's preferred outcome

[McEachern 1978, pp. 133-134]. Again, as with Pommeröhne's and Schneider's work, the evidence tends to support use of the median voter model.

12. In the case of rural hospital referenda, the county commission may assume the setter role.
13. The description in this paragraph is from Deacon [1977], p. 374.
14. This assumption is reasonable in light of federal regulations regarding the required number of on-duty personnel.
15. The author is indebted to Professor Robert Deacon for pointing this out in his comments on an earlier draft of the thesis.
16. The voting rule abstracts away from the case where $U_1^i = U_0^i$. With equal alternative utility levels, it is possible that the voter may abstain.
17. This argument -- that the reversion level of hospital capital is a primary consideration by voters -- is a commonly held viewpoint of rural hospital policy-makers.
18. The use of change notation is also adopted from Deacon and Shapiro [1975].
19. This specification is adopted from Borchertding and Deacon [1972].
20. Other assumptions are: 1) $q(w)$ is not an inferior good, 2) $(v^i)_A$ and $(v^i)_B$ are constant and greater than zero, 3) unrealistically, $u^i = u^j$, $i \neq j$. See Barr and Davis [1966, p. 152] concerning the above assumptions.
21. Important institutional considerations impacting rural hospitals over time include changes in the Hill-Burton Program, Medicare, and Medicaid.
22. See Pesaran [1974] for a discussion of non-nested hypotheses in the linear case and Pesaran and Deaton [1978] for a generalization to the non-linear case.

23. Calculation of a more complicated test statistic was not performed in this case. See Pesaran [1974] for the development of such a statistic.
24. Recall that expenditure per capita was chosen to represent the level of hospital capital under passage of the referendum, w_1 .

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