A NEOCLASSICAL MODEL OF THE TAX-EXEMPT BOND MARKET

By

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ABSTRACT

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The intent of this dissertation is to construct a model of the tax-exempt bond market which reveals the behavior underlying the decisions that determine tax-exempt bond demand and supply. Neoclassical theory is used to accomplish this goal. A secondary objective has two parts: first, to solve the supply equal demand system of estimated equations for the equilibrium rate of return and quantity of tax-exempts outstanding; and second, to examine how exogenous shocks affect these equilibrium values.

The model observes tax-exempt demand as one of several asset demands in investors' portfolios. The assets held depend on many variables, the main ones being the rate of return on each asset and the tax structure. The model is further divided into two private sectors --bank and non-bank.

Bank behavior is hypothesized as dependent on long run profit maximization, where safety is an important constraint. A bank equation is specified in which bank officers trying

to maximize long run profits choose their portfolio mix based on their expectations of future economic conditions.

The non-bank specification is similar to other Tobin-like asset demand models, except it has two important extensions. First, the tax rate applied to the rates of return is the tax rate of the investor who is indifferent between tax-exempts and corporate bonds. Second, the income of investors in tax brackets exceeding that of the marginal investor is an important variable.

Since there are two kinds of tax-exempt bonds --each with a different behavioral motivation behind its issue-- the bond supply model is correspondingly broken into two parts.

General obligation bonds are usually issued upon voter approval, hence a neoclassical model of voter choice is formulated here.

The decision-maker in the revenue bond supply model is an elected official; a city manager must determine whether or not the revenues from future user fees will cover the repayment of revenue bonds.

With all of the sources of demand and supply estimated, an analysis of the model as a demand equal supply system is presented.

ACKNOWLEDGMENTS

It is with a heavy heart that I squeeze out the last words of this fulfilling undertaking. It has been my full-time companion for the last four years, and I will miss it sorely. Unfortunately, others, who have shared this companionship, must also bid it adieu. At least they will receive some compensation for this loss in the credits below.

Of course the greatest thank you goes to Robert Rasche --the Chairman of the committee. His use of the Socratic method in guiding the progress of my dissertation I found highly productive. Many of the discoveries I made while attacking the tasks he put to me will be of great benefit in future research endeavors. I now feel, my next dissertation will be twice as good as this one.

The other committee members were also enormously helpful. Aaron Gurwitz supplied the original idea and motivation. Dan Saks provided many useful insights to the early drafts and from beginning to end was a constant morale booster. James Johannes, through a thorough and critical reading of the paper, forced me to rethink and reinvestigate some of my hypotheses and the empirical methodology of certain parts of the study. These suggestions were useful in the thesis and will be of further use as I continue to

refine the model. Chris Amsler must not only be thanked for her evaluation of the thesis and useful remarks, but also for putting up with my so-called sense of humor.

Several colleagues also contributed generously to the effort. Coburn Ward provided extensive computer programming help and mathematical advice. In return he asked only for a homemade pasta meal. Kerry Doherty was always willing to discuss technical snags with me. In return he asked only for my shirts. Hub Segur provided late night motivation. In return, he asked only that I support farm workers. Philip Hanser also discussed some technical issues with me. In return, he asked only that I not eat so much dessert at his house. Finally, Mark Haas, fellow student, suggested some Econometric methods which I later used. In return, he asked only that I never come back to Michigan.

In typing various drafts, fantastic people became available. My mother, Daisy, typed the early drafts. In return, she asked only that I be a good boy and not be such a violent father. Kathy Yoon volunteered to type the mid-period drafts. In return, she asked that I carry her to a major mixed-doubles tennis championship. After several unsuccessful attempts, it is now beginning to look like this may be a lifetime endeavor. Mary Gambatese, typed the final drafts. In return, she asked only for money. The final copy was skillfully done by Jan Wright. In return, she has not yet had a chance to ask for anything. However, me is

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she is in a position to make me pay for many things for a long time.

Phillip H. Allman, Jr., my father, drafted all of the figures and diagrams which appear in the final draft. He was also a motivational force. In return, he asked only that I finish. Max Allman, my son, provided the ultimate motivation. He bet me that he would finish his dissertation before me. This time the return goes to me. He owes me his allowance for a whole year.

Finally, Celeste Allman, Max's mother, contributed infinite outside support, sacrifice, motivation, and "necessary" threats. In return, she asked only that we do "everything" we did not do in the last four years.

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CHAPTER I

INTRODUCTION

Federal tax law permits state and local governments to issue bonds with interest payments which are tax-exempt (26 U.S.C. Sec 103, 1913). Because of this law and the kinds of participants evoked by this financial investment, the tax-exempt bond market is characterized by several features which clearly differentiate it from other financial markets. As in most financial markets, its chief function is to raise investment capital for its issuers. Tax-exempt bond issuers, however, behave differently than other issuers because capital financed with tax-exempt debt is for public purposes. Consequently, the decision-makers who supply the financial markets with tax-exempts do not attempt to achieve the same objectives as decision-makers who supply private debt. The distinguishing characteristic of tax-exempt debt on the demand side is the tax shelter it provides to its holders. Holders of tax-exempts are consequently those individuals or entities with potentially high tax payments.

To appropriately analyze the tax-exempt bond market, a financial model must be constructed which incorporates the above distinctions. It is the purpose of this dissertation to const

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to construct such a model. The model, although it focuses on the tax-exempt market, observes this specialized market within the context of a complete neoclassical asset demand system. Similarly, on the supply side, a neoclassical model of supply is assembled. This approach to the model allows a deeper theoretical and empirical view of the economic behavior underlying the tax-exempt bond market than previous models have been able to achieve.

There has always been particular interest in state and local debt because the tax-exemption has created political controversy, as well as criticism from the economics profession. The model set forth in this dissertation should further aid in the evaluation of the political consequences and criticisms of the tax-exemption.

The political controversy has historically centered on the immense losses in revenue absorbed by the Federal government as a result of the exemption. The state and local governments are the beneficiaries of about two-thirds of these revenue losses, since their interest payments are lower than on comparable taxable bonds. (Huefner, 1972, p. 2). Naturally state and local governments want to retain this advantage at the capital markets. Furthermore, state and local governments seem to stand on firm constitutional ground in demanding the preservation of their tax advantage, and what they consider unfettered local control of their finances.

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Some economists believe that the state and local governments should, on economic grounds despite constitutional guarantees, enter the capital markets on equal footing with other capital fund pursuants. They contend that the exemption distorts the proper allocation of resources within and between the private and public sectors. (Peckman, 1966; Rabinowitz, 1969). Other economists attack the exemption further. They find inefficiency and inequity because holders of tax-exempts with high marginal tax rates (the rich) receive a subsidy twice --once from the municipality which pays a rate high enough to induce investors with low tax rates to hold their bonds, and again from the Federal tax payment they escape.

Recently, several compromises have been proposed whereby state and local governments might receive subsidies or guarantees in lieu of the tax-exemption advantage (Kennedy-Reuss Bill, 1975; William Simon proposal, 1975; Mayors Plan, 1975). The political force behind these compromises can be assessed to some degree through the parameters determined in the model developed below. In short, the model helps answer some major questions such as; how committed are economists to the concept that the exemption significantly distorts resource allocation; how do Federal grants affect the allocation of resources; and how strong a political contingent of tax-exempt bond holders is and will be present in the future. The first on que

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two questions must come from an analysis of how supply side decisions are made. The third question comes from the demand side where one must ask how do economic conditions such as inflation affect the desire of middle income groups to hold tax-exempt bonds. These questions and other less far-reaching questions can be analyzed with the model.

Another political consideration which this model addresses is the recent series of municipal fiscal crises. These crises are the result of many fiscal difficulties and some financing errors by municipal government officials. One of these errors has been the overextension of revenue bond issues to the point that some municipalities have failed to meet the required debt payments. These failures have been primarily on revenue bonds because the legal requirements restraining their issuance are more lenient than old-fashioned general obligation bonds which are paid back through taxes and generally require voter approval. The model developed here examines these two kinds of bonds separately. This is an important distinction which has been ignored in all other tax-exempt bond models constructed to date. The offering decisions and effects on fiscal solvency differ widely between these two types of bonds. A realistic view of the effect bond issues have on fiscal conditions requires a separate analysis of revenue bonds.

The remainder of this study will proceed as follows. First the economic literature on tax-exempt bond markets will b

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will be reviewed, and the deficiencies in these models will be noted, then the present model will be formulated and described. The demand side will be examined first. The general theoretical model presents tax-exempt demand as one of many asset demands in investors' portfolios. The assets held depend on many variables, the main ones being the rate of return on each asset and the tax structure. The model is further divided into two private sectors --bank and non-bank. This division enriches the model considerably. It enables non-bank investors to place part of their funds with intermediaries, and shows that intermediaries choose asset mixes which differ from the choices of other individuals or households.

The demand model is then explicitly specified. The bank demand specification makes a marked advance over previous bank specifications. Bank behavior is presumed to be based on long run profit maximization where safety is an important constraint. In this model, to maximize long run profits, bank officers choose their portfolio mix based on their expectations of future conditions.

The non-bank specification is similar to previous models with two important extensions. First the tax-rate applied to the rates of return is the tax rate of an investor whose after tax rate of return on corporate bonds is equal to the rate of return on equal quality tax-exempt bonds. Second, the amount of income in tax categories equal

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equal to and exceeding the tax rate mentioned in the last sentence is one of the determinants of tax-exempt demand.

The supply model is described next. In formulating this model, a major effort was made to feature the state and local government behavior underlying the supply of state and local debt obligations. As the literature review discloses, no previous model has made a rigorous attempt to achieve this objective. Because of this void in the literature, the literature review chapter includes a discussion of previously formulated state and local government models which are related to the behavioral derivation of bond supply found in the present undertaking. Since there are two kinds of tax-exempt bonds, each with a different behavioral motivation behind its issue, the bond supply chapter is correspondingly broken into two parts.

General obligation bond supply is modeled first. These bonds are usually issued upon voter approval, hence a theoretical model of voter behavior is devised. The empirical specification consequently contains behavioral variables. This specification permits analyses which were previously difficult or impossible to examine, such as the effects of grants on state and local capital demands or the effect of voters' rates of time preference or the means used to finance local capital.

The revenue bond model follows. This is a particularly interesting means of state and local government finance where

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where this researcher has uncovered no significant economic inquiry. The procedure involved in issuing revenue bonds is unique for two reasons. First, the decision-maker is usually an elected official with an unknown time horizon in a management position. Second, the budget constraint facing this manager is difficult to determine. These two conditions have made research in this area difficult since few economists deal with models concerning the behavior of politicians, and most economists prefer researching areas where there is measurable data and quantitative conclusions can be derived. Thus the model presented here is a first effort. The difficulties encountered and final compromising results will be fully discussed.

With all of the sources of demand and supply estimated, an analysis of the model as a demand equal supply system is presented.

Finally, a concluding chapter connects the model to its political and economic implications, reiterates some of the innovations of the model, and discusses how this model fits into future inquiries of the tax-exempt bond market.

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CHAPTER II

REVIEW OF THE LITERATURE

A literature review of the tax-exempt bond market can be very broad. Most of this work is of a descriptive nature. Theoretical and empirical analyses of the tax-exempt bond market on the other hand have not received extensive attention. The earliest econometric analysis specifically designed to study the tax-exempt bond market appeared in Harvey Galper and John Peterson's "An Analysis of Subsidy Plans to Support State and Local Borrowing" (1971). This analysis was followed by Peter Fortune (1973), and Patric Hendershott and Timothy Koch (1977). Hendershott and Koch subsequently made further refinements (1980). The review shows that none of these empirical pieces adequately model the supply side of the market, since they all fail to develop the behavioral relationships entailed in bond supply decisions. It is essential to formulate a model of tax-exempt bond supply which considers how decisions to purchase and finance state and local goods are determined.

With these observations in mind, the review of literature is broken into three parts. First, the major descriptive studies of recent tax-exempt market conditions will be summarized. (Robinson, 1960; Huefner, 1972;

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Peterson, 1976; Rosenbloom, 1976). Second, the empirical works cited previously will be critically examined. Third, several state and local government models relevant to the tax-exempt bond supply model which will be developed here are reviewed.

Descriptive Studies

In the descriptive analyses conditions are observed in the market over a specified period of time, and then conditions for the next three to five years are predicted. Generally, their prognoses foresee state and local goverments headed for difficult times, as local officials attempt to float their bonds at rates significantly below the after-tax market rates on taxable bonds. In other words, they perceive greater and greater debt needs for local governments and an unstable group of buyers.

Peterson's paper (1976) is the most recent of this kind of study. The tax-exempt bond market is viewed through a short-run perspective only.

Peterson lists the important characteristics of the current market, especially those characteristics which have undergone recent changes. This list along with some comment is as follows: 1) The current U.S. experience is one of tight money conditions. This is of course a problem for <u>all</u> borrowers, so should not necessarily be perceived as a special situation. 2) The composition of tax-exempt buyers is tha

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is changing. Again, however, if this is seen as a problem, it would be myopic to judge the problem as permanent. If tax-exempts are worthy investments, the market will uncover participants. If not, then eliminating the instrument should not be viewed as a problem. 3) There has been a large influx of special purpose bonds --bonds liquidated with user fees from specific projects-- and short-term bonds which obviously are not used for the traditional tax-exempt bond purpose of financing local capital. 4) The above increase in non-traditional tax-exempt bonds in addition to fiscal crises in several urban centers has created new concerns over tax-exempt bond quality and riskiness; hence many new issues require higher risk premiums which impose further fiscal burdens. Soothsayers of doom would judge the situation as a vicious spiral leading to market collapse. In reality, if recent actions by local governments cause some insolvencies, retrenchments will necessarily occur. Similar situations frequently exist in private markets. Private capital-seekers often embark on aggressive actions which get them into financial trouble. When this happens, some appropriate reaction is attempted. Local officials can do the same.

With the problems created by conditions 1, 3, and 4 in the list above, Peterson looks to the "changing pattern in demand" --condition 2-- to see if some potential resolution rests here. A great deal of the research on the tax-exempt bond markets has been concentrated in this area. Peterson notes that the major buyers of tax-exempts have been individuals in high marginal tax brackets and commercial banks. Since World War II, the fraction of tax-exempt issues held by each has varied depending on cyclical conditions --"annual net purchases of municipal bonds...shows a fascinating contrapuntal motion between changes in bank holdings and those of the household sector. The relationship is particularly evident in the tight credit years." (Peterson, 1976, p. 35) Peterson warns, however, that as larger banks expand their leasing and foreign branch activities, their tax-exempt demand will fall, leaving only smaller banks to provide funds for increasingly needy local governments.

A similar warning is advised concerning fire and casualty insurance company demand. They are currently depressed and reducing asset holdings across the board.

Households, the other group supplying state and local funds, then must of necessity pick up the slack if the current market is to be saved. The household sector consists mainly of individuals, trusts, and bond funds. The average marginal tax rate for tax-exempt bond holders has been estimated at about 55% (Galper and Peterson, 1973). It is suggested that inflation and the progressive income tax system will systematically push more investors into this bracket, consequently raising demand in this sector. The empirical model developed here will investigate this possibility. Up to now there is no empirical evidence that this "bracket effect" (A.W. Sametz, et.al., NYU Paper No. 24) influences household demand.

Peterson concludes by observing that despite the current problems in marketing tax-exempts and the criticism for allowing tax-exemptions on state and local securities both on equity and efficiency criterion (Huefner, 1972 and Fortune, 1973), state and local governments still strongly favor the current legal provisions on state and local borrowing. Presumably, most local governments do not deem the current problems as pervasive or permanent. On a micro level, individual localities feel confident in their own long run ability to market debt in its present condition and have little interest in new Federal regulations or new kinds of subsidies.

If Peterson's list does not trouble the individuals making the decisions, it must not contain even a moderate basis upon which to study tax-exempt bond market behavior. In fact, the entire discussion offers no model or framework upon which to base an analysis.

Rosenbloom formulates a simplified theory through which to gauge tax-exempt bond market conditions (Rosenbloom, 1976). Given r_N is the rate on a tax-exempt bond and r_C is the rate on a corporate bond of equal quality, an investor with the marginal tax rate t is indifferent between the tax-exempt bond and the corporate bond when $r_N = (1-t)r_C$. Investors who are in tax brackets greater than t will prefer the tax-exempt to the corporate bonds. Rearranging terms: $t = 1-r_N/r_C$. Knowledge of r_N/r_C reveals the tax rate at which an investor will rearrange his/her portfolio. This ratio has been historically quite volatile and considered a reasonable estimate of tax-exempt bond market conditions. Rosenbloom examines tax-exempt supply and demand to disclose what makes this ratio vary.

Rosenbloom notes that supply increases have paralleled inflationary increases since 1960. These increases have shown no "apparent relationship to the business cycle" (Rosenbloom, p. 12). Hence the yield ratio fluctuations are not believed to emanate from the supply side.

As all other descriptive studies, Rosenbloom traces the demand history of each sector. He goes another step, however, as he adopts a theory of bank demand. He asserts that banks primarily strive to fill their portfolios with loans and to meet liquidity needs. Only the leftover or "residual" funds are invested in tax-exempts (p. 14). He notes through observation of Flow of Funds data that there is an inverse relationship between the fraction of deposits placed in loans and the fraction placed in tax-exempts. Both fractions fell in 1974 and 1975. This short run trend led Rosenbloom, as Peterson, to foresee trouble ahead.

1980 Flow of Funds data reveal the deep fears of demand slippage were too hasty. Total bank demand for tax-exempts, total deposits, and bank loans have all risen markedly.

Rosenbloom points out that individual demand is expected to pick up when banks leave the market. A fall in bank demand raises r_N/r_C, which lowers t, and causes more individuals to become subject to tax rates higher than tax rate t, the rate of marginal investors. Rosenbloom does not attempt to measure the strength of this effect.

Similarly, he notes but does not quantify the strengths of the fire and casualty insurance company sector. Unlike Peterson, Rosenbloom finds this sector a stable and strong source of demand. Current Flow of Funds data show Rosenbloom correct.

In concluding Rosenbloom takes a pessimistic view of the future market. In 1975 with bond demand falling, insurance companies making low profits, debt needs rising steadily, and rates subject to the vagaries of the business cycle, he sees municipalities facing an enormous marketing effort. A more general model might foresee future markets developing on their own. In fact, recent experience shows a considerable expansion in municipal bond funds and increased buying of tax-exempts by thrift institutions.

Beyond Rosenbloom another group of analysts has looked to the Federal government to stabilize the tax-exempt market. The empirical literature on tax-exempt markets was initiated to show how Federal subsidies and supply limitation policies would improve tax-exempt bond market conditions. Among those involved in this movement are Robert Huefner, Susan Ackerman, David Ott, Peter Fortune, Harvey Galper, and John Peterson.

Drawing on the work of Huefner, Ackerman, and Ott, Peter Fortune outlined a formal, yet elementary, theory of the tax-exempt bond market (Ackerman and Ott, NTJ, 1970; Huefner, NTJ, 1970; Fortune, NEER, 1973). This theory underlies the early theoretical and empirical work done on tax-exempt bonds. The foundation of this theory is embedded in Figure 2-1. The tax-exempt to taxable bond yield ratio discussed in Rosenbloom is on the vertical axis. Recall r_N/r_C is equal to 1-t. The volume of tax-exempt bonds issued is on the horizontal axis. To induce more individuals to purchase tax-exempts, the t value must fall, this means r_N/r_C must rise as shown by the positive slope of the demand curve. For simplicity of exposition it is assumed in Figure 2-1 that debt issues are independent of interest rates, therefore an inelastic supply curve is shown.

Figure 2-1 indicates that in order to sell all their bonds, municipalities must set $r_N/r_C = .7$ so that for the indifferent investor $t = .3$.

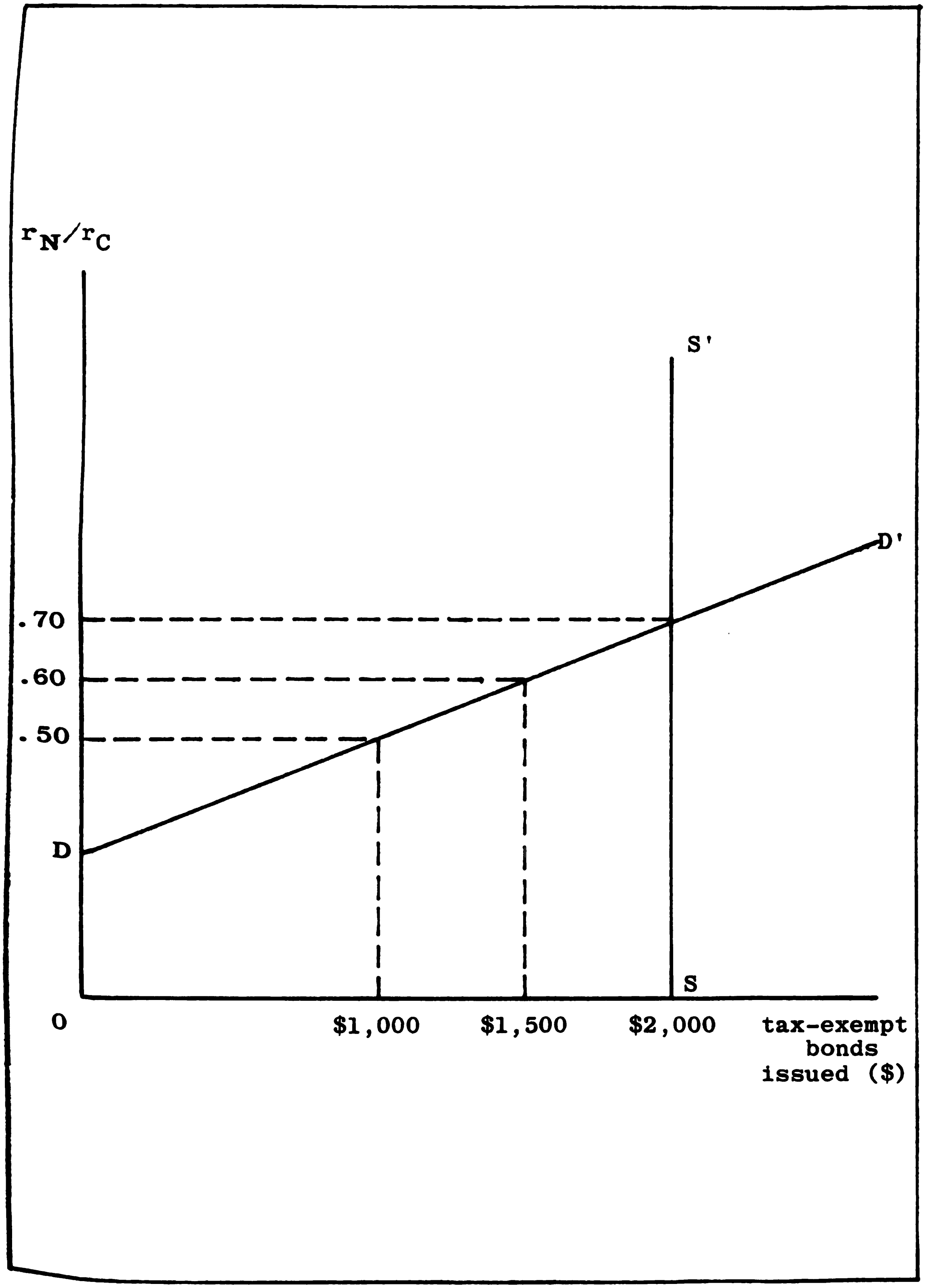
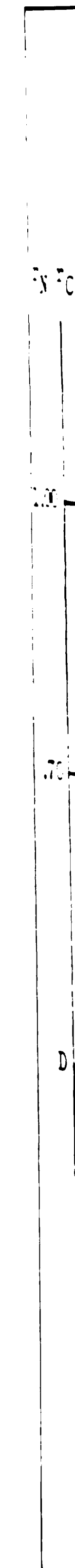


Figure 2-1

Fortune employs the model because it is useful in "pointing out the problems created for the municipal bond market by using tax-exemption to subsidize the interest of municipalities.... The chief problems are: (1) The special sensitivity of the interest rates to monetary policy; (2) The inefficiency of tax-exemption as a means of subsidizing municipal debt issues; and (3) the windfall income which accrues to individuals with higher tax rates than the tax rate of the last purchaser of municipal bonds." (p. 21)

The model can also be used to examine the possibility of a long run collapse in the market. Both supply and demand shift right as income and wealth rise. The crucial question in the long-run is which curve shifts faster, or will the shifts in supply exceed those in demand to the extent that r_N/r_C becomes too high for local governments to withstand. This poses a particular problem to Fortune because it exacerbates the problems he mentions above.

Figure 2-1 is redrawn in Figure 2-2. Area B is "paid twice", once by the municipality to inframarginal investors and once by the Federal government in lost tax receipts or tax expenditures. According to Fortune, here lies the source of inefficiency and inequity resulting from the tax-exemption. No general equilibrium models have emerged to counter this argument. Whether or not a general equilibrium model would alter Fortune's conclusions is irrelevant to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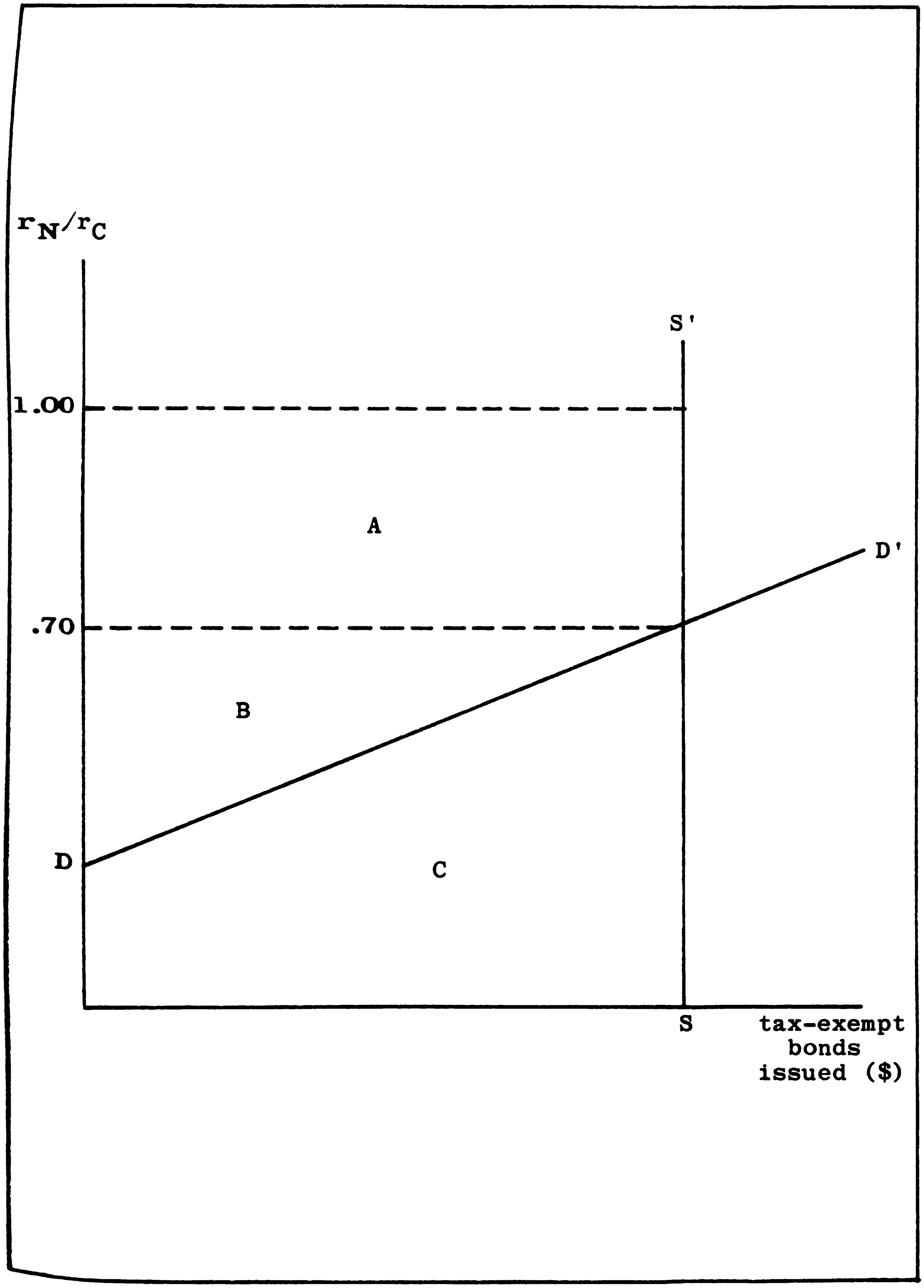

Figure 2-2

this paper. But it is important to note that the early empirical models are constructed to compare efficiencies in the above sense when different Federal subsidy options are offered to local governments to replace the tax-exemption.

Empirical Studies

Galper and Peterson present the first empirical analysis of the tax-exempt bond market (Galper and Peterson, 1971). The Galper-Peterson (G-P) model consists of a tax-exempt bond supply equation, a non-taxable bond supply equation, a household demand equation for tax-exempts, and a household demand equation for other bonds. Other sectoral demands for tax-exempt bonds are assumed exogenous. Specification of the demand equations are in line with the Rosenbloom and Fortune theory delineated previously. Household purchases of tax-exempts depend mainly on the ratio of the tax-exempt bond yield to the taxable bond yield. Bank demand for tax-exempts is regarded as exogenously determined; it comes out of the residual funds left over after loan demand is exhausted and liquidity needs are met.

Peter Fortune broadens the G-P model (Fortune, NTJ, 1973). His goal, like G-P, is to show the economic superiority of direct subsidies over tax-exemption. Fortune's model has five markets --tax-exempt bonds, private securities, U.S. bonds, thrift deposits, and bank

time deposits. This allows tax-exempt purchases to substitute for deposits or U.S. bonds, not just private securities as in G-P's model. More significant, Fortune fully specifies a bank demand equation with tax-exempt demand dependent on the rate differential between tax-exempts and long term corporate bonds. However, he doesn't reject the residual theory; the choice of what kind of long term bonds to buy is made <u>after</u> the total amount of long-term purchases is determined, which depends on bank loan and liquidity demands. Fortune makes his model a residual theory by scaling the yield ratio by the change in total long term bond purchases. Despite the additional attention to bank demand, the R^2 for Fortune's equation is .85 and the D.W. is .80. It appears that there are serious auto-correlation problems.

The household demand equation is similar to that in G-P with independent variables being the aforementioned yield ratio, the change in household purchases of <u>all</u> kinds of bonds and a list of definitions which allow Fortune to test the efficiency of different subsidy plans. Despite the complexity of this equation, its usefulness is questionable. The R^2 is .17 and the D.W. is .83. G-P also had poor R^2 and D.W. statistics although not as poor as Fortune. Fortune suggests the problem may be in his data, not his specification.

Both G-P and Fortune attempt to show a behavioral relationship between local government decisions and tax-exempt bond supply. G-P note that borrowing depends on local construction demand, which is assumed to be a linear function of GNP. Gross tax-exempt bond supply over construction demand is their dependent variable. The only major independent variable is the rate of return on tax-exempts. The equation has an R^2 of .66 and D.W. of 1.45.

Fortune's supply equation is no more explanatory than G-P's equation. Net issues of tax-exempt bonds is the dependent variable. To measure the demand for state and local capital goods, Fortune simply inserts disposable income as an independent variable. He also attaches net state and local government receipts to the equation. No rationale for its inclusion is given and there is probably a great deal of multicollinearity between net receipts and disposable income. The R^2 is .66 and D.W. statistic 1.79. The obvious inadequacies of these models led to the Hendershott and Koch study (1977).

Hendershott and Koch (H-K) have constructed the most comprehensive economic model of the tax-exempt bond market to date. On the demand side, they have delineated a full behavioral model. Bank and insurance company tax-exempt bond demands depend mainly on profits. Household demand depends mainly on the relative rate of return on a full portfolio of assets. Their supply model offers possibly a

slight improvement over the other models; an accounting framework is used to restate the same variables found in the equations of earlier studies.

H-K, in taking a profit maximizing approach to bank tax-exempt bond demand, put forward a more general, long-reaching model. H-K maintain that a certain base stock of tax-exempts must be held to obtain the long run income or profits which the banks expect to acquire. Discounting expected future income by the average rate on tax-exempts determines this base stock demand. From this base, H-K begin augmenting their equation. Other tax shelters and a minimum level of taxable assets to avoid legal harassment are subtracted from the base stock.

Two adjustments for short run deviations are then entered. When actual profits exceed expected profits, more tax-exempts are demanded because more income must be shielded from taxation. To show this effect, the discounted difference between actual and expected profits becomes a variable.

When the rate of return on tax-exempts relative to the rate on taxable securities is abnormally high, tax-exempt demand goes up to take advantage of these conditions. Conversely, when the relative rate on tax-exempts is abnormally low, tax-exempt demand falls. To capture this effect, H-K use a moving average of past ratios of tax-exempt rates to taxable rates as a proxy for the normal rate ratio. The difference between the current ratio and the normal ratio, scaled by profits, becomes an additional independent variable in the equation.

In their actual specification, H-K have observed data and decided to enter the independent variables alone and with two truncated time trend factors. The regression results show R^2 = .997 and D.W. = 2.04. This observor believes that these highly supportive results come about because of the time trend factors. H-K used their model to forecast future demands. Their second time trend factor follows a fall in demand over the later years of their observation period. Hence future forcasts are likely to be understated. In fact, their 1979 prediction is $10 billion short of the actual amount of tax-exempts held by banks. This is not to suggest that their model should be rejected, but a model with less manipulation of data and more descriptive power can surely be constructed.

H-K's use of the profit motive as the underlying characteristic of tax-exempt demand is noteworthy. The model put forward in this paper will begin with the same premise when reconstructing a bank demand equation. However, H-K's method of making profits a determinant of tax-exempt demand is peculiar. It seems unrealistic for bank managers to have some expected profit level in mind to which they adjust their tax-exempt bond holdings. Bankers adjust their portfolios on a daily basis in anticipation of market conditions and changing expectations of future rates

of return on many competing assets. A more descriptive profit maximization model should observe the behavior of bank asset managers and how they adjust their portfolios in an unending effort to maximize short-run and long-run profits --keeping in mind that short-run and long-run profit maximization may require conflicting portfolio choices.

H-K also model Property Insurance Companies and in a later article (1980) model the demand of thrifts. These models follow the commercial bank model outlined above as no significant changes in methodology are made.

To model the household sector H-K utilize standard portfolio theory. The demand for tax-exempts depends on the own rate of return, the after tax rates of return on U.S. government bonds and equities, and the total value of asset holdings.

H-K's empirical estimates immediately run into problems. The coefficient on the tax-exempt yield is unacceptably low and the D.W. statistic is low. H-K attribute the low coefficient to "simultaneous-equation bias." The rates must adjust for the demand of each asset market to clear the existing supply. Although they ignore the possibility, their method of choosing the proper tax rate could also have damaged their results.

To resolve their problem, H-K make the tax-exempt rate of return the dependent variable but find that the rate of rel

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return on taxable bonds overshadows all other relationships. Thus, they make further adjustments and reestimate household demand as a function of the original variables. The results show R^2 = .768 and D.W. = 1.38, still statistically weak.

To model tax-exempt bond supply, H-K employ an aggregate state and local government sources-equal-uses statement. Simple algebra yield issues of tax-exempt bonds equal to uses of funds minus the sources of funds other than tax-exempt bonds. These categories of uses and sources are redefined and a linear function is expressed: tax-exempt bond issues = $\beta_0 + \beta_1$ (structures) - β_2 (federal grants) - β_3 (net of all other sources and uses). H-K implicitly assume that structures and grants are the variables whose relationships with tax-exempt bond issues are the most important to uncover.

Structures are deemed important because most states have legal debt limits allowing debt to be issued only for special purposes, such as capital financing, or requiring current operating budgets to balance. Grants are important because they provide state and local governments a substantial source of funds, which offer numerous additional options to state and local government finance. H-K expect grants to be negatively related to tax-exempt issues, as this relationship follows from the accounting identity.

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To the three regressors from the accounting relationship, H-K adjoin a ten year tax-exempt rate "in an attempt to capture this permanent portfolio response" (p. 39). As a final regressor, they try to reveal short run supply variations in reaction to the tax-exempt rate by observing deviations of the present rate from a "normal" rate. They foresee state and local managers adopting regressive expectations of future rates --i.e. local government managers think the rate will return to its normal level which is an average of previous rates.

H-K have merely added ornamentation to G-P and Fortune. There is essentially no behavioral analysis involved in this equation. Statistically, the results are excellent, but they should be inasmuch as the explanatory equation is based on an accounting identity of the variable being estimated. The dollars spent on structures and received from Federal grants are obviously involved in the decision to issue bonds, but these dollars do not hold a direct causal relation with bond issues. All of the variables found in the accounting relationship are ex post; these numbers appear after the important decisions have been made. Local governments agree upon some method of choice to determine the structures they need, the taxes they are willing to pay, how they will use grant money, and the amount of debt they want. Embodied in these decisions are the effects of borrowing rates, which H-K tack on to their accounting structure. Only on an accounting sheet should it inques

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unquestionably hold that Federal grants reduce state and local bond issues. Grants can lead to larger volumes of local debt because matching grants make local public services relatively cheaper than private services. H-K's model misses these behavioral relationships.

State and Local Government Models

The literature related to the model developed here utilizes standard household optimization procedures to derive an expression of demand for state and local services. Although the entity whose welfare is maximized may vary slightly from model to model, the optimizing variables are quite similar.

A pioneer article using this approach was formalized by James Henderson (1968). "It is postulated here that the resultant public expenditure and tax decisions can be explained as if they were the result of maximizing a social welfare function subject to a social budget constraint, both defined in expenditure space" (p. 156). The community welfare function is $W = (a_0 + a_1Y + a_2R + a_3P) \log_e G + X$, where Y is per capita personal income, R is per capita grant money, P is the community's population, G is per capita local public spending, and X is all other uses of income.

The community budget constraint is: $Y-X = T = b(G-R)$, where T is per capita local taxes and b is a fixed proportion of the difference between local spending and grants.

Hence 1-b of each expenditure dollar is financed with debt issues.

Henderson maximizes the welfare function subject to the budget constraint and generates an expression of expenditure demand. As in all maximization problems, he regenerates the budget constraint when taking the derivative of W with respect to the Lagrange multiplier. Unfortunately, however, he then rearranges the budget constraint to isolate X, which he interprets as the demand for private goods.

Henderson's initial idea is creditable, but his method fails to catch the whole picture. First, note the form of W --when taking the derivative of W with respect to X, X drops out. Second, the budget constraint is a constraint on G spending only, while W, the variable being maximized, allows for X spending as well. A proper constraint would bind all spending, not just certain appointed kinds of spending. Finally Henderson neglects the production side of the problem entirely. Borcherding and Deacon rectify many of these defects as they present a broadened model in a later article (Borcherding and Deacon, 1972).

Borcherding and Deacon (B-D) consider their model the first non-<u>ad</u> <u>hoc</u> construction, as their model is based on the accepted theory of collective decision making (Bowen, 1943; Arrow, 1963; Black, 1948; Downs, 1957; Buchanan and Tullock, 1962). B-D follow the original Bowen argument that the provision of local goods is set where the marginal benefit of the median voter is equal to the marginal tax price of the median voter. B-D further assume that log-rolling is inefficient and not done; and they assume bureaucracy does not create productive inefficiency, so local goods are produced with least cost methods. Finally, the production function is assumed to be a Cobb-Douglass type.

B-D derive a marginal cost function which with its Cobb-Douglas properties is horizontal. The amount of the local good consumed by the median voter depends on the degree of rivalry inherent in the good. B-D posit this consumption as total production over community population taken to an exponent which reveals the good's degree of rivalry. They further assume that the marginal tax price of the median voter is equal to the marginal cost of the good divided by the community's population level.

From this point B-D take a large leap. They postulate a median voter's local good demand function; it is log-linear and depends on the median voter's marginal tax price, previously derived, and the median voter's income. B-D use this form because it offers a highly tractable empirical specification, which is subsequently estimated.

B-D have also passed over some crucial pieces of theory. The median voter must optimize with limited resources, but the choices and resources available are ignored. Hence the demand function B-D posit has an unknown base from which to emanate. There is no reason to accept their demand schedule. Second, the financing decisions are not clear. These decisions are embedded somewhere in the marginal tax price, but there is no mention of where.

B-D have, however, broadened the model to include production, and the idea that a median voter chooses between public and private goods with a constraint on <u>all</u> choices. Bergstrom and Goodman in an article following shortly after B-D attempt to clarify the relationship between the demand schedule and the optimizing behavior of the median voter (Bergstrom and Goodman, 1973).

Bergstrom and Goodman (B-G) note a utility function whose arguments are public goods and private goods. The median voter maximizes utility subject to a budget constraint where income is equal to the price of private goods times the number of private goods purchased plus the marginal tax price --as explained in B-D-- times the quantity of public goods produced. B-G assume that the demand schedule derived from this procedure is very similar to the demand curve postulated by B-D. B-G, as did B-D, then go about estimating their log-linear equation. Although they have been openly vague about the proper form of the median voter's utility function, B-G have taken another step toward a complete median voter model.

At about the same time as B-G, Gramlich and Galper (G-G) came out with another utility maximization state and local government model (Gramlich and Glaper, 1973). The entity whose utility is maximized is unclear, but we are given some "objectives" of state and local decision-makers. These objectives are the arguments of the utility function G-G posit. This utility could belong to the community, as in Henderson. It could belong to the median voter, or possibly to the officials themselves. It could even be some combination of official and community welfare as perceived through an unstated procedure of collective action. In any event, the local decision-makers attempt to maximize this utility subject to the localities budget constraint.

The objectives of state and local government are: (1) higher current expenditures; (2) higher disposable income; (3) greater flows of services from the capital stock; and (4) greater flows of services from the stock of financial assets. The budget constraint ensures that any rise in <u>local</u> spending is matched by a grant, taxes, or the sale of financial assets. Just like Henderson, this constraint only binds certain variables in the utility function. The choice between private goods and local goods must be made, before the model becomes operable; i.e. objective 2 above is not bound by the state and local government budget constraint --it must be exogenous or predetermined.

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As a tool in developing a state and local debt model, the G-G model is further deficient in that it does not allow expenditures to be financed with debt --not even the expenditures on capital. G-G do, however, advance the state and local model by suggesting that services flow from current accounts and capital accounts. This distinction is useful in developing a bond supply model. Ott and Ott consider this distinction in an even more comprehensive state and local government model presented a couple of years later (Ott and Ott, 1975).

Following the work of Buchanan and Tullock who assert "collective action, along with private action, is motivated by individually-conceived ends, and all action proceeds only after a mental calculus is performed by some individual or individuals" (Buchanan and Tullock, p. 316), Ott and Ott (O-O) adopt the median voter approach to state and local government decision-making behavior. Similarly to Borcherding and Deacon, O-O assume that majority rule leads to a combination of choices in line with the optimal choice of the median voter.

O-O affirm that the median voter in choosing public and private consumption within his/her budget must be restricted to current account purchases only. "It is impossible to specify the appropriate 'tax price' for the services of state and local capital, and even if it were possible, the necessary data on state and local government stocks of capital and flows of services would still be lacking" (p. 12). Hence O-O only use the median voter approach to analyze the current account, while they take an *ad hoc* approach to analyze the capital account.

For their current account model, O-O adopt the assumptions laid down by B-D. Their utility function contains a basket of state and local goods and a basket of private consumption, savings, and Federal goods. Each of these goods is expressed with a population variable taken to an exponent to express, just as B-D and B-G, the degree of rivalry in consumption.

The budget constraint is the price of private and Federal goods times the quantity of private and Federal goods purchased plus the tax price to the median voter times the quantity of local goods purchased set equal to the median voter's income, assumed to be the mean of community income.

The first order conditions yield an expression of demand for each of these goods. They are a function of per capita income, the tax price, the price of private goods, and population. In estimating these demands O-O make assumptions limilar to B-G.

O-O then move to the capital account or "structures" side of their model. They point out that capital provides a flow of capital services, "the median voter demand is for a flow of capital services during a given period" (p. 17).

I disagree. The median voter wants a flow of local government services. Providing these services requires capital. In fact, the government services described by O-O earlier on the current account can only partially be provided without the services of capital.

O-O dismiss capital from their central model because they perceive inequalities in the payment flows and benefit flows of capital services from one time period to the next since the services of capital extend over such a long time span. They express an uneasiness about the high probability that "the price of capital services the median voter is willing to pay may not be equal to debt retirement plus interest" (p. 18).

In the final segment of their model, O-O pronounce a bond supply specification. It is a function of construction expenditures minus grants, the tax-exempt bond rate, and the previous period's asset to debt ratio. This specification has the same deficiencies referred to during the discussion of Hendershott and Koch, and Fortune, etc. There is no behavioral motivation behind the specification. The bond supply decision must be made contemporaneously with the decision of how many local goods to produce and the choice of inputs necessary for this production.

In the next two chapters a model will be developed which addresses the deficiencies discussed in this review.

CHAPTER III

A NEOCLASSICAL MODEL OF DEMAND FOR TAX-EXEMPT BONDS

In this chapter a model of tax-exempt bond demand will be delineated. The theoretical model is cast in a modified "capital account" framework (Tobin, 1969). Tax-exempt bond demand is considered within a whole portfolio of competing assets, where a vector of rates of return and other variables adjust to equilibrate the supply and demand of every asset in the portfolio. Observing tax-exempt bond demand within a portfolio of financial assets and liabilities, rather than in isolation, insures that no relevant variables are neglected; every asset demand function contains the same interrelated variables.

With the above variables determined, the model's empirical specification of tax-exempt bond demand is expressed in a partial equilibrium framework. The desired fraction of assets placed in tax-exempt bonds becomes the dependent variable and the endogenous variables from the general equilibrium system become in equilibrium the independent variables of the regression equations. This implicitly assumes that the endogenous variables in the general equilibrium system adjust quickly to equilibrate asset demands with asset supplies.

The Theoretical Model

The theoretical model of tax-exempt bond demand formulated for this analysis departs from previous studies in two ways. First, tax-exempt bond demand is observed within a general equilibrium system comprised of two sectors and seven financial markets.

Second, the relative after tax rates of return on financial assets depend directly, via the tax structure, on the level of nominal wealth. (Unlike the capital account approach adopted in this analysis, the "balance account approach" (Brunner and Meltzer, 1963, 1972, 1973) asserts that wealth changes do alter the yield and price structure of assets. However, they are not altered in the systematic way put forward in this model.)

To depict fully the demand for tax-exempt bonds within a comparative static framework, it is necessary to construct a model which places several financial markets and two sectors into a general equilibrium system. Such a system shows the interrelationship between tax-exempt bond demand and other financial asset demands, and displays the intersectoral activity which determines total tax-exempt bond demand. In particular, it is important to separate the financial sector from other sectors, since the activities of financial intermediaries heavily influence the allocation of the economy's wealth.

The requisite sectors of the model are the banking and household sectors; they have historically combined to fill 80 to 90 per cent of total tax-exempt bond demand. Insurance companies have held most of the remaining 10 to 20 per cent. The dominance of these two sectors results from a lack of alternative tax shelters which insulate other upper income entities from high marginal tax rates. The two sectors appearing in the model are "banks" and "non-bank private," where non-bank private includes the household sector and private business enterprise. Business is included in this sector because businesses and households share in the demand for the assets observed in the model, and because businesses supply corporate bonds which are close substitutes for tax-exempt bonds in the household's portfolio. Most businesses are not interested in tax-exempts because they can obtain more profitable ways to avoid taxes, such as depletion allowances, investment credits, depreciation deductions and other businesses expenses. Insurance companies, lacking some of these tax-sheltering opportunities, have been the major buyer of tax-exempt bonds among businesses.

The financial assets relevant to the portfolio decisions of the two sectors are (in real terms) equity capital (qK), high-powered money (M/P), federal government securities (S/P), non-taxable bonds (N/P), corporate bonds (C/P), bank deposits (D/P), and bank loans (L/P), where P is the price level. (Note: the q in qK is taken from Tobin's model --the price of existing capital over the price of new capital (Tobin, 1969).)

The basic model is formulated at a single point in time, where the general price level and flow variables are exogenously determined. This formulation is used since financial assets are stock variables which can be measured only at a particular moment. An economic unit can either accumulate or depreciate its wealth over time, but at each instant that a portfolio decision is made, the unit's desire to hold assets is constrained by a given legacy of wealth. This technique of analysis as alluded to previously is termed the "capital account approach" (Tobin, 1969).

The amount of an asset held by either sector depends on the rate structure, real wealth, and several other variables which will be discussed later. According to the capital account approach, the desired amount of each asset is homogeneous in wealth --that is, if the rates of return do not change, an increase in real wealth will bring about a proportional increase in the desired amount of each asset. This will occur if there is a proportional increase in all asset supplies.

Unlike the standard capital account approach, in this model a proportional increase in all assets directly changes the relative after tax rates of return on the assets. This direct effect occurs because as nominal wealth rises, none of the additional nominal income earned on additional tax-exempt bonds is lost when investors move into higher income tax brackets. At the same time the added nominal income earned on the other assets is subject (due to the progressive income tax law) to higher marginal income tax rates. This model follows the capital account approach, nevertheless, in that decisions to save are independent of asset portfolio allocations. This independence is retained in the model developed here. (The direct effects of wealth on the rate structure will be examined in greater detail later.)

The Variables

The nominal rates of return in the model are:

r'_K the rate of return on equity capital

r'_M the rate of return on currency and reserves

r'_S the rate of return on treasury securities

r'_N the rate of return on tax-exempt securities

r'_C the rate of return on corporate securities

r'_D the rate of return on bank deposits

r'_L the rate of return on bank loans

d' Federal Reserve discount rate

$\hat{r}'$ is the vector $(r'_K, r'_M, r'_S, r'_N, r'_C, r'_D, r'_L, d')$.

The real after tax rates of return on assets held by the banking sector are:

r_M^u the real after tax rate of return on free reserves and required reserves

r_S^u the real after tax rate of return on treasury securities

r_N^u the real after tax rate of return on tax-exempt securities

r_L^u the real after tax rate of return on bank loans

d real Federal Reserve discount rate

r_D the real rate of return on bank deposits, a liability, hence requiring no tax rate

$\hat{r}^u$ is the vector $(r_M^u, r_S^u, r_N^u, r_L^u, d, r_D)$.

The rates of return on capital and on corporate bonds are not entered into the banking vector, as banks are legally prohibited from investing in most types of corporate stock, and very few banks invest in corporate bonds.

r_D is also constrained by government regulations; legal ceilings have been placed on the nominal rates of bank deposits. With the exception of large certificates of deposit, in recent years the market rates on deposits have rarely fallen below the ceiling rates. Consequently, bank supplies of total deposit offerings to the public have been very elastic.

The discount rate, d, is important because when it goes down relative to the rates on bank assets, it becomes profitable for banks to borrow from the Federal Reserve and invest in the income earning assets. This means the level of non-interest bearing assets held by banks should decrease. In short the fraction of bank assets held in free reserves should fall. This conclusion cannot be asserted unequivocally, however, since it is not certain how excess reserves will change in response to a change in d. Historically, the level of excess reserves has remained relatively stable when compared to the level of borrowed reserves. (Historical Chart Book, 1978). The argument is often made that many banks attempt, quite successfully, to keep their excess reserves close to zero. This would suggest that most of the fluctuations in free reserves in response to changes in d occur through the effect of d on borrowed reserves, where there is a clear negative relationship. Thus when d rises, the demand for borrowed reserves falls and the demand for free reserves rises. Furthermore, free reserves may be held in case reserve requirements cannot be met when d is prohibitively high.

The after tax real rates of return on assets held by the portion of the non-bank private sector supplying funds (i.e., lending) are:

r_K^t the real after tax rate of return on equity capital

r_M^t the real after tax rate of return on currency

r_S^t the real after tax rate of return on treasury securities

r_N^t the real after tax rate of return on tax-exempt securities

r_C^t the real after tax rate of return on corporate securities

r_D^t the real after tax rate of return on bank deposits.

The real rates on liabilities to the non-bank sector are:

r_C the real rate of return on corporate securities

r_L the real rate of return on bank loans.

$\hat{r}^t$ is the vector $(r_K^t, r_M^t, r_S^t, r_N^t, r_C^t, r_D^t, r_C, r_L)$.

d is not included because only banks can borrow from the Fed. With the introduction of inflationary expectations, taxes, and the price of existing capital, the after tax real rates of return can be more precisely defined. The symbols involved and their rationale are described below.

π^* is the expected rate of change in the price level. In choosing a time series for this variable the literature has been thoroughly reviewed. The time series data chosen was produced by John Scadding whose series is in close touch with the current state of the art on the subject of inflationary expectations (Scadding, 1979):

> This paper (John Scadding) presents a model of how individuals might rationally extract information about the underlying inflation rate from observed price changes, and how they might use that information to forecast future prices...
>
> Traditionally, economists have assumed that economic agents form their expectations about future events adaptively, i.e. the forecast for next period is formed by adjusting this period's forecast by some

fraction of this period's forecast error. Price expectations are commonly modelled this way, although the adaptive model is in part ill-suited for this purpose because it leads to chronic underprediction of prices if prices are growing. The reason is fairly obvious. The adaptive model implies that forecast prices are a weighted average of current and past prices, which will always be less than the current level when prices are growing. The forecasting model developed in this paper represents a generalization of the adaptive model that allows for systematic growth in prices and therefore avoids the problem of chronic underprediction. The model has the added attraction of being derived from optimizing behavior, rather than adduced on an *ad hoc* basis as is typically done (Scadding, 1979, p. 7).

It is also important to note that although the price level is fixed and acts as a constraint at the moment of a decision, expected price changes do enter into the decision-making process. In short π^* injects a dynamic element into a static decision-making model.

u is a weighted average of the marginal corporate income tax rates facing a bank in a given year. Each rate is weighted by the fraction of bank income which is taxed at its rate. These rates have periodically changed.

$T = T(y^*(W), P^*, T^*)$ is the expected income tax rate applied to investors who are indifferent between tax-exempts and corporate securities. y is the real income derived from the human and non-human wealth of these marginal individuals; so $y^* = y(1 + (\text{the expected growth rate of } y))$.

$P^* = P(1+\pi^*)$ is the expected price level. T^* is the expected tax structure, which is assumed to be realized. Here again a dynamic element is placed within the static framework. When P^* or y^* rise, the number of investors in tax categories greater than or equal to T rises.

q as previously noted, is equal to the market price of ownership claims to existing capital divided by the reproduction price of new capital (the general price level). Allowing the value of equity capital to be a proxy for all financial claims to existing capital, an old car has market value included in qK under the general title of equity capital. The variable q enriches the model, as it allows the general price level (the price of new capital) and the price of existing capital to diverge. This divergence in relative prices causes financial portfolio rearrangements discussed below.

$r_K' = R/q$; this simplified form for the real pre-tax rate of return on equity capital assumes that capital does not depreciate and has an infinite life. R is the marginal product of capital which in equilibrium is equal to the rental cost of capital (RC) divided by P. Since Pq is the amount an investor must pay for a claim to a unit of existing capital, $r_K' \cdot Pq = RC$ or $r_K' = RC/Pq$; and since $RC/P = R$, then $r_K' = R/q$.

If the depreciation and lifetime assumptions are dropped, the inverse relationship between r_K' and q still holds. For instance, if the price of existing capital rises relative to the price of new capital (q rises), then r_K' falls because it costs more to buy the existing capital used to produce a steady return to its owner.

There are two effects as a result of a fall in r'_K. The first is financial; when the rate on equity changes, all rates must change in order to restore equilibrium in the market for each asset. The second effect is real; if new capital costs less per unit than old, then it pays for the investor to invest in new capital --that is, increase the level of the capital stock. This of course requires time and causes W to change. Thus a link is provided from the financial markets to a short-run flow model of income determination. At the end of each period W will be different, but fixed for the moment, and r'_K, as well as the rates on other assets, must adjust in order to induce financial investors to hold the existing stock of each asset.

Although it is an essential part of this study to understand the theoretical relationship between the rate of return on equity relative to the rate of return on tax-exempts (especially during inflationary periods), the components of the variable R/q are difficult to measure and apply to practical use. Efforts to measure R and q have been conducted (Brainard and Tobin, 1968), but these methods require a great deal of approximation. A simple, more practical measurement of r'_K should serve the purposes of the present undertaking. Keeping in mind that the price of equity is used as the general price of a claim to all existing capital, a standard definition for the real rate of return on equity is employed --r'_K = (nominal earnings per period, E) ÷ (the value of stock prices at the period's beginning, SP) minus the expected rate of inflation at the beginning of the period, π^*; $r'_K = E/SP - \pi^*$.

The revised definition is easily related to the previous one. When the price of new capital or the marginal product of capital rises, E should rise --when prices rise, nominal earnings rise, and when productivity rises, real earnings should rise. Changes in stock prices reflect changes in the price of existing capital. Since E is the nominal return, π^* must be subtracted to get the asset's real rate of return. With this rationale, the changes in r'_K can be viewed as the result of changes in q or R. With these relationships established, the list of after tax real rates of return can be further explained.

$r^u_M = - \pi^*$. There is no nominal interest rate on required or free reserves, so there is no income earned or tax placed upon them, but there is an anticipated loss in purchasing power shown by the expected rate of inflation.

$r^u_S = (1-u)r'_S - \pi^*$. (1-u) is the fraction of income derived from federal securities which is not taxed away, and again π^* shows the expected loss in real buying ability.

$r^u_N = r'_N - \pi^*$. There is no tax rate applied to the nominal return of state and local bonds, as they are tax-exempt. This rate is not precisely correct, but making it correct would require redefining other rates in a way which is impossible to do when using aggregate rates.

When measuring the after tax return on an asset, to be completely correct, the tax reduction associated with the tax deductions from interest payments on funds borrowed to purchase the asset should be added to the after tax return of the asset. Correspondingly, the after tax rate of return should be modified by adding to the rate of return a fraction equal to the borrowing rate times the individual's tax rate. Of course determining this rate is impossible to do on the aggregate, since not everyone borrows to invest, and borrowers acquire their funds from different sources with different rates of return. However, this concept is still relevant to tax-exempt bond demand because the Internal Revenue Service does not permit individuals to deduct interest payments on funds used to purchase tax-exempts. Since bank funds come from a <u>general</u> source which may be invested in any number of assets, banks can still deduct the full value of their interest payments from taxable income. This law then provides banks with a greater incentive to invest in tax-exempts than it does individuals; the banking sector's rate of return should additionally include ur'_D, while for individuals, interest deductions in taxes would not be included in the rate of return for tax-exempts.

$r_D = r'_D - \pi^*$. r'_D is a weighted average of the rates on demand deposits, savings deposits, and time deposits. Some of these rates are legally fixed at a level below their unregulated rate.

$r_L^u = (1-u)r_L' - \pi^*$.

$d = d' - \pi^*$. Since banks borrow from the Fed, π^* is an expected gain because the banks pay off their debt with money which has less purchasing power.

$r_K^t = (E/SP)(1-T) - \pi^*$. This variable has an upward bias because it overlooks the double taxation of corporate income. At the same time it has a downward bias because T (the marginal investor's tax rate) may be greater than the corporate tax rate for most investors and the tax advantage of capital gains on equity is ignored. Obviously, a perfect measurement of the aggregate after tax rate of return of equity is impossible to uncover, but using T as a rate applied to corporate earnings puts the after tax rate on equity more closely in line with the after tax rates on other assets.

$r_M^t = - \pi^*$. π^* is the inflationary loss of holding currency. Not included in r_M^t is the shoe leather cost of trying to keep currency holdings at a minimum.

$r_S^t = (1-T)r_S' - \pi^*$.

$r_N^t = r_N' - \pi^*$.

$r_C^t = (1-T)r_C' - \pi^*$.

$r_D^t = (1-T)r_D' - \pi^*$. r_D' is influenced by regulation Q. The weighted component of r_D' referring to demand deposits is equal to zero (until recent decontrols). Thus when π^* rises, r_D' cannot adjust fully to the desired real rate of return, so r_D^t falls relative to the rates on other assets and the desired amount of bank deposits is reduced.

$r_L^t = r_L' - \pi^*$. Loans are a liability to this sector.

Other symbols used in the model are:

f_{ip}--the fraction of wealth which the non-bank private sector wishes to hold as asset i.

f_{ib}--the fraction of loanable bank assets (which equals their deposit liabilities minus required reserves) the banks desire to put into asset i.

K is a weighted average of the legal reserve ratio on time deposits and demand deposits.

Y/W denotes the transactions need for money --currency or demand deposits. Conventional theory of money demand says as income rises, more money must be readily available to make the greater volume of purchases allowed by the higher level of income. With the level of W fixed, there must be a corresponding decrease in the fraction of public wealth desired in other assets. If W rises by the same proportion as Y rises, more money can be held for transaction's needs, without changing the fraction of wealth held in money balances. Similarly, if W rises by a greater proportion than Y, more money can be held while the fraction of wealth held in money balances decreases.

pol represents changes in banking portfolio policy (similar to a "taste" variable as an argument in the demand for a real good). This variable reflects the degree of bank aggressiveness or caution when choosing between profitable (illiquid) and safe (liquid) assets.

NS stands for new forms of tax shelters for banks. The most important of these is leasing operations which gives banks all the investment tax credits and deductions allowed to companies employing physical capital. Another, though less important shelter is foreign activities. The advantage here is that the United States allows tax credits on foreign profit taxes.

These last two variables are essentially shift variables in the sense of Brainard (Brainard, 1964).

The Equations

With the variables listed and discussed, the static financial asset model can be formally stated.

The definition of real private net wealth is:

$$W = qK + (N + M + S)/P$$

The balance equations for the capital account are:

	Banks		Non-bank private		
(1)			$f_{1p}(\hat{r}^t, Y/W)W = qK$		(equity capital)
(2)	$kD + f_{2b}(\hat{r}^u, pol; NS)D(1-k)$	+	$f_{2p}(\hat{r}^t, Y/W)W = M/P$		(high-powered money)
(3)	$f_{3b}(\hat{r}^u, pol; NS)D(1-k)$	+	$f_{3p}(\hat{r}^t, Y/W)W = S/P$		(federal securities)
(4)	$f_{4b}(\hat{r}^u, pol; NS)D(1-k)$	+	$f_{4p}(\hat{r}^t, Y/W)W = N/P$		(tax-exempt bonds)

(5) $$f_{5p}(\hat{r}^t,\ Y/W)W = 0$$ (corporate bonds)

(6) $$f_{6b}(\hat{r}^u,\ pol;\ NS) + f_{6p}(\hat{r}^t,\ Y/W)W = 0$$ (bank deposits)

Definition: $D = f_{6p}(\hat{r}^t,\ Y/W)W$

(7) $$f_{7b}(\hat{r}^u,\ pol;\ NS)D(1-k) + f_{7p}(\hat{r}^t,\ Y/W)W = 0$$ (bank loans)

In each line the private demand for that line's asset is to the left of the equal sign. To the right of the equal sign is the net supply of the asset. If the net supply is equal to zero, total debts equal total credits leaving no net supply. If the net supply is greater than zero, as in the equity equation, assets exceed liabilities in the private sector; or, as in equations 2, 3, and 4, the government is a net debtor leaving net assets in the private sector. This implies the wealth equation above, W is equal to the sum of the net asset supplies. The sum of all banks' asset demands equals total bank deposits less required reserves --$f_{2b} + f_{3b} + f_{4b} + f_{7b} = 1$. And the sum of all non-bank private asset demand is equal to W -- $\sum_{i=1}^{7} f_{ip} = 1$.

Further note that all variables relevant to a sector are included in every equation. This is necessary because the demands are constrained by wealth; so if a variable in an equation changes, causing its demand to go up, the change in the variable must also make a corresponding decrease in the demand for some other variable or variables in order to remain within the wealth confines.

Mathematically, this means:

$$\Sigma \partial f_{ib}/\partial(\text{any functional argument}) = 0, \text{ and}$$

$$\Sigma \partial f_{ip}/\partial(\text{any functional argument}) = 0.$$

Also, implicit in the system is Walras' Law. All of the equations must sum to W, therefore at least one equation is not independent.

In addition, all assets are assumed gross substitutes so that the following restrictions are placed on the partial derivatives:

(1) $\partial f_{1p}/\partial r^t_K > 0, \ \partial f_{1p}/\partial r^t_{i \neq K} < 0, \ \partial f_{1p}/\partial(Y/W) \overline{<} 0$

(2) $\partial f_{2b}/\partial r^u_M > 0, \ \partial f_{2b}/\partial r^u_{i \neq M} < 0, \ \partial f_{2b}/\partial d > 0$

$\partial f_{2p}/\partial r^t_M > 0, \ \partial f_{2p}/\partial r^t_{i \neq M} < 0, \ \partial f_{2p}/\partial(Y/W) \overline{>} 0$

(3) $\partial f_{3b}/\partial r^u_S > 0, \ \partial f_{3b}/\partial r^u_{i \neq S} < 0,$

$\partial f_{3p}/\partial r^t_S > 0, \ \partial f_{3p}/\partial r^t_{i \neq S} < 0, \ \partial f_{3p}/\partial(Y/W) \overline{<} 0$

(4) $\partial f_{4b}/\partial r^u_N > 0, \ \partial f_{4b}/\partial r^u_{i \neq N} < 0,$

$\partial f_{4p}/\partial r^t_N > 0, \ \partial f_{4p}/\partial r^t_{i \neq N} < 0, \ \partial f_{4p}/\partial(Y/W) \overline{<} 0$

(5) $\partial f_{5p}/\partial r^t_C > 0, \ \partial f_{5p}/\partial r^t_{i \neq C} < 0, \ \partial f_{5p}/\partial(Y/W) \overline{<} 0$

(6) $\partial f_{6p}/\partial r^t_D > 0, \ \partial f_{6p}/\partial r^t_{i \neq D} < 0, \ \partial f_{6p}/\partial(Y/W) \overline{>} 0$

(7) $\partial f_{7b}/\partial r^u_L > 0, \ \partial f_{7b}/\partial r^u_{i \neq L} < 0, \ \partial f_{7b}/\partial d < 0$

Most obvious when observing these partials is that the partial with respect to an assets own rate of return is always positive, and the partial with respect to the rate of return on any other asset in the decision-maker's portfolio is always negative. The assets are gross substitutes within each sector. This is consistent with the adding up requirement discussed in the last paragraph. The partial with respect to Y/W is positive for the two money assets and negative for the other assets; this is also consistent with the last paragraph.

Finally, it is assumed the partial of free reserve demand with respect to the discount rate is positive:

$\partial(FR/D)/\partial d = 1/D \cdot \partial FR/\partial d$, since D is constant,

$= 1/D \cdot \partial ER/\partial d - 1/D \cdot \partial BR/\partial d$, since FR

= excess reserves (ER) - borrowed reserves (BR).

$\partial BR/\partial d$ is negative, as a higher discount rate discourages borrowing. It is not certain what ER will do in reaction to d, but it is reasonable to assume an increase in d will indicate to banks that restrictive monetary policy is being undertaken, so they should expect a contractionary future. Under these circumstances banks will want to hold at least the same level of ER and probably increase ER in anticipation of contractionary withdrawals of deposits. Under this reasoning both terms, $\partial ER/\partial d$ and $\partial BR/\partial d$, signify $\partial FR/\partial d > 0$. This result implies that the partial of some other asset or assets with respect to d must be negative. The demand for treasury securities and tax-exempts are probably not affected greatly by d, but loans should rise significantly when d falls. It becomes more profitable to borrow more and lend more at the higher borrowing-to-lending differential, thus the partial listed above for loan demand with respect to d is negative. No partial is listed for tax-exempts or treasury securities. It is clear, however, that if the partial of FR does not equal the partial of loans, tax-exempt or treasury security demand must change in some way for the wealth constraint to be preserved.

A brief discussion of the balance equations will complete the static model's description.

The first balance equation, showing the demand for equity capital, has no demand function for banks since, as previously mentioned, banks are legally restricted from this kind of investment. However, in recent years banks have begun leasing operations. One is tempted to place such activity into the capital equation under the banking sector. For now, however, this activity will be included as part of NS (new shelters). These operations are becoming increasingly attractive to banks because they offer sizable tax loopholes, which means leasing investment is a likely future substitute for non-taxable bonds.

The second equation shows the total demand for high-powered money --i.e., bank demand for free reserves plus required reserves plus non-bank private demand for currency. The third equation shows total demand for short-term government securities, and the fourth equation shows total demand for tax-exempt bonds. Both the banking and non-bank private sectors hold a large share in the demand for each of these assets. The fifth equation shows net demand for corporate securities. The banks are insignificant in this market. Both the liabilities and assets of this debt instrument are held by the non-bank private sector. Since demand for the asset must equal the demand for its liability (i.e., negative demand), the two must sum to zero.

Even though corporate securities are not part of net private wealth or the liabilities of banks, it is important to include this equation because it has an impact on the rate structure of the system.

Equation six shows the demand for bank deposits (D) and the willingness to accept these deposits as liabilities (f_{6b}). (Note f_{6b} is _not_ a fraction.) For the deposit assets of households to equal deposit liabilities of banks, $D + f_{6b}$ must equal zero. Banks generally provide a highly elastic supply of deposit liabilities because of the rate ceilings.

Equation seven is the bank loan demand and non-bank private loan supply equation. $f_{7b}\ D(1-k)$ is an asset to the banks and $f_{7p}\ W$ a liability to the non-banking private sector. These also must sum to zero to maintain the equality between borrowing and lending.

Of these seven equations the fourth and seventh have the greatest direct effect upon the demand for non-taxable bonds. Equation four is obviously important, while equation seven is closely associated with bank demand for tax-exempt bonds. Banks attempt to keep the volume of their loans as high as possible within the limits of safety --i.e., minimizing high risk loans and maintaining liquidity needs. Bank profits are highest when they are able to make these loans without suffering from liquidity crises or excessive losses on bad loans. Skilled managers will move in and out of certain uses of funds depending on the prevailing conditions of the time. When few auspicious loan prospects exist, the funds tend to go into tax-exempt bonds where after tax returns are normally better than other investments. When this occurs, r_N' falls, and the quantity of tax-exempt bonds demanded by the non-bank private sector declines. On the other hand when banks anticipate favorable loan prospects, f_{4b} falls and r_N' rises, which induces a greater quantity of tax-exempt bonds demanded by the non-bank private sector.

It should be noted that the movement of funds from tax-exempts to loans is not frictionless. Tax-exempts and loans are not highly liquid assets, so it might involve time and risk to move strictly from one to the other. Consequently, banks also hold short term treasury securities which allow them to bridge this transition with greater safety and profitability. The dynamics of these activities will be detailed in a later section.

Essentially, however, bank managers observe the <u>after tax</u> rate of return differential between tax-exempt bonds and loans; if $r_L^u = (1-u)r_L' - \pi^*$ exceeds $r_N^u = r_N' - \pi^*$ plus a risk premium (which accounts for liquidity needs and the quality of competing assets), then the banks put their funds into loans. If not, the funds go into tax-exempt bonds. Naturally, phenomenon occurring in the remainder of the system also exerts feedback into tax-exempt bond demand, but the interplay is not as strong.

Solution to the System

In solving the system, recall the wealth equation, seven balance equations, and thirteen rate of return equations, together totalling twenty independent equations. $T = T(y^*, P^*, T^*)$, Y, M, S, K, N, r_M', π^*, P, d', k, u, pol, and NS are exogenous variables, while q, W, r_K^t, r_M^u, r_M^t, r_S', r_S^u, r_S^t, r_N', r_N^u, r_N^t, r_C', r_C^t, r_D', r_D^u, r_D^t, r_L', r_L^u, r_L^t, and d are twenty endogenous variables determined by the simultaneous solution of the independent equations. If r_D' is exogenous, because of a legal ceiling $\bar{r}_D'$, then there are nineteen endogenous variables. The number of independent equations also becomes nineteen since the bank deposit equation is no longer an equation since banks cannot get all the deposits they would like at the legal ceiling. If a product market equilibrium and a labor market equilibrium is added to the system of equations, they Y and P can also be determined endogenously. All of this implies that for any set of exogenous variables, only one set of values for the endogenous variables exists which equates the demand for tax-exempt bonds with their supply.

Wealth Effects

A complete model which includes saving and the growth of real income requires specification of the "real" side of the economy and a growth mechanism. The "financial" side of the economy formulated above is easily related to the real side via the variable r_K' which, as explained previously, is one of the determinants of real investment. (This link between the real and financial sector is one approach to studying the transmission mechanism. Of course, there is a whole literature concerning this controversial linkage (Tobin, 1969; Friedman, 1970; Fand, 1970; Teigan, 1972)). The growth of income increases saving and consumption. When saving increases, total wealth increases, and unless the rate structure of assets is perverse (returns on private financial assets are higher than the returns on government assets of equal quality), net wealth will rise. Thus it can be expected that real wealth goes up nearly every period since income in recent years has risen every period. The magnitude of these increases depends not only on income, but the real return from saving, the level of real per capita wealth, and general rate of time preference among savers.

Changes in wealth can also occur when q changes, as this will change the real value of equity capital. Similar to this change, although not explicitly shown in the model, is a change in N caused by a change in the price of municipal bonds. This detail is left out of the model to avoid over-complication. Neither of these wealth effects, however, is systematically related to time, as saving has been in recent years. Given this glance at wealth dynamics, the earlier assumption --wealth accumulation and wealth allocation decisions are independent at a point in time-- remains. Recall this means the desired amount of each asset is homogeneous in wealth.

The adding-up requirements of the static framework provide a link from wealth changes to the balance equations and consequent changes in asset demands. More precisely:

$$\Sigma \partial f_{ib}/\partial D(1-k) = 1, \text{ and } \Sigma \partial f_{ip}/\partial W = 1.$$

W, as a dynamic link, plays an important part in the analysis of tax-exempt bond demand since greater wealth permits more investment in <u>all</u> assets. Of particular interest, households, although their relative demands may change, are potentially able to place more of their savings into N without reducing their holdings of other assets. Additionally, the non-bank private sector can increase the amount of deposits available for investment by the banking sector which may further raise tax-exempt bond demand.

In the absence of outside interference, given the homogeneity assumption, an increase in wealth raises the demand for each asset in proportion to the wealth increase. However, the progressive income tax system disturbs these homogeneous adjustments. Assuming that prices do not fall, the additional income earned on the added wealth is subject to a higher tax rate. This would not notably modify the relative after tax rates of return among assets if the income earned on all assets was taxed equally. However, the income earned on certain assets is tax-free, thus creating a marked rearrangement in the relative after tax rates of return and a consequent asset reallocation.

The above phenomenon can be illustrated by utilizing a simple geometric version of mean-variance portfolio selection theory --demonstrated in Figure 3-1 (Tobin, 1965). ER is the expected after tax real return of an asset, and σ_R is a measure of asset riskiness. Assuming the investor is risk-averse, ER is a good and σ_R is a bad, so that IC_1 represents an indifference curve on a risk-averse investor's utility surface. In this illustration, there are three assets, A, B, and C, where B and C are taxable, and A is tax-exempt. At an initial level of real wealth, point A shows the (σ_R, ER) combination available when all wealth is placed in asset A; point B does the same for asset B; and point C gives the risk-return combination for asset C. The line DC denotes the efficient opportunity locus of (σ_R, ER)

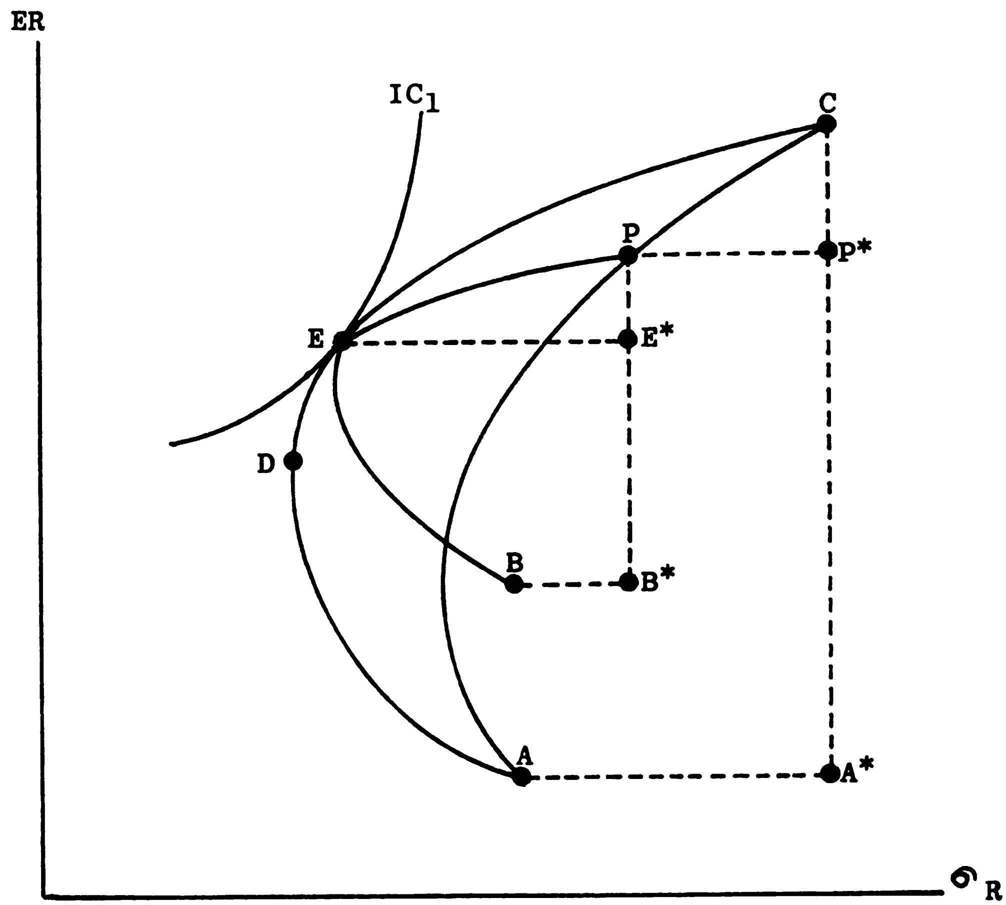


Figure 3-1

combinations corresponding to every possible allocation of wealth between assets A, B, and C. This drawing assumes the correlation between the returns on the assets is close to zero. APC shows the opportunities between assets A and C, and BEP shows the opportunities between asset B and blend P of assets A and C. The utility maximizing investor divides his/her wealth between assets A, B, and C so that he/she has the (σ_R, ER) combination at point E. CP*/CA* is the fraction of assets A and C held in asset A. B*E*/B*P is the fraction of wealth held in assets A and C. Therefore, the fraction of wealth held in A = CP*/CA* • B*E*/B*P.

If nominal wealth increases in the same proportion as prices increase, real wealth will not change, but with the progressive tax structure, the after tax rates of return on taxable assets will fall. A similar result will occur if all asset supplies increase proportionately. Figure 3-2 shows the opportunity loci following either of these events. (Note that the utility achieved is per unit of wealth; hence a proportional increase in all assets which raises total utility will not necessarily increase utility per unit of wealth.) After the shift in the desired portfolio mix, C'P'*/C'A* is the fraction of assets A and C held in asset A. B'*E'*/B'*P"* is the fraction of wealth held in A or C. So the fraction of wealth held in A becomes C'P'*/C'A* • B'*E'*/B'*P"*. Observing Figure 3-2, it can be seen that C'P'*/C'A* > CP*/CA* and B'*E'*/B'*P"* > B*E*/B*P.

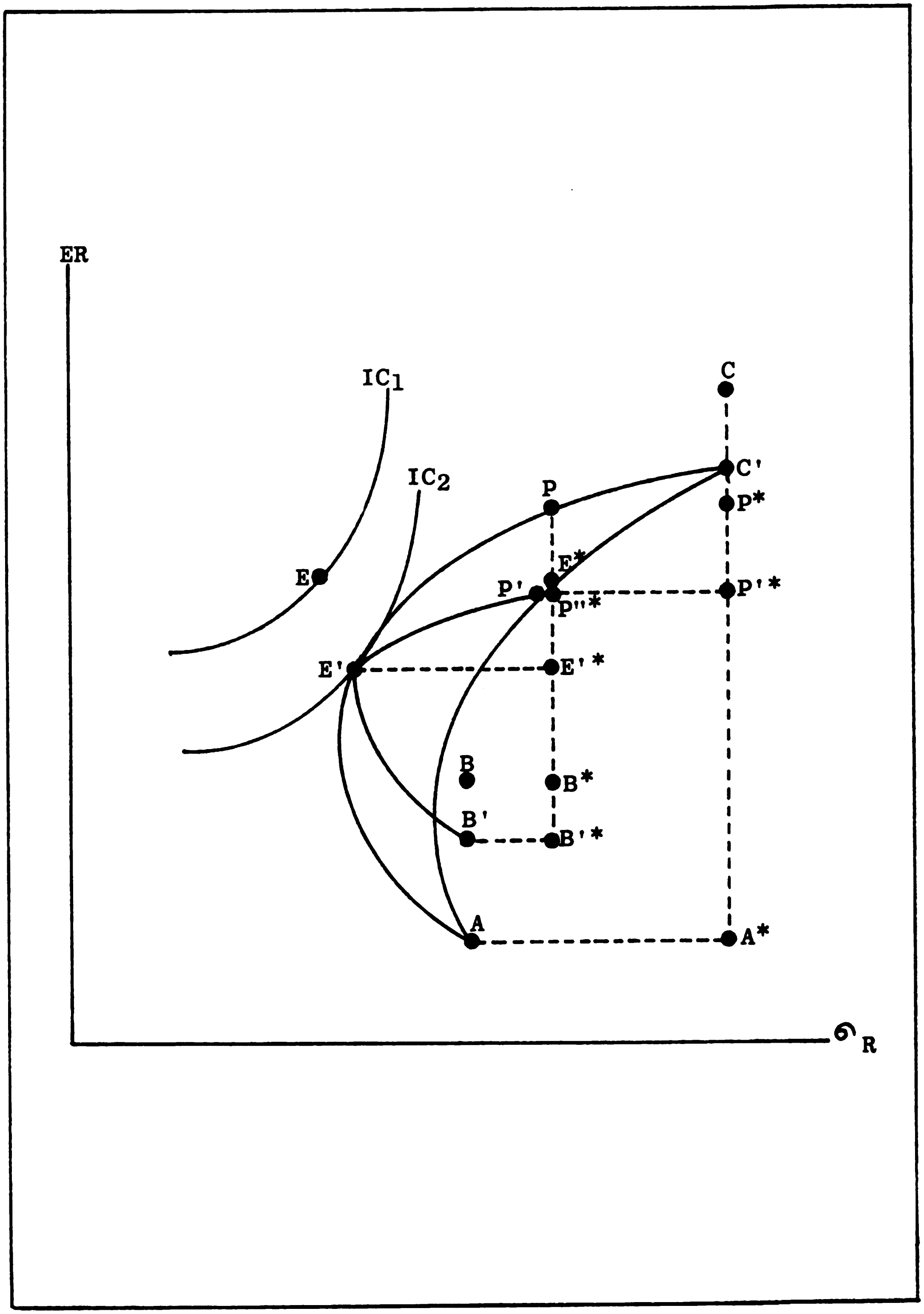


Figure 3-2

Therefore, $C'P'^*/C'A^* \cdot B'^*E'^*/B'^*p''^* > CP^*/CA^* \cdot B^*E^*/B^*P$. The events above cause the fraction of assets held in A (the tax-exempt asset) to rise.

A simpler illustration depicted in Figure 3-3 again shows the same concept. In this example, it is assumed that there is perfect positive correlation between the returns of each asset. BC is the initial opportunity locus for an investor, when asset A is dominated by asset B and not in <u>this</u> investor's portfolio. (This is not to say that asset A is not in the portfolio of another investor in a different tax category.) The proportional rise in nominal wealth and prices moves B and C to B' and C', as the expected after tax real rate of return of these two assets decreases. With the increase in nominal wealth and rise in nominal income generated by this added nominal wealth, holders of assets B and C are pushed into higher income tax brackets. Since asset A is tax-free, it does not experience this tax loss in ER, and the situation depicted in Figure 3-3 can arise, where B' is below A. Asset B is now dominated by asset A, and the opportunity locus becomes AC', with asset B no longer included in the investor's portfolio. To maximize utility, wealth is allocated between asset A and asset C with a (σ_R, ER) combination at point E'. (Again this only means <u>this</u> investor drops B from his/her portfolio; investors in lower tax-brackets may still hold asset B.)

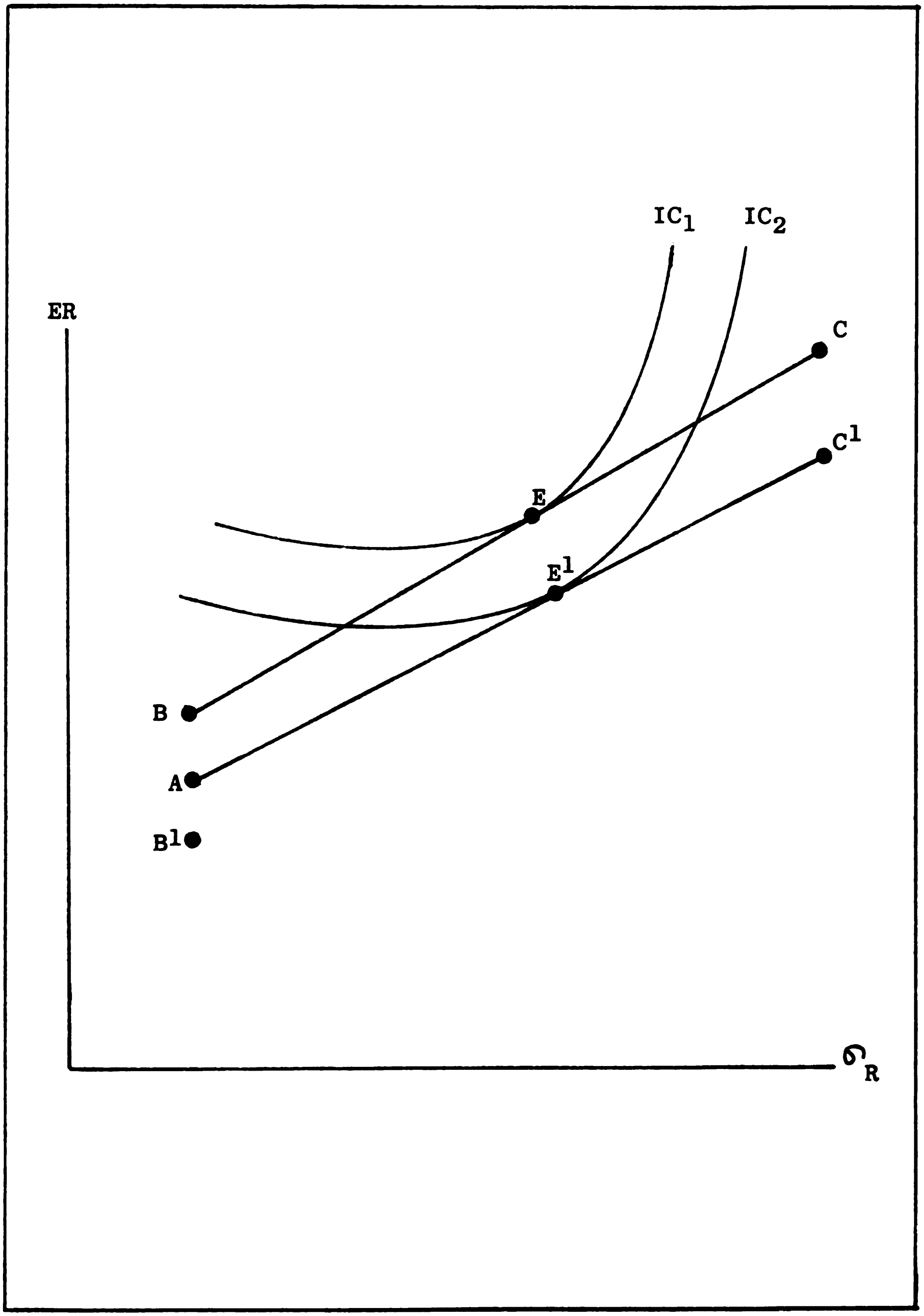


Figure 3-3

As shown above, an important wealth effect is inflation. A rise in P reduces the real value of N or any other financial asset. This means, as previously mentioned, that for the real supply and demand of tax-exempt bonds to be maintained at their pre-existing level, nominal supply and demand increases must be commensurate with price increases. The effect of a price increase without commensurate nominal wealth increases can also be demonstrated with the use of portfolio selection theroy. The asset reallocation results are similar to the results analyzed above, however, total utility, as well as per unit utility, will fall.

With the above theoretical model of demand laid out, it remains to construct the empirical model associated with it.

Empirical Specification

The total demand for tax-exempt bonds is composed of three sectoral demands: individuals, commercial banks, and casualty insurance companies. The non-bank private sector presented in the theoretical section consists of casualty insurance companies and individuals which in turn includes households, trusts, unincorporated businesses, and municipal bond funds. The variables delineated in the theoretical system affect these sectoral demands in different ways. At the same time each sectoral demand influences the values of variables in other sectors. Figure 3-4 provides a schematic

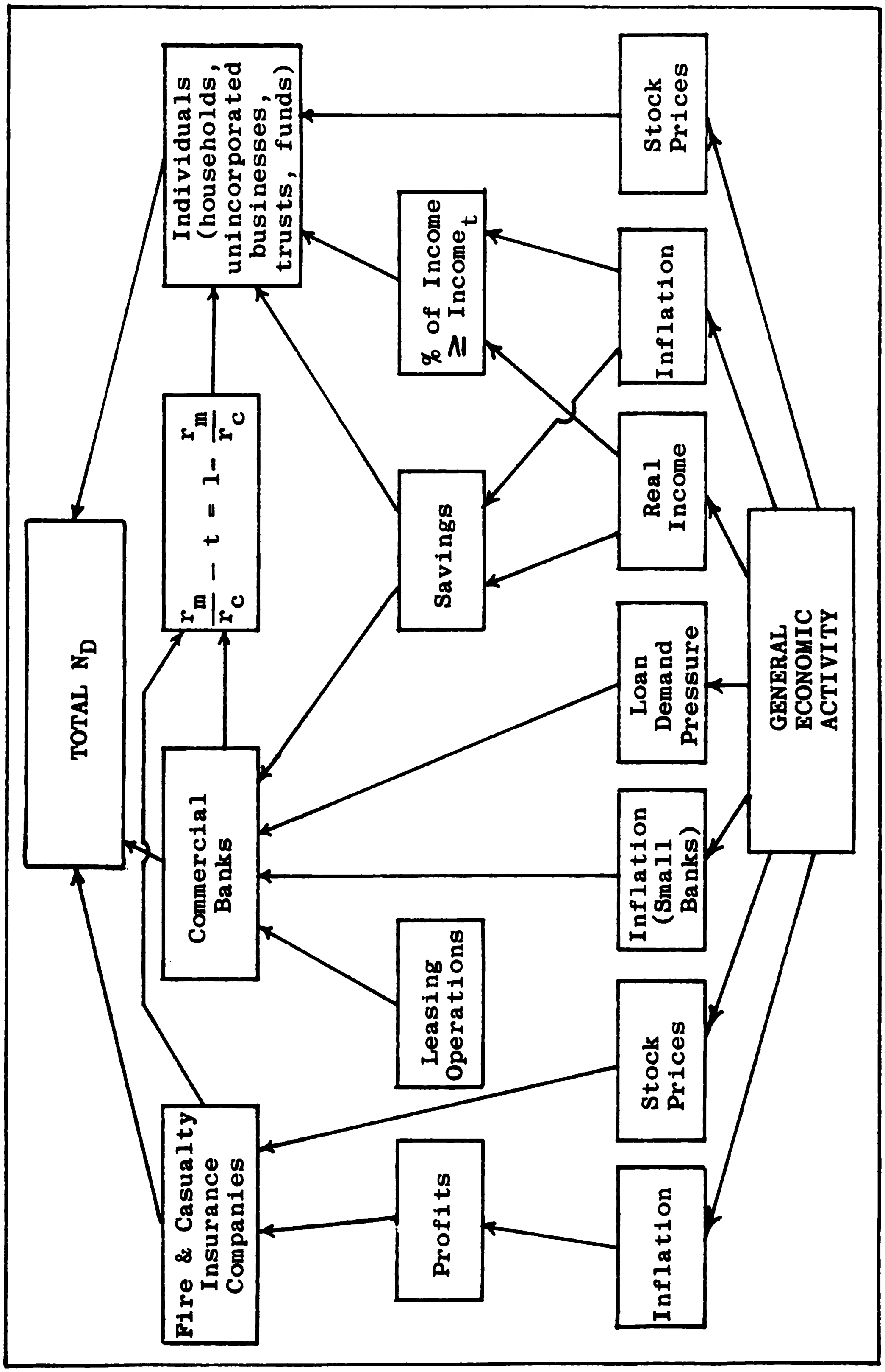

TOTAL N_D
Individuals (households, unincorporated businesses, trusts, funds)
$\frac{r_m}{r_c} - t = 1 - \frac{r_m}{r_c}$
Commercial Banks
Fire & Casualty Insurance Companies
% of Income ≥ Income$_t$
Savings
Leasing Operations
Profits
Stock Prices
Inflation
Real Income
Loan Demand Pressure
Inflation (Small Banks)
Stock Prices
Inflation
GENERAL ECONOMIC ACTIVITY

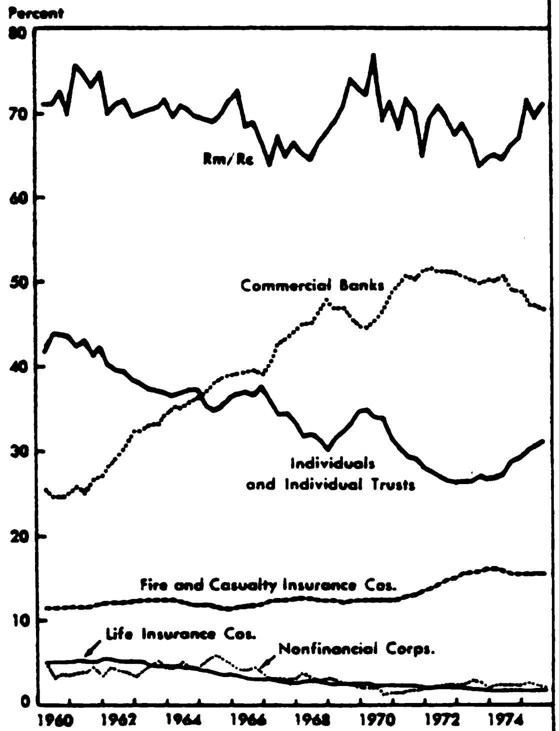
Figure 3-4

picture of this interaction. Income, inflation, the tax structure, savings, and certain rates of return influence individual demand. The savings of individuals, leasing operations, inflation, and the loan market affect commercial bank demand, which in turn affects the rates of return relevant to the non-bank private sector and its ultimate demand.

Figure 3-4 suggests that the tax-exempt demand of the insurance sector is not as responsive to economic conditions and the behavior of other sectors as are the banking sector and household sector. The data shown in Figure 3-5 shows that fire and insurance companies as a group are the most stable source of demand in the market. Industry profits, which have generally risen steadily, are the major determinant of demand in this sector (Rosenbloom, p.15). Consequently, there will not be a separate specification for insurance company demand. This demand, since its percentage of the total remains essentially constant, will appear in the constant coefficient in the non-bank private sector demand equation, which will be specified later.

As indicated in the theoretical section, only one set of values for the internal variables in the general system of asset demand equations will establish equilibrium. An estimate of demand for tax-exempt bonds can be made without estimating the demand for other assets, as each equation has common variables which must adjust across all asset

PERCENT OF STATE AND LOCAL DEBT HELD BY EACH DEMAND SECTOR COMPARED TO Rm/Rc



Sources: Board of Governors of the Federal Reserve System, Flow of Funds; U. S. Treasury Department, Treasury Bulletin; Salomon Brothers, Analytical Record of Yields and Yield Spreads.

Figure 3-5

demands to establish equilibrium in every asset market. Thus, specification of the relevant variables in the tax-exempt bond equation, while ignoring other asset demands, will generate a valid approximation of tax-exempt bond demand. It is still important, however, to begin the analysis from a general equilibrium framework so that all of the variables relevant to tax-exempt bond demand are considered.

Recall that in the theoretical framework, equilibrium demand was obtained upon the adjustment of the endogenous variables to clear the existing asset supplies. Now, it is assumed that equilibrium occurs rapidly in financial markets so that equilibrium bond demands are observed in response to equilibrium values of demand-determining variables. Thus the endogenous variables of the theoretical model will be exogenous variables in the empirical specifications.

Finally, the demand functions in the <u>Theory</u> were general; they will now be expressed as specific functions. And since the theoretical model expresses asset demands as a fraction of total net private wealth, the empirical equations below estimate this fraction.

Bank demand will be specified first. Comparative static equations are specified, and then equations allowing for dynamic stock adjustments are specified. Non-bank priavate demand will then be specified. Similarly, a comparative static specification is made, followed by a specification with the stock adjustments.

Bank Demand

Specification

According to the theoretical model, banks place their deposit liabilities into required reserves, free reserves (a safety asset), and three income earning assets --loans, tax-exempt bonds, and Federal securities. In the static model where the amount of deposits is observed at a single point in time, the fraction of these deposits which banks wish to hold as tax-exempts at that moment must be determined in order to find the dollar value of the banking sector's tax-exempt bond demand. To accomplish this, two alternative dependent variables are tested: first, $N_b^D/D(1-k)$, the fraction of deposits not held as required reserves which are invested in tax exempts; and second, $N_b^D/D(1-k) - f_{2b}D(1-k) = N_b^D/D(1-k)(1-f_{2b})$, the fraction of deposits not held as required or free reserves which are invested in tax-exempts. Two dependent variables are estimated because, as discussed earlier, there is no *a priori* relationship between the discount rate (d) and tax-exempt bond demand. The discount rate is specified in equations determining the first variable. Equations estimating the second dependent variable are based on the premise that the level of free reserves is determined prior to and independent of the amount of tax-exempt bond investment. Since the level of free reserves is pre-determined, the discount rate does not appear in specifications related to this variable.

More than two equations are specified below because desired bank holdings of tax-exempts depend upon the economic events expected by bank officers. Since no single variable can always reveal the expectations of a decision-maker, several slightly different equations are posited and tested. Before listing these equations, however, a short discussion of the banking theory behind their specification must be considered.

The required reserves of a bank (denoted by kD) must be considered a highly illiquid asset, as bankers cannot rely heavily on these funds during an emergency because they must stay with the Fed or in a vault. Consequently, excess secondary reserves are maintained to meet sudden deposit outflows or unexpected loan demands. These are mostly short-term assets which mature quickly at par value with only a slight risk of a capital loss. The remaining funds are placed in loans or investments. Most modern aggressively run banks attempt to place most of their assets in loans. There are two reasons for this. First, banks gain goodwill and hold onto depositors. Second, loans usually pay a higher rate of return. Even if the face rate on a loan is lower, the effective rate is probably higher because the loan might be paid off in installments or the borrower may be required to hold compensating balances. Thus funds going into U.S. government securities and tax-exempts are only received when loan demands are low. When loan demand is up, investment officers generally sell their assets and turn the funds over to loan officers.

Funds become available to investment officers during recessionary periods. As all bank officers, the investment officer's goal is to maximize bank profits. When he or she invests during a recession, bond prices are high and rates of return low; hence the crucial decision to be made is whether to invest long at higher rates of return or short where the investment can be easily converted into a loan, if and when the opportunity arises. If the investment officer expects a recession to persist, then investments will be placed long (tax-exempts). If the recession is expected to end soon, funds will be put into short-term securities (U.S. government securities), where there is less chance of capital losses due to falling bond prices at the time the banker liquidates investments to acquire loanable funds.

With expansionary expectations, investment officers must be ready to provide funds for the loan officer. Often this is done at a capital loss since rates of return have already begun to rise and bond prices to fall, but investment officers will gladly take capital losses on investments as long as the expected gains from loans exceed the capital loss and forgone returns of investments. The better the investment officer is at predicting the waves of the economy, the higher bank profits will be. He or she will tend to invest long (tax-exempts) when loan demand is not imminent and short when loan demand is at the horizon.

To summarize, the theory of banking investment presented above is a theory of investment officer expectations.

The specifications are:

$$f_{4b} = N_b^D/D(1-k) = \beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 + \varepsilon; \tag{1}$$

$$f_{4b} = N_b^D/D(1-k) = \beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 + \beta_5 LOP + \varepsilon; \tag{2}$$

$$f_{4b} = N_b^D/D(1-k) = \beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 + \beta_5 LOP + \beta_6 DUNLR + \varepsilon; \tag{3}$$

$$f_{4b} = N_b^D/D(1-k) = \beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 + \beta_5 LOP + \beta_6 DDUNLR + \varepsilon; \tag{4}$$

$$f_{4b} = N_b^D/D(1-k) = \beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 + \beta_5 LOP + \beta_6 \pi^* + \varepsilon; \tag{5}$$

$$f_{4b}/1-f_{2b} = N_b^D/D(1-k)-FR = \beta_0 + \beta_1 X25 + \beta_2 X35M + \beta_3 YBP61 + \varepsilon; \tag{6}$$

$$f_{4b}/1-f_{2b} = \beta_0 + \beta_1 X25 + \beta_2 X35M + \beta_3 YBP61 + \beta_4 LOP + \varepsilon; \tag{7}$$

$$f_{4b}/1-f_{2b} = \beta_0 + \beta_1 X25 + \beta_2 X35M + \beta_3 YBP61 + \beta_4 LOP + \beta_5 DUNLR + \varepsilon; \quad (8)$$

$$f_{4b}/1-f_{2b} = \beta_0 + \beta_1 X25 + \beta_2 X35M + \beta_3 YBP61 + \beta_4 LOP + \beta_5 DDUNLR + \varepsilon; \quad (9)$$

$$f_{4b}/1-f_{2b} = \beta_0 + \beta_1 X25 + \beta_2 X35M + \beta_3 YBP61 + \beta_4 LOP + \beta_5 \pi^* + \varepsilon. \quad (10)$$

Since this estimate is the fraction of D(l-k) desired in tax-exempts, it must be multiplied times D(l-k) (the real value of non-required deposits) to get the real value of tax-exempt bond demand.

N_b is the real value of tax-exempt bonds desired by banks.

D(l-k) is real total deposits less real required deposits.

d is the real value of the Federal Reserve discount rate. It equals the nominal Federal Reserve discount rate (d') minus the expected rate of inflation (π^*). d falls when d' falls or π^* rises. As discussed earlier, when d' falls banks will probably borrow more, reduce their free reserves, and place more funds into income earning assets. If loan demand exists, the funds will be placed in loans. If the fall in d' is seen as a move by the Fed which will shortly lead to greater loan demand, the funds will probably go into short term securities. If little future loan demand is expected (bankers see the decrease in d' as a futile attempt to stimulate demand), the borrowed funds may go into tax-exempts. Similarly, the response of bank demand for tax-exempts to a rise in d' will depend upon bankers' perceptions of how the d' increase will affect credit demands.

A rise in π^* usually signals that loan demand is rising. Consequently, tax-exempt demand will fall, either directly replaced by loans or shifted into short-term securities in anticipation of future loan demand. In general, one could expect bank demand for tax-exempts to fall as d falls.

Conversely, a rise in d' will reduce borrowing and loans, while instilling an atmosphere of expected loan decline. Some bank officers may decide to begin converting loans into tax-exempts as soon as possible in order to buy while their prices are still low. Similarly, a fall in π^* is a sign of contractionary expectations and will raise tax-exempt demand. In summary, a rise in d, is expected to raise tax-exempt demand, unless bankers judge the Fed's policy as too weak to slow down demand.

Equations 6 through 9 drop d as a variable, because of the possible ambiguity concerning its effect on tax-exempt demand and other asset demands.

$X25 = (r_N^u - r_L^u) - (\frac{1}{4}\sum_{i=1}^{4}(r_N^u - r_L^u)_{-i})$; where r_N^u is the real after tax return on tax-exempts, r_L^u the real after tax rate of return on commercial loans, and i quarterly observations. $\frac{1}{4}\sum_{i=1}^{4}(r_N^u - r_L^u)_{-i}$ represents a proxy for a normal rate of return differential. Several lag structures were tested for the normal rate differential with a one year moving average minimizing the regression equation standard error.

X25 is an important variable in the determination of the fraction of bank assets which go to commercial loans. Since bankers view loans as their primary profit source, they react quickly to indications that loan demand may be picking up. When X25 falls, bank officers try to take advantage of the rise in the loan rate relative to the tax-exempt rate and begin taking funds out of tax-exempts and Treasury securities so they can be used to make loans. Conversely, when X25 rises, it is hypothesized that bankers will sense a drying up of loan demands and will begin placing funds in tax-exempts and Treasury securities before their prices begin to rise significantly. Thus bank officers react to current rates relative to the normal rates not only to acquire current profits, but also with an eye on future profits since X25 can be an indicator of future loan demand, as well as current demand.

In summary, it is hypothesized that when X25 rises, bank officers adopt adaptive expectations, so tax-exempt demand rises. Similarly, when X25 falls, bankers reduce their demand for tax-exempts and acquire more loans.

X35M = $(r_N^u - r_S^u) - (\frac{1}{4}\sum_{i=i}^{4}(r_N^u - r_S^u)_{-i})$; where r_S^u is the real after tax rate of return on three to five year U.S.

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government securities, and $\frac{1}{4}\sum_{i=1}^{4}(r_N^u - r_S^u)_{-i}$ is a proxy for the normal rate differential again with a lag structure which minimizes the standard error.

X35M provides an indication of how funds are distributed between tax-exempts and Treasury securities. Unlike the bank officers' behavior with respect to X25, it is hypothesized that the investment officer adopts regressive expectations with respect to X35M. This kind of behavior is likely to occur because investment managers know that their investments may be temporary, since they plan to convert investments into loans when loan rates exceed investment rates plus capital losses on investment sales. The rates on securities are lower than on tax-exempts, but normally the capital losses upon their sale are also lower. Furthermore, U.S. securities can usually be liquidated faster than tax-exempts. Hence, when loan demand is expected to rise, investments will be placed into short term U.S. securities, where the transactions cost of converting securities to loans is lower; and when loan demand is expected to diminish, investment funds are shifted into tax-exempts, where they can be stored with greater profitability. This hypothesis can be clarified by investigating the mechanics of X35M changes.

When X35M falls, r_N^u must decrease more than r_S^u decreases, or r_S^u must rise faster than r_N^u rises. When r_N^u decreases more than r_S^u decreases, two signals of possible fut

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future events are suggested to the investment officer. First, a deep recession is coming because r_N^u is falling faster than r_S^u despite possible Fed policies to lower r_S^u. With a deep anticipated recession, the investment officer will want investments safely consigned to the more profitable long-term asset, tax-exempts. Second, with r_N^u falling faster than r_S^u, the price of tax-exempts is rising faster than the price of U.S. securities. If the investment officer wants to get into the more profitable tax-exempts without taking a large capital loss upon the eventual tax-exempt bond sale, he/she will buy tax-exempts quickly, before the price rises even further.

When r_S^u rises faster than r_N^u, again the investment officer receives signals of the probable future. Tight money policy is very likely succeeding, as r_S^u is rising fast. Hence an economic downturn is imminent, which will make the return on loans fall. Therefore, it may be profitable to begin moving funds into tax-exempts while their price is still low.

In summary, when X35M falls, it is hypothesized that tax-exempt demand should rise.

Conversely, it is hypothesized that when X35M rises, tax-exempt demand falls. X35M rises when r_N^u falls at a slower rate than r_S^u, or r_N^u rises faster than r_S^u. A rapid fall in r_S^u suggests to the investment officer a future of recovery and falling tax-exempt bond prices, as the increase in their prices have already begun to slow down.

Consequently, managers begin shifting into U.S. securities, where they are in a more liquid position and suffer lower capital losses when loan needs arise. When r_N^u rises faster than r_S^u, the investment officer perceives prolonged expansion. Loans and long-term investments are still in demand and the Fed has not cut credit to the extent that r_S^u is rising faster than other rates. Hence any investment funds available will stay in U.S. securities to insure meeting loan needs.

YBP61 is real annual bank income. As nominal income rises, more banks enter the higher corporate income tax bracket, creating a greater need for tax shelters, such as tax-exempts. Real income is the variable specified, rather than nominal income, because the effects of the inflationary part of a rise in nominal income should be accounted for by other variables in the equation. Nevertheless, the equation will be tested with nominal income as a variable, and the results of this test will be discussed in a later portion of the paper.

Other studies have implicitly suggested that a positive relationship between bank income and tax-exempt bond demand exists (Fortune, 1972, Talley, 1972). Fortune did an empirical study showing that the larger the bank the more banks will replace U.S. securities with tax-exempts. Since bank income has grown at a much greater rate than has the number of banks, it can be safely concluded that the number of large banks has risen with overall bank income growth. Talley studied the behavior of bank holding companies and found they tend to invest more heavily in the riskier tax-exempts than the safer U.S. securities. Again it can be concluded that higher income allows a greater risk cushion and therefore more tax-exempt demand.

LOP is a dummy variable indicating the years in which bank leasing operations have become a popular alternative to tax-exempt bonds as a tax shelter.

DUNLR is the change in the unemployment rate. This is another expectations-variable. When the unemployment rate is rising, bank officers expect a recession and begin converting funds into tax-exempts. When the unemployment rate is falling, they expect favorable loan prospects.

DDUNLR is the rate of increase or decrease in the changing unemployment rate. This is probably a better expectations-variable than the simple change in the unemployment rate. When the unemployment rate is rising at an increasing rate, the banker expects a deep recession coming and this signals him/her to put funds in tax-exempts. However, when the unemployment rate is rising at a decreasing rate, the recession may have bottomed out and an expansionary period with greater loan demand may be coming soon. So the investment officer might predict that greater profits can be made by converting tax-exempts into U.S. securities, while tax-exempt bond prices are still high.

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Similarly, if the unemployment rate is falling at a decreasing rate, the bank officer may anticipate the end of an expansion and think it more profitable to buy tax-exempts while their price is low. In summary, there should be a positive relationship between DDUNLR and tax-exempt bond demand.

π^*, the expected rate of inflation is a possible substitute for DUNLR or DDUNLR as another expectations-variable. When π^* is low, a recession is usually expected and tax-exempt demand is up. Most of this variable's effects may be captured in $d' - \pi^*$, so it probably does not strengthen the model as much as DDUNLR. Even in the equations where $d' - \pi^*$ is dropped, many of the π^* effects should be captured by variables X25 and X35M.

Note, all variables relevant to every asset demand of the banks are specified in the tax-exempt demand equation. This is important because whenever a variable affects any asset demand, this effect requires some adjustment in the demand for tax-exempts. A tax-exempt demand equation which omits variables affecting other asset demands would thus present an incomplete picture of the tax-exempt bond market.

The static equations above have only limited use since economic units normally do not adjust their portfolios instantaneously to equilibrium. Extending the model to a dynamic setting, specifying an equilibrium adjustment mechanism, will further enrich the model. Again, as in the static model, no variables should be omitted since the adjustment process of other bank assets will affect the adjustment towards equilibrium of tax-exempt bond demand.

Since banks cannot immediately adjust their desired level of an asset to the actual level of the asset, a partial-adjustment model is adopted here to capture the disequilibrium behavior of bank investment managers.

f^{*}_{4bt} is the desired fraction of bank assets placed in tax-exempts. So $f^{*}_{4bt} - f_{4bt-1}$ is the desired change and $f_{4bt} - f_{4bt-1}$ is the actual change. Since the actual change is only a fraction of the desired change:

$$f_{4bt} - f_{4bt-1} = \delta(f^{*}_{4bt} - f_{4bt-1}),$$

where f^{*}_{4bt} is the static equation (1) and $0 < \delta \leq 1$. So,

$$f_{4bt} - f_{4bt-1} = \delta(\beta_0 + \beta_1 d + \beta_2 X25 + \beta_3 X35M + \beta_4 YBP61 - f_{4bt-1} + \varepsilon_t), \quad (11a)$$

and

$$\begin{aligned} f_{4bt} &= \delta\beta_0 + \delta\beta_1 d + \delta\beta_2 X25 + \delta\beta_3 X35M + \delta\beta_4 YBP61 \\ &\quad +(1-\delta)f_{4bt-1} + e_t, \\ &= \gamma_0 + \gamma_1 d + \gamma_2 X25 + \gamma_3 X35M + \gamma_4 YBP61 \\ &\quad + \gamma_5 f_{4bt-1} + e_t, \end{aligned} \quad (11b)$$

where $\gamma_0 = \delta\beta_0$, $\gamma_1 = \delta\beta_1$, $\gamma_2 = \delta\beta_2$, $\gamma_3 = \delta\beta_3$, $\gamma_4 = \delta\beta_4$, $\gamma_5 = 1 - \delta$. Therefore, $\hat{\delta} = 1 - \hat{\gamma}_5$, $\hat{\beta}_0 = \hat{\gamma}_0/1 - \hat{\gamma}_5$, $\hat{\beta}_1 = \hat{\gamma}_1/1 - \hat{\gamma}_5$, $\hat{\beta}_2 = \hat{\gamma}_2/1 - \hat{\gamma}_5$, $\hat{\beta}_3 = \hat{\gamma}_3/1 - \hat{\gamma}_5$, $\hat{\beta}_4 = \hat{\gamma}_4/1 - \hat{\gamma}_5$.

Equations 12-20 analogously follow from the static equations 2-10.

Although this stock adjustment technique adds another dimension to the model, Brainard and Tobin ("Pitfalls") warn of a potential problem which may arise. The adjustment speed toward equilibrium of an asset within a general system of assets varies, depending upon what exogenous variable causes the disequilibrium disturbance and is driving the system to a new equilibrium. The adjustment parameter (δ) estimated when using time series data must necessarily result from some combination of several economy-driving exogenous variables. As a predictive tool this adjustment speed coefficient may be a good predictor on the average, but when observing the cyclical adjustment process created by a change in a particular exogenous variable, the coefficient loses predictive accuracy.

Results

The 20 equations above were estimated using ordinary least squares. The results of six of the equations are shown in Table 3-1. Each cell contains a regression coefficient and its associated t-statistic. Note in equations 7, 8 and 9, where the dependent variable is not lagged, that the Durbin-Watson statistic is low, which suggests serial correlation. In equations 17, 18 and 19, where the dependent variable is lagged, the DW statistic is within the indecisive range when checking for serial

Table 3-1. Bank Demand Estimates Using Ordinary Least Squares

Eqn.	DEP	C	RDISC	X25	X35M	YBP61	LOP	DUNLR	DDUNLR	π*	DEP(-1)	R^2	F	DW	n
7	F4BNOF	.061		.0070	.015	.00000002	.020					.8963	119	.76	60
		(10.17)		(2.89)	(-4.36)	(11.78)	(5.35)								
8	F4BNOF	.062		.0075	-.016	.00000002	.020	.0031				.8982	95	.91	60
		(10.02)		(3.04)	(-4.46)	(11.24)	(5.32)	(1.01)							
9	F4BNOF	.061		.0076	-.015	.00000002	.020		.0020			.8975	94	.91	60
		(10.17)		(2.99)	(-4.42)	(11.71)	(5.32)		(.78)						
17	F4BNOF	.053		.0055	-.0091	.00000002	.015				.172	.9080	107	1.35	60
		(8.36)		(2.30)	(-2.39)	(7.87)	(3.81)				(2.62)				
18	F4BNOF	.054		.0058	-.0098	.00000002	.015	.0015			.164	.9084	88	1.29	60
		(7.91)		(2.33)	(-2.37)	(7.80)	(3.81)	(.48)			(2.42)				
19	F4BNOF	.053		.0061	-.0095	.00000002	.015		.0019		.171	.9091	88	1.29	60
		(8.36)		(2.43)	(-2.47)	(7.84)	(3.79)		(.81)		(2.61)				

Table 3-2. Bank Demand Estimates Using the Cochrane-Orcutt Method

Eqn.	DEP	C	RDISC	X25	X35M	YBP61	LOP	DUNLR	DDUNLR	π*	DEP(-1)	R^2	F	DW	n
1	F4B	.109	-.0014	.0026	-.0085	.00000002						.9185	152	2.72	59
		(6.76)	(-.81)	(.96)	(-1.76)	(5.02)									
2	F4B	.075	-.0009	.0037	-.010	.00000002	.015					.9214	124	2.42	59
		(5.44)	(-.56)	(1.32)	(-2.11)	(6.77)	(2.38)								
3	F4B	.086	-.0008	.0053	-.011	.00000002	.011	.005				.9265	109	2.54	59
		(5.30)	(-.45)	(1.83)	(-2.20)	(5.86)	(1.63)	(1.99)							
4	F4B	.097	-.0013	.0043	-.0077	.00000002	.0080		.0032			.9266	109	2.69	59
		(5.28)	(-.77)	(1.55)	(-1.60)	(5.17)	(1.11)		(2.13)						

Table 3-2 (cont'd.)

Eqn.	DEP	C	RDISC	X25	X35M	YBP61	LOP	DUNLR	DDUNLR	π*	DEP(-1)	R^2	F	DW	n
5	F4B	.075 (5.40)	-.0011 (-.44)	.0037 (1.27)	-.010 (-1.95)	.00000002 (5.27)	.015 (2.29)			-.00028 (-.10)		.9214	101	2.41	59
6	F4BNOF	.108 (6.83)		.0030 (1.11)	-.0087 (-1.83)	.00000002 (5.04)						.9171	203	2.72	59
7	F4BNOF	.073 (5.91)		.0040 (1.51)	-.011 (-2.23)	.00000002 (7.12)	.015 (2.43)					.9202	156	2.42	59
8	F4BNOF	.085 (5.66)		.0056 (2.01)	-.011 (-2.29)	.00000002 (6.00)	.011 (1.68)	.0052 (2.08)				.9258	132	2.55	59
9	F4BNOF	.089 (5.53)		.0047 (1.75)	-.0084 (-1.76)	.00000002 (5.63)	.010 (1.46)		.0030 (2.03)			.9252	131	2.63	59
10	F4BNOF	.075 (5.52		.0039 (1.45)	-.011 (-2.23)	.00000002 (5.32)	.014 (2.11)			.00071 (.40)		.9205	123	2.44	59
11	F4B	.026 (3.55)	.000012 (-.01)	.0027 (1.26)	-.0026 (-.81)	.000000006 (3.01)					.705 (9.99)	.9222	126	2.28	59
12	F4B	.030 (4.11)	-.0004 (-.40)	.0026 (1.28)	-.0038 (-1.23)	.000000007 (3.41)	.0072 (2.15)				.591 (6.84)	.9285	112	2.15	59
13	F4B	.031 (4.03)	-.00019 (-.18)	.0034 (1.56)	-.0063 (-1.76)	.000000007 (3.46)	.0077 (2.20)	.0024 (.90)			.570 (6.36)	.9292	96	2.17	59
14	F4B	.029 (3.83)	-.00026 (-.25)	.0041 (1.92)	-.0057 (-1.81)	.000000007 (3.27)	.0067 (2.00)		.0047 (2.04)		.610 (6.96)	.9337	103	2.18	59
15	F4B	.027 (3.94)	-.0029 (-2.17)	.0014 (.72)	.00058 (.02)	.000000009 (4.22)	.0091 (2.87)			-.0029 (-2.50)	.618 (7.84)	.9357	106	2.18	59
16	F4BNOF	.025 (4.26)		.0027 (1.42)	-.0025 (-.82)	.000000006 (3.12)					.709 (10.11)	.9216	159	2.29	59
17	F4BNOF	.050 (4.93)		.0052 (2.06)	-.013 (-3.15)	.00000002 (6.43)	.015 (3.18)				.179 (1.78)	.9171	117	2.12	59

Table 3-2 (cont'd.)

Eqn.	DEP	C	RDISC	X25	X35M	YBP61	LOP	DUNLR	DDUNLR	π*	DEP(-1)	R^2	F	DW	n
18	F4BNOF	.052 (5.90)		.0066 (2.50)	-.016 (-3.56)	.00000002 (6.22)	.015 (3.17)	.0050 (1.78)			.175 (1.79)	.9219	102	2.09	59
19	F4BNOF	.028 (4.49)		.0044 (2.28)	-.0059 (-1.95)	.000000007 (3.40)	.0065 (1.97)		.0046 (2.11)		.617 (7.14)	.9331	121	2.21	59
20	F4BNOF	.024 (3.28)		.0034 (1.84)	-.0037 (-1.22)	.000000009 (3.70)	.0071 (2.19)			-.0011 (-1.19)	.614 (7.20)	.9295	114	2.26	59

Table 3-3. **Bank Demand Estimates Using Real Bank Income**

Eqn.	DEP	C	RDISC	X25	X35M	YB (*)	LOP	DUNLR	DDUNLR	π*	DEP(-1)	R^2	F	DW	n
	F4BNOF	.021 (2.94)		.0023 (1.18)	-.0014 (-.46)	.0000000004 (.70)	.0042 (1.21)		.0055 (2.29)		.830 (11.82)	.9193	99	2.55	59
	F4BNOF	.136 (5.86)		.0041 (1.55)	-.0067 (-1.44)	.000000007 (3.18)	.00034 (.04)		.0037 (2.57)			.9210	124	2.93	59

correlation. However, as discussed in Maddala (p. 371), when there is a lagged dependent variable on the right side of the equation, there is danger of accepting the hypothesis that there is insignificant serial correlation when in fact a serious serial correlation problem may exist. He warns that the DW test may not be applicable in these models. Maddala also points out that the coefficient on the lagged dependent variable is overestimated, thus distorting the estimated speed of adjustment.

To allow for serial correlation the Cochrane-Orcutt procedure is adopted. Using the Cochrane-Orcutt procedure, the 20 equations are again estimated. These results are shown in Table 3-2.

The constant term is positive and significant in all 20 equations. There is no a priori or post test basis for not retaining it in the equation.

As suggested previously, the discount rate might be dropped from the equation. The t-statistics in equations 1 through 5 and 11 through 15 indicate a possible weak negative relationship between the two variables. Since the a priori and post test grounds for retaining this variable are weak, it is dropped, leaving only equations 6 through 10 and 16 through 20 to investigate.

Another variable which could be omitted is LOP. The a priori sign on this coefficient is negative, as leasing operations are an alternative to tax-exempt bond investments.

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However, the coefficient is positive and has a high level of significance in every equation. This suggests the dummy variable is a poor measure of leasing operation effects on banking behavior. However, on statistical grounds, the variable should not be discarded from the equation. Equation 16 is estimated without LOP as an explanatory variable. The coefficients of the other explanatory variables are nearly the same as the coefficients of equation 19, where LOP is included. Hence it is clear that LOP does not distort the conclusions about the other variables. In fact, the inclusion of LOP strengthens these conclusions. The t-statistics associated with these coefficients are markedly more significant in equation 19.

In equations 7 through 10 and 17 through 20 the variables C, X25, X35M, and YBP61 are in almost all cases statistically significant, and always in agreement with *a priori* relationships discussed earlier. These results strongly substantiate the hypothesis that bank demand for tax-exempts depends not only on current rates of return, but expected future rates as well.

The distinguishing variable in each equation is an economic-outlook variable. Choosing one static and one adjustment equation containing an economic-outlook variable which best characterizes the tax-exempt bond demand of banks is a difficult task from a statistical point of view. However, from an economist's viewpoint, one equation may provide a better analysis of a certain situation than another equation. Furthermore, the equations can be ranked based on the best combination of statistical significance and economic description.

Among the static equations equation 8 clearly has the greatest statistical significance. All t-statistics are significant and its R^2 value is the highest of the four equations. However, on the grounds discussed previously, I view DDUNLR in equation 9 as being a better descriptive variable than DUNLR in equation 8. As far as statistical significance is concerned, equation 9 ranks second; the LOP t-statistic is significant at the 10% level of confidence, while the remaining t-statistics are 5% or better. The coefficients of both equations 8 and 9 are almost the same, and it should make little difference which of these two equations one might use for predictive purposes. Equation 7 ranks third statistically; the t-statistic associated with X25 is only significant at the 10% level. From an economic standpoint, all the effects of forecasting done by bank managers must be shown by the coefficients of X25 and X35M; hence equation 7 is not as descriptive as 8 and 9. In equation 10 the t-statistic for X25 is the lowest of the 4 equations, barely significant at 10%. The coefficient for π* is insignificant and positive, while the expected _a priori_ sign is negative. Obviously, this equation should be discarded.

Among equations 17 through 20, equation 19, for the same reasons as applied to equation 9, is ranked first on an

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an *a priori* basis. Furthermore, statistically, equation 19 is ranked first. Every variable in equation 19 has a high t-statistic and it has the highest R^2 of all 20 equations. Equations 17 and 18 also have statistically strong results. In fact, they are almost identical and either could interchangeably be a good predictor. It should be noted, however, that they model the adjustment process differently than equation 19. According to equation 19, .383 of the adjustment occurs each period, while equations 17 and 18 allow more than twice this pace. The slower paced equation 19 could be deemed more realistic since the t-statistic concomitant to the lagged dependent variable has a far more significant t-statistic in equation 19 than in either equation 17 or 18.

As for equation 20, the coefficient for π^* has the expected sign, and the t-statistic is nearly high enough to signify a 10% confidence level. This equation is weaker than the other three both statistically and descriptively, but if one is explicitly interested in inflationary effects in the tax-exempt bond market, this equation may be the most useful of the four. Also note that the rate of adjustment in equation 20 is almost identical to the rate in equation 19. Finally, Table 3-3 shows as expected, when nominal bank income replaced real bank income in an equation, the t-statistic was never significantly high. Since real bank income was a significant variable in every equation and there was solid *a priori* grounds for this significance, it can be concluded that the effect of inflationary increases in bank income on tax-exempt bond demand is accounted for by the other variables.

To find the absolute amount of bank demand for tax-exempts, the demand for bank deposits must be determined. Bank deposits are a financial asset of the non-banking private sector. Hence the non-bank private sector's demand for a financial asset must be analyzed when determining bank demand for a financial asset. After discussing non-bank private demand for tax-exempts and bank deposits, the discussion will turn to total bank demand for tax-exempt bonds.

Non-Bank Private Demand

Although there is a whole menu of financial assets available to the non-bank private sector, only tax-exempt demand and bank deposit demand is examined here. The other assets, however, are not completely ignored in this partial equilibrium analysis since the variables important to the demand for every asset are contained in each demand equation --tax-exempt bond demand and bank deposit demand included.

Specification

Since the level of real net wealth (W) is momentarily fixed, the fraction of this wealth which the non-bank private sector wishes to hold in a certain asset is the important variable to determine. As explained in the theoretical section, the demand for an asset depends on the after tax rate of return on itself and alternative assets, and on the transactions demand for money. Rather than entering these independent variables into the estimated demand equations and trying to contend with multicollinearity and oversimplification, the independent variables will be redefined in a way that avoids high correlation among independent variables and more closely portrays the behavior of asset holders.

Looking first at the tax-exempt bond market, the closest substitute for the tax-exempt is the corporate bond. They are equally desirable when $r'_N - \pi^* = (1-T)r'_C - \pi^*$ or $T = 1 - r'_N/r'_C$, where T is the marginal tax bracket in which investors are indifferent between tax-exempts and corporate bonds; r'_N is the nominal rate of return on tax-exempts; and r'_C is the nominal rate of return on corporate bonds. When r'_N/r'_C rises, T falls, making the after tax rate of return on tax-exempts higher than on corporate bonds for more investors.

Figure 3-6 helps show the primary behavior occurring in the tax-exempt market. As discussed above, when r'_N/r'_C rises, T falls, and the tax-exempt demand of households rises; this is represented by a movement up the N_D curve. This illustration also helps in seeing the interaction of

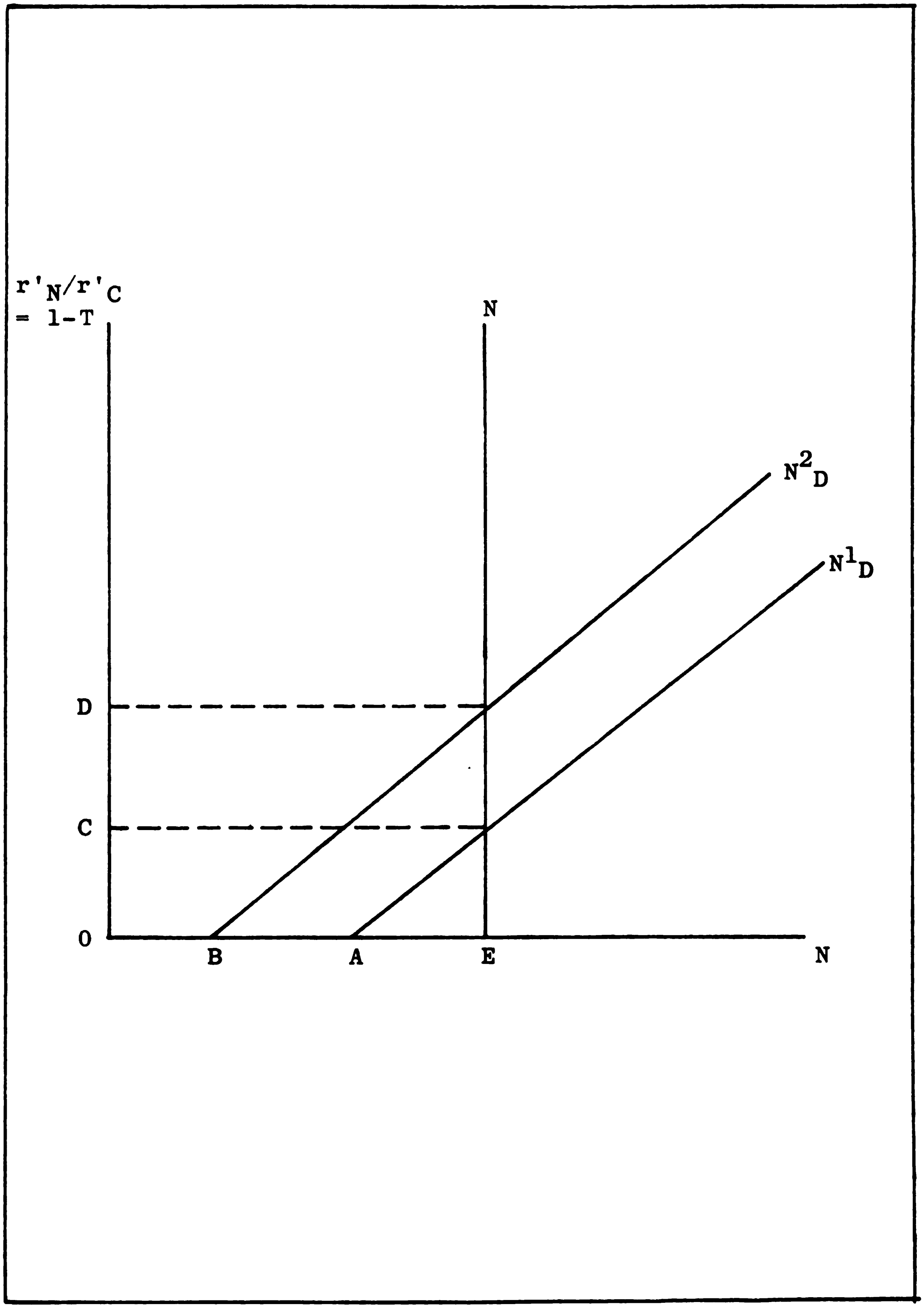

Figure 3-6

bank demand with non-bank demand as shown in Figure 3-4. If bank demand drops from OA to OB, r_N'/r_C' must rise from OC to OD to reestablish equilibrium. In so doing, non-bank demand rises from AE to BE, while T falls. When T falls, the after tax rate of return on tax-exempts is higher than on corporate bonds for more investors.

When looking at the bank deposit market, it should be recalled that banks generally will accept all the demand deposits and passbook savings they can get at the going rate, which has typically been the ceiling rate. Time deposits without ceilings are more inelastic, but in total the supply of deposits available from the banks as a way for the non-bank sector to hold assets can be viewed as highly elastic at the going real bank depost rate --$r_D = r_D' - \pi^*$, where r_D' is a weighted average of the rates on demand deposits, savings deposits, and time depostis. This is shown as D_S in Figure 3-7. D_D is the demand for bank deposits by the non-bank private sector.

With these ideas in mind equation 21 specifies non-bank private demand for tax-exempt bonds, and equation 22 specifies the demand for bank deposits.

$$f_{4p} = N_p/W = \beta_0 + \beta_1 TYBIL + \beta_2(Y/W) + \beta_3(r_N' - r_S'(1-T)) + \beta_4(r_K^t - r_D^t) \qquad (21)$$

$$f_{6p} = D/W = \beta_0 + \beta_1 TYBIL + \beta_2(Y/W) + \beta_3(r_N' - r_S'(1-T)) + \beta_4(r_K^t - r_D^t) \qquad (22)$$

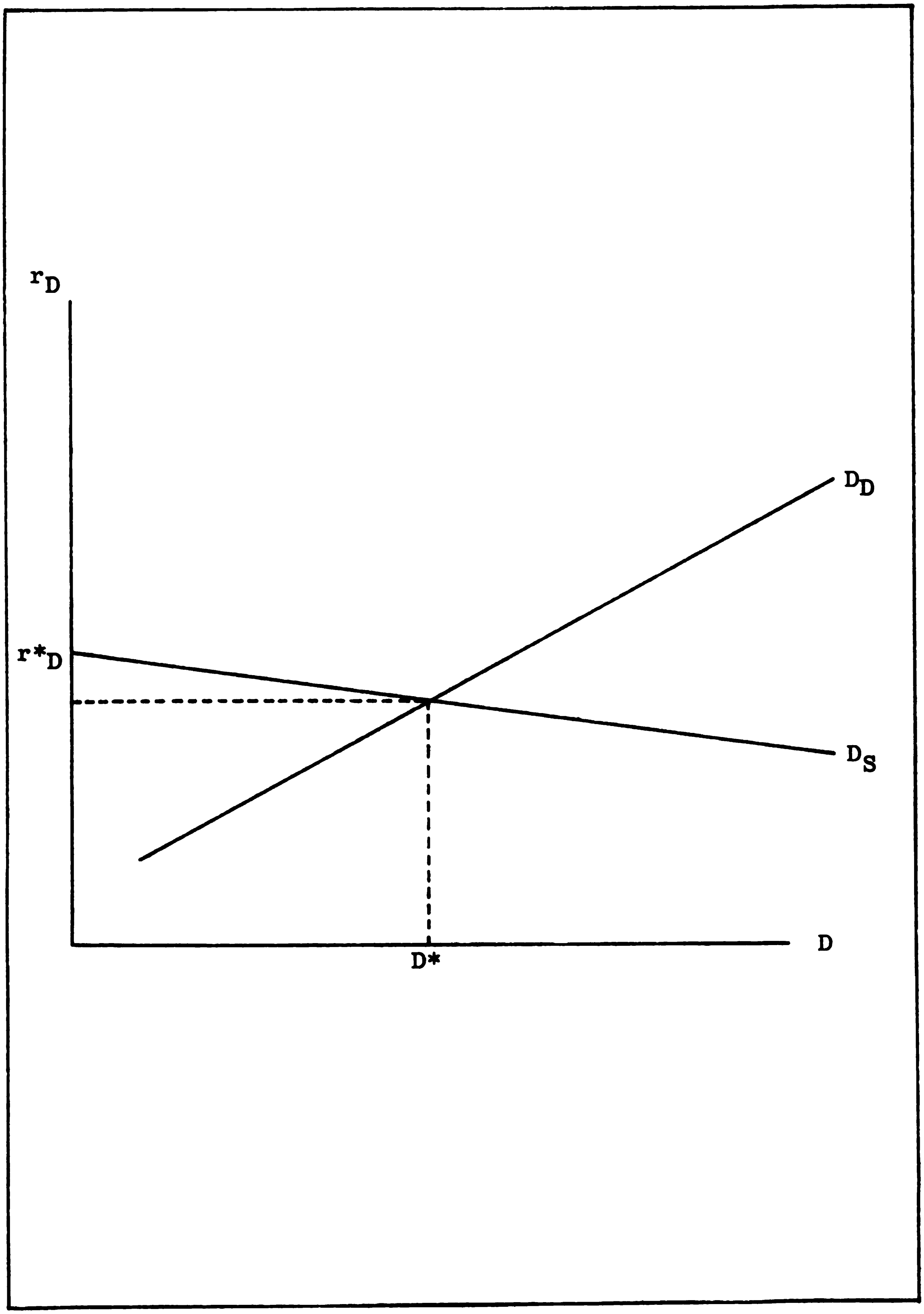

Figure 3-7

The independent variables are the same for every asset demand function. The specification of an asset demand which omits a variable whose major impact is on the demand for some other asset will attribute the equal offsetting impact of this variable to the unwritten equations. Hence all relevant variables must appear in every asset demand function.

N_p is the real demand for tax-exempt bonds by the non-bank private sector.

TYBIL is the amount of taxable income in tax categories $\geq T = 1 - r'_N/r'_C$. When TYBIL rises, more taxable income is anticipated, so tax-exempt demand goes up, too. This could be the most important variable in the equation; it causes non-homogeneity between f_{4p} and wealth.

The value of TYBIL depends on three factors: tax laws which change the marginal tax rate corresponding to each income level; r'_N/r'_C which fluctuates with banking conditions and the volume of bonds offered; and income. Tax laws, which have frequently changed to adjust for inflation, have historically reduced TYBIL. Income growth raises TYBIL. Banking conditions either raise or lower TYBIL: when bank demand for tax-exempt bonds rises, r'_N/r'_C falls, T rises, TYBIL falls, and the quantity demanded by individuals declines; and when bank demand falls, similar events occur in reverse directions. All of these forces, which are subsumed into the variable TYBIL, have a net effect upon f_{4p}.

Also imbedded in this variable is an implicit wealth effect, even though wealth at the moment does not change. (This effect is discussed in the Theory with use of the risk-variance model.) At each point in time a new level of wealth is observed which in turn depends on past income and corresponding saving decisions. Recall from the theoretical discussion that as wealth rises with rising income, the progressive income tax first distorts the allocation of assets in favor of tax-exempts, and second, reduces the saving rate, holding future levels of wealth lower than they would be with a proportional income tax. The relationship between f_{4p} and TYBIL picks up the allocative impact of progressive taxation --at any given moment the absolute value of W by way of its income-earning capacity and corresponding level of taxable income in itself affects tax-exempt demand.

TYBIL should also affect the fraction of assets placed into deposits. Since certain deposits earn interest income which is taxable, a rise in TYBIL should reduce f_{6p}, with the funds being shifted from deposits (as well as other assets) into tax-exempts.

Y/W, as indicated in the Theory, is the ratio of income to wealth. When Y/W rises, the transactions demand for bank deposits rises. With the exception of tax-exempts, the rise in bank deposit demand will cause an offsetting fall with the demand for other assets. The tax-exempt demand for the non-bank private sector may also rise when

Y/W rises because, as discussed earlier, during expansionary periods when income is rising, the bank demand for tax-exempts tapers off and the non-bank private sector replaces this demand. Consequently, when Y/W is used as a measure of the transactions demand for bank deposits, the cyclical effect of income on tax-exempt bond demand cannot be avoided.

$r'_N - r'_S(1-T)$ is specified because the rate of return on U.S. securities, relative to tax-exempts and corporate bonds, must be included in order to pick up offsetting effects of adjustments occurring in the U.S. security market. Since r'_C is related to r'_N in the TYBIL variable, offsetting effects of U.S. security market adjustments would also be picked up by the variable $r'_N - r'_S(1-T)$ in a corporate bond demand function; although this function is not explicitly specified here.

When $r'_N - r'_S(1-T)$ rises, tax-exempt demand should also rise, as the after tax rate of return on tax-exempts rises relative to the rate on U.S. securities. The effect of this variable on bank deposit demand is uncertain.

$r^t_K - r^t_D$, the difference between the after tax rate of return on equity and on bank deposits, is important in both equations. Equity offers an attractive substitute to the tax-exempts, especially in the face of inflation. r^t_K is much more volatile than r^t_D, thus the investor's reactions to r^t_K changes are reflected by the variable $r^t_K - r^t_D$. When

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r_K^t rises relative to r_N^t (usually when $r_K^t - r_D^t$ rises), f_{4p} should fall.

r_K^t is important in the bank deposit equation, as well as the other equations, because it represents the Tobin rate of return which links the monetary to the real side of the economy. The relationship between $r_K^t - r_D^t$ and f_{6p} should be negative, since the opportunity cost of holding money rises as $r_K^t - r_D^t$ widens.

Individuals in the non-bank private sector, similarly to individuals in the banking sector, cannot adjust their portfolios to the desired level immediately. Again a partial-adjustment model is adopted to determine disequilibrium behavior. The specifications become:

$$f_{4p} - f_{4pt-1} = \delta(\beta_0 + \beta_1 TYBIL + \beta_2(Y/W) + \beta_3(r'_N - r'_S(1-T)) + \beta_4(r_K^t - r_D^t) - f_{4pt-1} + \varepsilon_t) \tag{23a}$$

$$f_{4pt} = (N_p/PW)_t = \gamma_0 + \gamma_1 TYBIL + \gamma_2(Y/W) + \gamma_3(r'_N - r'_S(1-T)) + \gamma_4(r_K^t - r_D^t) + \gamma_5 f_{4pt-1} + \varepsilon_t \tag{23b}$$

$$f_{6pt} - f_{6pt-1} = \delta(\beta_0 + \beta_1 TYBIL + \beta_2(Y/W) + \beta_3(r'_N - r'_S(1-T)) + \beta_4(r_K^t - r_D^t - f_{6pt-1} + \varepsilon_t) \tag{24a}$$

$$f_{6pt} = (D/W)_t = \gamma_0 + \gamma_1 TYBIL + \gamma_2(Y/W)$$
$$+ \gamma_3(r'_N - r'_S(1-T)) + \gamma_4(r^t_K - r^t_D)$$
$$+ \gamma_5 f_{4pt-1} + \varepsilon_t, \qquad (24b)$$

where δ = the adjustment parameter ($0 < \delta \leq 1$), $\gamma_0 = \delta\beta_0$, $\gamma_1 = \delta\beta_1$, $\gamma_2 = \delta\beta_2$, $\gamma_3 = \delta\beta_3$, $\gamma_4 = \delta\beta_4$, $\gamma_5 = 1 - \delta$. Therefore, $\hat{\delta} = 1 - \hat{\gamma}_5$, $\hat{\beta}_0 = \hat{\gamma}_0/(1-\hat{\gamma}_5)$, $\hat{\beta}_1 = \hat{\gamma}_1/(1-\hat{\gamma}_5)$, $\hat{\beta}_2 = \hat{\gamma}_2/(1-\hat{\gamma}_5)$, $\hat{\beta}_3 = \hat{\gamma}_3/(1-\hat{\gamma}_5)$, and $\hat{\beta}_4 = \hat{\gamma}_4/(1-\hat{\gamma}_5)$.

Again, as discussed earlier, the potential problems admonished by Brainard and Tobin ("Pitfalls") are still present.

Results

Table 3-4 summarizes the results. In all four equations, the R^2 and F statistics are high, while the Durbin-Watson statistics signify no serial correlation problems. The adjustment parameter for both tax-exempts and bank deposits is very close to one, indicating rapid portfolio adjustments by non-bank investors. In fact this adjustment is so fast that there is little difference between the regression coefficients in the static models and in the partial adjustment models. The lagged dependent variable is significant for both assets, and the R^2 is higher in the lagged equations. Consequently, equations 22 and 24 probably depict the asset demand more accurately than equations 21 and 23.

Table 3-4. Non-Bank Private Demand Estimates

Eqn.	Dependent Variable	Constant	TYBIL	Y/W	$r'_N - r'_S(1 - t)$	$r^t_F - r^t_D$	Lagged Dependent Variable	R^2	F	DW	n
21	f_{4p}	-.0165619	.00000310762 (2.01)	.053705 (13.39)	.00329696 (2.84)	-.000556842 (-1.17)		.9894	1263	1.95	59
22	f_{4p}	-.0144393 (-2.80)	.00000341793 (2.25)	.0513227 (12.92)	.00269436 (2.33)	-.000399464 (-.86)	.0471366 (2.19)	.9902	1069	2.07	59
23	$f_{6p}{}^W$	-12006.3 (-.51)	13.4631 (.34)	506503.0 (9.36)	55120.4 (2.99)	-53366.8 (-5.73)		.9045	130	.56	60
24	$f_{6p}{}^W$	-1158.52 (-.31)	-18.0884 (-2.72)	26594.9 (1.83)	3678.05 (1.16)	-3780.09 (-1.90)	.981395 (42.64)	.9925	1401	1.96	59

The only variable not significant in equation 22 is $r_K^t - r_D^t$. This variable is not expected to be significant in this equation, as its effects should be felt more strongly in the demands for other assets --particularly equity. The regression coefficients of all variables, however, have the expected a priori sign.

In equation 24 again $r_K^t - r_D^t$ is not significant, but possesses the expected a priori sign. Although this variable might be deemed important in a Tobin IS-LM model ("General Equilibrium Approach to Monetary Theory," 1969), non-significance is not surprising because this is not a simple capital-money model, so most of the effects of the variable $r_K^t - r_D^t$ can be felt in the markets for other assets. Also insignificant in equation 24 is $r_N' - r_S'(1-T)$. This lack of significance is not surprising since the effects of $r_N' - r_S'(1-T)$ on the demand for deposits should only pick up small offsetting and often conflicting adjustments from U.S. security, tax exempt, and corporate bond market activities. Y/W is strong and with the predicted sign, as is TYBIL which offsets a rise (fall) in tax-exempt demand when TYBIL rises (falls).

Total Demand

An estimate of the total demand for tax-exempts can be determined by combining the banking sector estimate of the fraction of non-required deposits placed in tax-exempts

with the non-bank sector estimate of the fraction of net wealth it places in tax-exempts, and applying net private real wealth (W) to these fractions.

To complete the model, the supply of tax-exempt bonds must be determined. This is the intent of the next chapter.

CHAPTER IV

A NEOCLASSICAL MODEL OF STATE AND LOCAL GOVERNMENT BOND SUPPLY

As revealed in the literature review, most studies of government bond supply observe a governmental unit's balance sheet statement, where the difference between expenditures and revenues is equal to the amount of bonds issued during the fiscal year. This kind of analysis is severely lacking in economic content, as most of the behavioral relationships involved in the decision to issue bonds are overlooked. In fact, many state and local governments generate a surplus nearly every year, yet still issue bonds. A model which studies the behavior of these economic units, rather than their balance sheets, will explain conditions such as the one above where bonds are issued while surpluses show up on the balance sheets. The intent of this chapter is to construct a model of state and local government bond supply which reveals the decision-making behavior involved in determining the amount of state and local government bonds issued.

Such a model requires an analysis of conditions under which citizens demand state and local goods, how much of these goods will be demanded, and the variables which determine how these goods will be paid for. When making these decisions, citizens are simultaneously deciding the amount of state and local government debt that best satisfies their constrained wants. Since the model involves more than a simple determination of bond supply, it has other uses as well. Some of these uses will be mentioned as the model is developed, and one use will be discussed at some length.

To analyze how well consumer wants are met, conventional neoclassical theory employs individual utility as a measure of an individual's economic welfare. Further, economic efficiency is attained when an individual citizen's income is allocated between state and local goods and other goods in a way that maximizes his/her utility. The model of state and local government good production formulated here is based on the premise that state and local governments spend their revenues in a way which attempts to achieve the above-stated standard of economic efficiency.

When private markets fail to produce wanted goods and services efficiently, the production of these goods by state and local governments is justified. Justified, of course, on the presumption that governments, acting in behalf of the will of their constituents, can and will produce these goods efficiently. The causes of market inefficiency can be broken down into two general categories. First, some goods (or bads), once produced, are by their mere presence shared by many individuals, with or without payment for the positive (or negative) services they afford --parks, streets, and garbage, for example. Second, certain goods are deemed "natural" monopolies, and in private hands are considered detrimental to the local welfare of the citizenry --too little of the good will be produced at too high of a price.

Since goods in the first category (public goods) run into free-rider difficulties, market pricing signals are disrupted and inefficient levels of these goods are produced. Therefore, some means other than private markets must be used to determine the optimal amounts of state and local goods to be produced. To uncover citizen wants, while avoiding free-riders, local governments have their citizens vote for the amounts of public goods desired. This method of local public good allocation is not optimal to every citizen, but will reveal the efficient amount of production better than the pricing mechanism. Production of state and local goods often requires a large initial capital outlay, which must be financed. State and local bond issues are used to acquire a large fraction of the money necessary for capital outlays.

Voter behavior then has a large influence on the amount of state and local bonds issued. In fact most states require voter approval of all bonds whose principal and interest must be covered out of local taxes. This kind of bond is called a general obligation bond. Voter rejection or approval of a general obligation bond referendum is actually a means of expressing the amount of local public goods desired. Therefore, the ensuing model of general obligation bond supply is based on voter behavior.

For the second category of market inefficiency -- natural monopolies-- state and local officials must determine where natural monopolies exist. Once this determination is made, it is up to the officials to insure that production of this good is executed like an efficient non-profit enterprise. Generally, the enterprise is expected to be run with zero profits --average cost pricing rules are used. Bonds to help defray the capital expenditures for these goods have few legal limitations, since as in private enterprise, revenues from users of the good are expected to cover interest payments and eventually retire the bonds. Such bonds are called revenue bonds. The amount of revenue bonds issued depends on the number of revenue projects local officials regard as being in the public interest. Officials are interested in the public interest because satisfying voters will keep officials in office, which gives utility to officials. Therefore, the utility of local officials is observed in deriving a model of revenue bond supply.

Neither of the above categories can be perfectly defined. Public goods have degrees of publicness, as some non-payers can usually be excluded from using the good. In such cases local officials may decide to produce this good as a self-supporting endeavor, or voters may reject government production of the good entirely. Determining where natural monopolies are present and require government intervention is an important and imprecise decision of local government officials, one which to a large extent circumscribes the scope of state and local government. This decision, of course, also greatly influences the size of total revenue bond issues.

Offering revenue bonds can itself be a further means of extending the scope of government. Although general obligation issues and revenue bond issues are treated independently in this study it should be understood that revenue bond issues depend to some degree on general obligation issues. When public officials feel committed to issue bonds, while general obligation bond issues are constrained by legal limitations, officials may look for reasons to issue revenue bonds and thus circumvent lending restrictions. (Maxwell and Anderson, 1977, p. 212).

Although achieving efficient economic solutions is generally considered the central responsibility of state and local governments, distributional objectives are also present in these decisions. Even perfect private markets do not account for income inequality. Thus many state and local governments feel a social responsibility to provide some goods for distributional purposes. Furthermore, they tend to promote tax systems which contain an ability to pay component, a component which is not neglected below.

A full description of the model will proceed as follows. First, a theoretical voting model of general obligation bond supply is posited. Some extensions beyond bond supply are discussed. The empirical specification of the model is set forth. And the empirical results are shown and evaluated. Similarly, a revenue bond model is constructed, specified, and its results evaluated. The model's implications will be examined in a later chapter.

General Obligation Bonds

The Theoretical Model -- A Model of Voter Choice

As mentioned above, general obligation bonds are issued to help purchase capital needed to produce state and local public goods which have been sanctioned by referenda. Therefore, general oblibation bond supply can be construed as a means of financing capital which is a derived demand resulting from voter demand for state and local public goods. The first step in constructing a theoretical model of general obligation bond supply is to develop a voting model which reveals the amount of state and local public goods demanded by a locality's citizens. The production of the voter-approved amount of local public goods requires a corresponding amount of capital. Determining this amount of capital and the means of financing this capital completes the model.

As a result of local government defaults during the Great Depression, most states have placed constitutional and statutory restraints upon the ability of localities to issue general obligation bonds. One of the most common restrictions is a referendum requirement for all general obligation issues. In an effort to preserve public choice and fiscal solvency all but eight states impose this requirement (ACIR, 1977, pp. 92-93). This suggests that a voting model will show, better than other models, how decisions to issue general obligation bonds are made. Since voters determine, by passing or turning down bond issues, now much of a public good will be produced, the utility of the individual voter is the building block of this kind of model. In short, an individual votes for the amount of local public goods which maximizes his/her income constraint.

The Utility Function

A well known theory of individual behavior involved in the choice of local public goods is the Tiebout hypothesis (Tiebout, 1956). According to the Tiebout hypothesis, citizen voters, as a mechanism of registering their preference for local public goods, move into locations where their preferences are best satisfied. Thus, voters tend to move into jurisdictions where their neighbors will have similar utility functions. If, after searching all communities, the members of a community find that they still have markedly different preferences from their neighbors, they will undertake efforts to influence the tastes of one another. This process tends to homogenize preferences within a community, even when a family is initially unable to move to a community providing the local goods they desire (Brown and Saks, 1978). The income of each member of the community, however, may vary greatly. Allowing this similarity in the preference patterns of voters within a community, the utility function postulated here is assumed to be the same for all members of a certain community.

The utility function of each community is initially assumed to have the following general form:

$U = Ax^a g^b n^{-c}$; $a > 0$, $b > 0$, $c \geq 0$; where g is the amount of state and local public goods consumed, x is all other goods consumed (these goods are provided by the private and federal government sectors), and n is the number of people in the individual's community. c indicates a loss in the publicness of g or the degree in which the consumption of others affects an individual's consumption of g; these might be called density or congestion effects. When there are no congestion effects, $c = 0$; and if congestion eliminates all individual utility, c approaches infinity. a is the utility elasticity with respect to x, and b is the utility elasticity with respect to the individual's consumption of the local public good. It is assumed in the initial analysis that every member of the community has the same a and b. a and b can differ among communities, however.

If c = 0, population size has no effect on individual utility. If c is greater than 0, congestion creates interdependent utilities and population growth and concentration reduces indivdual utility. Congestion-created externalities, which reduce individual g consumption and utility, also motivate greater demand for public good consumption --i.e., the demand for goods which alleviate the problems of congestion. This relationship is evident in the utility function. If U and x are held constant, there is a positive relationship between n and g. It is important to remember, however, that although population growth necessitates an increase in g or x consumption in order to maintain an individual's utility at its pre-growth level, additional population potentially carries additional income. This potential allows more g to be available to all and the possibility of maintaining or raising prior utility levels.

Another demographic variant, the age composition of a community's population, can also affect the demand for g; this would reflect a shift in the taste parameters. Communities with many young or old residents would be expected to have a higher <u>b</u> to <u>a</u> ratio than medium-aged populations.

<u>The Budget Constraint</u>

With the utility function understood, it is necessary to look at the constraint on this utility. Since g is a public good, it is either partly shared (it may not be a pure public good) or provided equally to all community members. This means the income of the whole community should be a component of the individual's income constraint. As is well known in public finance theory, it is difficult for each member to receive the amount of g desired because some members of the community will not pay for the amount of g they desire. They count on someone else to make the payment, while everyone shares in g's consumption. Therefore, showing just how community income enters into the income constraint of an individual can be a diffcult task.

Theory gives an indication of where to start. The familiar Pareto-optimum condition for a public good specified by Samuelson is that the sum of the marginal rates of substitution for all members must equal the marginal rate of transformation between other goods and the public good (Samuelson, 1954). This condition can be broken down further --the sum of the individual demand prices for the public good must equal the marginal cost of the public good and the individual demand price must equal the individual marginal cost for every individual. This normative criteria takes a strict benefit approach to the optimal payments for a public good, just as in the payments for private goods.

It is only a first step, however, because even with the distribution of community income constant, the Samuelson condition still allows an infinite number of Pareto efficient solutions. Hirofumi Shibata demonstrated this result in his article "A Bargaining Model of the Pure Theory of Public Expenditure" (Shibata, 1971). Shibata shows that from an initial income distribution point, prior to sharing the cost of a public good, there exists an "area" of Pareto preferred points and a contract curve of "Pareto-preferred Pareto optima." Only the Pareto-preferred Pareto optima meet the efficiency standard set forth earlier in this paper. Even within these efficiency confines, the marginal cost of each individual is subject to game theoretic strategies, i.e., political contests which determine the tax system. Theoretically, local governments strive to achieve one of the efficient solutions, and at the same time reach an agreement as to which of these solutions is best.

In so doing, a locality must determine via a tax system the distribution of costs among its citizens. A valid voting model must come close to revealing the desired production of g and at the same time include a tax system which delivers the revenues necessary to purchase the desired amount of g. The locality can only hope that the desired amount of production is a Pareto-preferred Pareto optimum, and that the costs of production are equitably distributed.

Most voter models adopt the benefit approach to the provision of public goods and try to find out how close the voter-model solution is to the Pareto optimality solution (Bowen, 1943; Black, 1948, Barlow, 1970). Even when these voting models' solutions are not near an optimal solution, they are recommended as good studies in positive economics. Bowen's model is the earliest and probably best known of these models. This model reduces the efficient solution set to one solution by imposing the same per-unit tax on all voters --the marginal cost of the public good divided by the number of individuals in the community is equal to the marginal cost to the individual. This payment scheme is Bowen's assumption of what a locality might consider an equitable distribution of local public good payments. Each voter has a different demand for the local public good because of different preferences or incomes. Bowen concludes that the amount of g produced is where the marginal cost of the voter with the median demand curve is equal to the demand price of the voter with the median demand. This may or not be the efficiency solution, but it is considered much closer than a private provision of g could achieve. Most subsequent voter models have been extensions of Bowen's model. The model used in this analysis is to some degree also an extension of Bowen's model. The basic benefit approach is used, but an ability to pay element is placed in the taxing scheme of localities (the result of political con

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contests), and the level of individual incomes are explicitly considered.

A local government, acting in accordance with constituent wants, taxes its citizens not only on benefits derived from the local goods, but also on an individual's ability to pay for the goods, i.e., his/her personal income or wealth. Henry Aaron has found that on the average, local taxes are proportional to income (Aaron, 1975, p. 38). Theoretically then, it is assumed in this model that a locality's concept of an individual's ability to pay in terms of equal sacrifice is "equal proportional" --taxpayers give up utility in proportion to their <u>utility</u>. This assumption provides an outcome to the infinite range of Pareto efficient distributions of tax payments. It is the final result of political contention. With this assumption, a unique Pareto efficient amount of g can result which meets both the efficiency and equity standards which localities ostensibly wish to attain.

According to Musgrave equal proportional sacrifice requires a proportional tax rate if as income rises, the marginal utility decreases at the same percentage rate as the average utility (Musgrave, 1959, Ch. 5). Given the utility function postulated above, the appropriate tax scheme for the locality is a tax which is proportional to the level of income. This can be easily proved:

$$dU/dg = bn^{-c}Ax^{a}g^{b-1},\ U/g = n^{-c}Ax^{a}g^{b-1},\ d\ \ln\ (dU/dg)$$
$$= d\ \ln\ (U/g) = b(b-1)n^{-c}Ax^{a}g^{b-2}/bn^{-c}Ax^{a}g^{b-1}$$
$$= (b-1)g^{-1}dg,\ \%\Delta MU = \%\Delta AU = (b-1)\%\Delta g.$$

Having established conditions where a proportional income tax is desirable, the amount of g to produce and the corresponding proportional income tax rate can be determined.

Since government goods are socially produced, no profit should be derived from their consumption. The total amount paid by the community and through federal grants should equal the production cost. It should also be noted, however, that this budget is only balanced on a current account, not on a capital account. With this in mind,

$C = t \sum_{i=1}^{n} y_i + mC$ or $t = C(1-m)/ \sum_{i=1}^{n} y_i$; where C is the total cost of local government goods; t is the proportional tax rate; y_i the income of consumer i, m the fraction of state and local expenditures paid for by Federal grants, and n the number of voters in the community. The actual value of t is still unknown, since the amount of g is not yet determined.

The value of m of course is not a specific rate for a specific project. The Federal government extends many grants, each with its corresponding matching rate. Rates may range from zero to one --no grant for a project to a fully subsidized project (a project which is completely financed via a block or unconditional grant). When aggregating all of these projects an average rate on matching grants results; this is the m value observed above. Even as an average, however, m should cause both substitution and income effects on the consumption of g.

In order to determine the amount of g desired by an individual voter, the voter's per unit cost or price of g (P_{gi}) must be known. Allowing constant returns to scale in the production of g, the average cost of g becomes a constant equal to marginal cost. As discussed in further detail later, the production function of g is assumed to be a Cobb-Douglas production function. So $C = \overline{AC} \cdot g$, where $\overline{AC}$ is constant. With this assumption, the total cost to individual i is: $C_i = ty_i$ or $C_i = C(1-m)y_i / \sum_{i=1}^{n} y_i = \overline{AC}g(1-m)y_i / \sum_{i=1}^{n} y_i$. So the per unit cost of g to individual i is: $Pg_i = \overline{AC}(1-m)y_i / \sum_{i=1}^{n} y_i$. Letting the price of good X (P_x) be competitively given, the budget constraint for citizen i becomes: $y_i = P_x x_i + P_{gi} g = P_x x_i + (\overline{AC}(1-m)y_i / \sum_{i=1}^{n} y_i)g$.

The Optimal Level of State and Local Goods

With the utility function and budget constraint defined, it now remains to optimize the citizens utility. Holding n^{-c} (the demographic parameters) constant, the utility function stated previously, $U = Ax^a g^b n^{-c}$, can be maximized subject to:

$$P_x x_i + P_{gi} g = y_i,$$

The interior solution is:

$$\lambda = aAg^b x^{a-1} n^{-c}/P_x = bAx^a g^{b-1} n^{-c}/P_{gi},$$

or

$$ag/P_x = bx/P_{gi}. \quad \text{So } x = (P_{gi}a/P_x b)g.$$

Substituting into the income constraint:

$$y_i = P_{gi}g + P_x(P_{gi}ag/P_x b) = P_{gi}(1+a/b)g.$$

Substituting into P_{gi} yields:

$$y_i = (1-m)\overline{AC}y_i(1+a/b)g/\sum_{i=1}^{n} y_i,$$

or

$$\sum_{i=1}^{n} y_i = (1-m)\overline{AC}(1+a/b)g,$$

so

$$g^* = \sum_{i=1}^{n} y_i/(1-m)\overline{AC}(1+a/b). \qquad (1)$$

Note that this solution for g* is the same for every voter of the community, regardless of his/her income --y_i and x_i are <u>not</u> present in the g* solution. Further note that this is the Pareto efficient solution since each voter is paying the amount he/she is voluntarily willing to pay in order to consume g* of g. Figure 4-1 illustrates with n = 3. The three straight lines are the income constraints of the three voters. Voters with more income can operate within a higher budget line. As income rises, however, the slope of the budget line, $-P_{gi}/P_x$, becomes steeper; this is because as income rises, $y_i/\sum_{i=1}^{n} y_i$ rises, which in turn makes

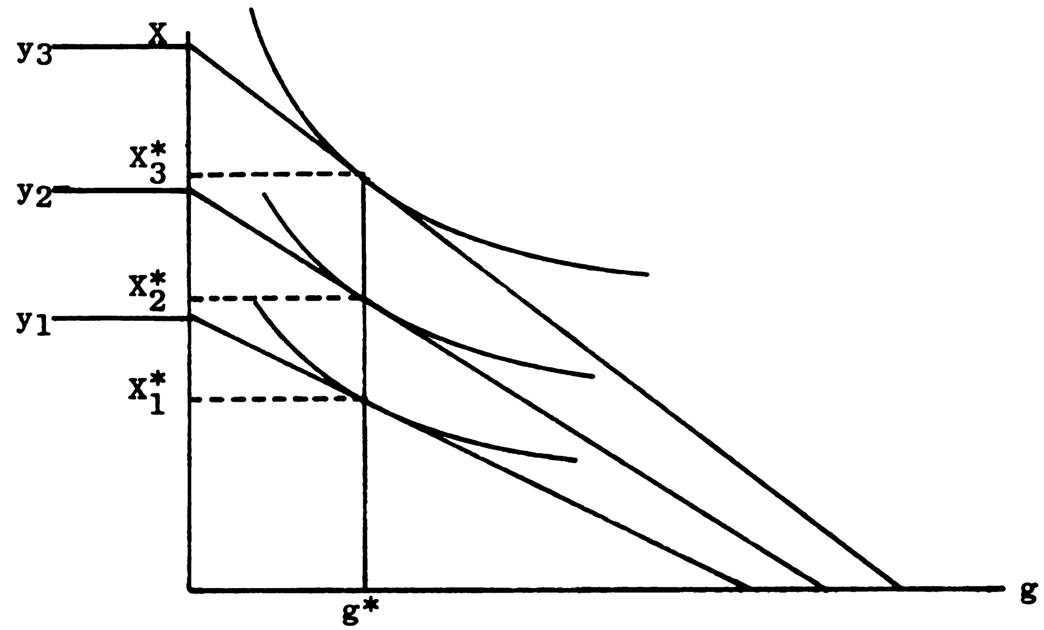

Figure 4-1

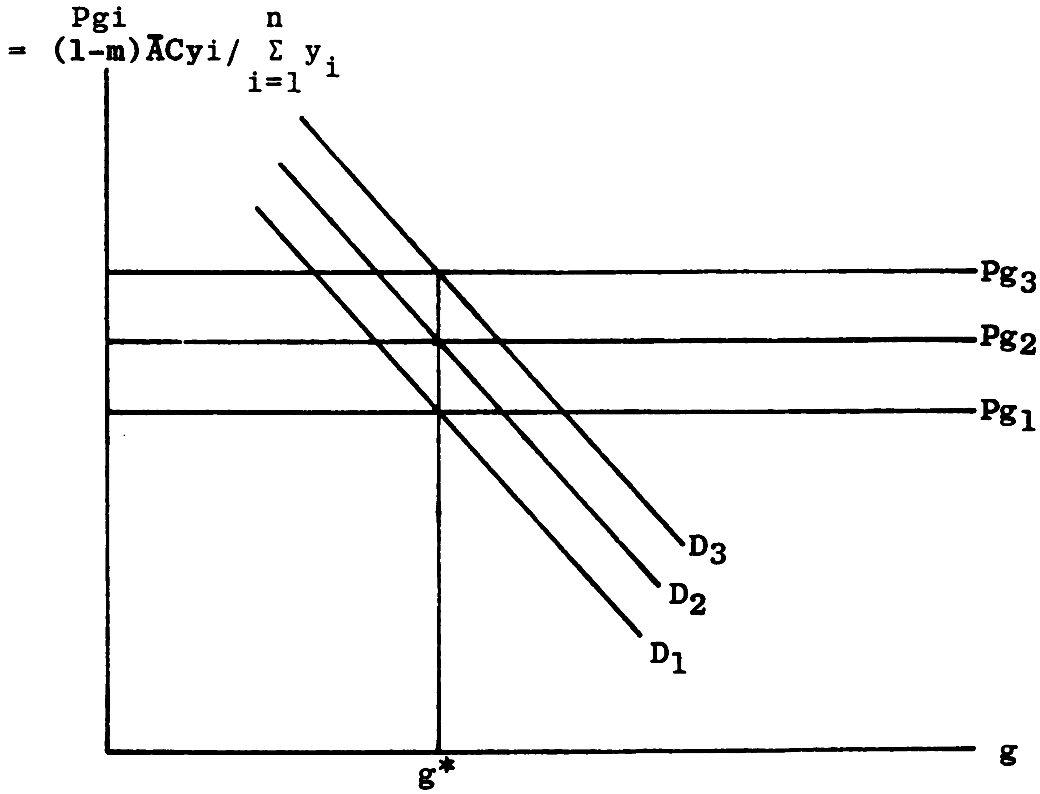

Figure 4-2

P_{gi} go up. In short an income effect on the consumption of g is exactly offset by a substitution effect. As for Pareto optimality, it can be observed that at g*, every voter maximizes his/her utility, each subject to his/her respective income constraint.

Figure 4-2 shows a second illustration which is similar to the model described by Bowen. Again, demand goes up as income rises --D_1 to D_2 to D_3, but the rise in P_{gi} associated with the income increase exactly counter-balances the increased demand. Pareto optimality is also demonstrated since the demand price is equal to the supply price for every voter at g*.

If we now relax the assumption that all members of the community have the same utility function --the a and b parameters differ among the citizenry-- then in a majority voting model, the median voter again gains prominence. (Remember, however, with a proportional income tax, as previously defined, individual income doesn't determine the optimal amount of g for the individual; it is determined by the parameters of the utility function and production function, and the amount of total community income.)

When voters are not alike, a large common utility group, a median utility individual, or a common utility group in the median range will determine g*. Figure 4-3 illustrates. There are 3 income classes --A, B, and C-- where $y_A > y_B > y_C$ and $P_{gA} > P_{gB} > P_{gC}$. There are five voters

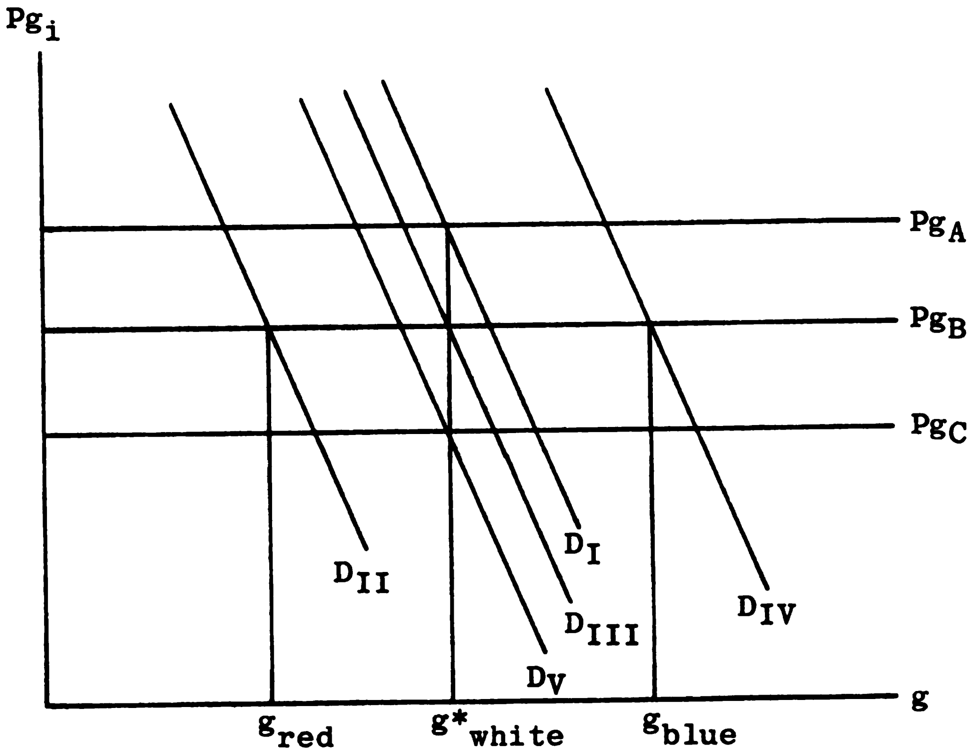

Figure 4-3

and three utility groups --red, white, and blue. Voter I is in income class A and utility group white; II in class B and group red; III in class B and group white; IV in class B and group blue; and V in class C and group white.

The white group, which is the median utility group, determines g. Voter II, in the red group, will not vote for more than g_{red} since beyond this amount his/her demand price is less than his/her supply price. Voters I, III, and V, of the white utility group, will vote for all amounts of g up to and including g* since their demand price exceeds their supply price up to level g* where their demand price equals their supply price. Voter IV will vote in favor of all amounts up to g_{blue}. So there is a clear majority of votes (4/5 approval) at g*. So with different utility functions, the model is no longer Pareto optimal (the supply price does not equal the demand price for voters II and IV). It does retain a sound operational character, and provides g at a level closer to optimal than the private sector can accomplish.

Members of the white group will also get the proportional tax rate which they consider optimal. Any member of this group, regardless of his/her income level, can be the central individual whose behavior determines local government output. It happens in this illustration that Voter III is in the middle income class as well as the median utility group, but this need not necessarily be true.

Throughout the remainder of the analysis, whenever the determination of g* is of interest, it is assumed that all community members have the same utility function or that the utility function of the median voter is observed. These assumptions provide a rationale for an optimal or near-optimal provision of local public goods. Further work could be done with this voting model and the g* associated with it. For instance, a/b could be estimated for different communities, or the calculation of t could be examined under various assumptions of individual utility. These kinds of analyses, however, do not serve the purpose of the present undertaking. g* is important in this analysis, because it affects the amount of state and local debt issued to partly finance the capital stock necessary to generate the capital services that must be employed to produce g*.

The Optimal Tax Rate

With voter i knowledgeable of his/her per unit tax rate (P_{gi}) --which is related to his/her relative income-- g* as shown above can be determined. The value of g* in turn allows authorities to calculate the proper income tax rate to place upon each individual. Since g is equal to g*, $C^* = \overline{AC}g^*$ and $t^* = C^*(1-m)/\sum_{i=1}^{n} y_i$, the desired proportional income tax rate is: $t^* = g^*\overline{AC}(1-m)/\sum_{i=1}^{n} y_i$.

A sidelight of this result is that t* can be used to find the ratio of the utility elasticities: substituting for g^*, $t^* = 1/(1+{}^a/b)$; ${}^a/b = (1-t^*)/t^*$.

Finally, notice the tax rates yield a Pareto optimal solution when it is assumed that all members of the community have the same utility function. If they have different utility functions (and they should not be too different according to the Tiebout hypothesis), then the median voter obtains an optimal amount of x and g for every time period.

On Balancing the Budget

Debt, as has been discussed, is important to the production of g^*, since the cost of debt is part of the cost of the capital needed for production. This cost is implicit in $\overline{AC}$, one of the variables determining g^*. The total cost of g^* (using least cost production methods) is C^*, while the cost to state and local governments is $(1-m)C^*$; so total local taxes equal $t^* \sum_{i=1}^{n} y_i = \sum_{i=1}^{n} P_{gi} g^* = (1-m)C^*$, state and local expenditures on public goods.

The above result, that taxes equal expenditures, gives the impression that the budget is balanced; suggesting there is no debt. The model does assume there is a balanced budget on the current account, but one of the costs in this current account is debt service. This service includes interest payments and repayment of principal at a rate equal to the rate of capital depreciation.

The total value of state and local capital and any debt issued to pay for the original outlay of capital is not of central interest to the taxpayer; of more concern is the amount he/she must pay each time period to obtain the services of capital needed to produce g*. In short, a locality may borrow to buy capital needed to produce g*, but the total value of this debt does not appear on the current account, only the amount to be paid each period.

The Optimal Capital Stock and Price of State and Local Capital Services

The level of capital services needed to produce g* using least cost production techniques is denoted k* and can be determined if the local public good production function is known. The previously assumed Cobb-Douglas production function is again postulated here to look at the main determinants of the desired state and local capital stock. To determine the optimal level of capital services, it is necessary to minimize $C = P_{cs}k+wL$, subject to $g^* = Dk^qL^{q-1}$, where w is the wage rate, L labor, k the real value of capital services per period, and D and q production parameters of the postulated Cobb-Douglas production function.

P_{cs} is the real price of capital services or cost of capital to a locality. In defining the price of capital services, the approach taken by Dale Jorgenson "The Theory of Investment Behavior" in Determinants of Investment

Behavior (1971) will be used. Jorgenson's presentation operates in competitive private markets where the value of the marginal product of a unit of capital can be directly observed. A local voter when making a local capital investment decision does not have this advantage when compared to a private firm making a similar decision. However, recall the voter had to choose between private goods with a market price and value and government goods with a price based on costs, income, and grants. Given this non-market "price" for government goods, the voter still decided how much in private goods he/she must sacrifice to obtain the desired amount of local government goods. In obtaining the final unit of capital needed to produce local goods, some market value of private goods was given up. This in effect is the value of the marginal product of local capital in the same sense that private firms purchase capital to the point where its rental cost is equal to the value of its marginal product.

Rather than acquiring capital to the level where the value of the marginal product of capital equals its rental cost, the utility maximizing voter will allocate capital so that its marginal value in each use is equal. Since the marginal value of capital in local good production is equal to its marginal value in private use, the marginal value of state and local capital also equals the rental cost of capital.

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This rental cost is called the price of capital services (RC). When deciding upon how much capital to purchase, the voter will weigh the price of a unit of capital, Pm, with the benefits generated by the capital in the future. A unit of capital purchased for Pm dollars will deteriorate at the rate $^1/Z$ each period and what remains will produce the value of its marginal product = RC in each future period. In equilibrium, the price of a unit of capital will just equal the present value of the future rentals it generates, or:

$$
\begin{aligned}
Pm &= \sum_{t=1}^{\infty} (1+r_N)^{-t} RC(1+{}^1/Z)^{-t} \\
&= RC \sum_{t=1}^{\infty} (1+r_N)^{-t} (1+{}^1/Z)^{-t}
\end{aligned}
$$

The annual rental RC is discounted by the rate r_N to bring it to a present value. r_N, the rate on tax-exempts, is the appropriate discount rate since this is the rate voters must pay to borrow financial capital. It is also a good proxy for the opportunity cost of investing in local capital rather than other assets, as the after tax return on equally risky assets tends to equalize with r_N. RC is also discounted at the rate $^1/Z$ which reflects capital depreciation and corresponding amortization of any debt issued to purchase the local capital.

The infinite sum of $(1+r_N)^{-t}(1+{}^1/Z)^{-t}$ equals $^1/(r_N+{}^1/Z+r_N\cdot{}^1/Z)$. If $r_N\cdot{}^1/Z$ is ignored then this reduces to $1/(r_N+{}^1/Z)$ and one obtains $RC = Pm(r_N+{}^1/Z)$. The real price of capital services --$\frac{RC}{Pm} = P_{cs}$-- thus becomes $P_{cs} = r_N+{}^1/Z$. This simple expression offers the best practical definition for the real price of state and local capital services. The depreciation rate could be somewhat modified if expressed in a way showing how debt will be repaid. However, this would be vastly complicated.

From this point forward, the analysis of P_{cs} is far simpler than it was for Jorgenson. State and local government investors do not have to deal with taxes, hence the P_{cs} is not complicated by taxes as it is when considering private investment. Jorgenson must bring in a series of taxes which lowers his private P_{cs}. (Of course, in equilibrium the P_{cs} for state and local capital is equal to the P_{cs} of private capital since r_N and the after tax rate of return on private securities adjust until they are equal.)

P_{cs} is implicit in the $\overline{AC}$ used to determine g* in the voting model. This can be seen by observing the first order conditions resulting from the cost minimization procedure which yields:

$$k^* = g^*q^{1-q}w^{1-q}/D(1-q)^{1-q}P_{cs}{}^{1-q} \tag{2}$$

and

$$\overline{AC} = P_{cs}w^{1-q}(1-q)^{q-1}/Dq^q. \tag{3}$$

Returning to equation (1) and substituting equation (3) makes

$$g^* = \sum_{i=1}^{n} y_i \cdot Dq^q/(1-m)P_{cs}{}^q s^{1-q}(1-q)^{q-1}(1+{}^a/b),$$

so

$$k^* = \sum_{i=1}^{n} y_i \cdot Dq^q q^{1-q} w^{1-q}/(1-m)P_{cs}{}^q w^{1-q}(1-q)^{q-1}$$
$$(1+{}^a/b)D(1-q)^{1-q}P_{cs}{}^{1-q}$$
$$= \sum_{i=1}^{n} y_i \cdot q/(1-m)(1+{}^a/b)P_{cs}. \tag{4}$$

$$\text{and, } (1-m)P_{cs}k^* = \sum_{i=1}^{n} y_i/(b+a)/aq, \tag{4a}$$

which means aq/(b+a) is the average fraction of community income which voters agree to put into state and local capital during each pay period over the lifetime of the capital in order to get the flow of local public goods they desire.

With the optimal flow of state and local goods, optimal flow of state and local capital services, and the optimal tax rate determined, the optimal level of debt can also be determined.

The Optimal Level of General Obligation Bonds

To complete the model of general obligation bond supply, the median voter must determine h --the fraction of non-Federally funded state and local capital stock which is financed by state and local debt. To determine h, the median voter's preference pattern of x and g over many time periods must be recognized. When considering the use of capital with a lifetime of Z years, the median voter will try to maximize his/her utility over Z periods of time. At the moment the maximization decision is made, all constraints must be observed and all parameters assumed constant in order to simultaneously find the optimal value for each variable; that is citizen i maximizes

$$U_i = U_i(x_1, x_2, \ldots, x_Z, g_1, g_2, \ldots gZ, h_1, h_2, \ldots, h_Z)$$

subject to $\sum_{j=1}^{Z} y_{ij} = \sum_{j=1}^{Z} P_{xj}x_{ij} + \sum_{j=1}^{Z} P_{gij}g_j,$

and

$$P_{gij} = (P_{csj}w_j^{1-q}(1-q)^{q-1}/Dq^q)1-m_j)y_{ij}/\sum_{i=1}^{n} y_{ij}$$

for $j = 1, 2, \ldots, Z$.

Determining a solution to this problem would require an explicit utility function and strenuous mathematical effort, but it is clear that optimizing values for $x_1{*}, x_2, \ldots, x_Z{*}, g_1{*}, g_2{*}, \ldots, g_Z{*}, h_1{*}, h_2{*}, \ldots, h_Z{*}$, are determinant.

For each $g_j{*}$, there is a cost minimizing capital services requirement --$k_j{*}$. An expression showing $k_j{*}$ desires would be like the expression shown in equation (4), except that rate of time preference parameters must also appear in the expression. For any desired $k_j{*}$, there is also a requisite amount of state and local capital --$K_j{*}$. The relationship between these two variables is typically some straightforward technical correspondence --possibly linear. In fact it is not unusual to view this relationship as linear.

Given a relationship between capital services and the capital stock, the relationship between desired state and local capital services and the desired general obligation bond supply can be determined. If $h_j^* = 1$, for $j = 1,2,\ldots,Z$, then K_j^* will equal N_j^* --the desired supply of tax-exempt bonds. Of course, as is evident from the utility function, h_j does not equal 1. Local citizens feel uncomfortable financing all of their capital needs with debt. Fear of insolvency and other subjective factors frequently pressure local citizens to pay more in captial expenses out of current revenues than is necessary. Each period, a utility maximizing h_j is found. The optimal value for h_j is found where $\partial U_i/\partial h_j = 0$. When this condition is met prior to $h_j = 1$, then current-period capital expenses will exceed interest payments on debt plus depreciation. $(1-h_j^c)(1-m_j)\Delta K_j^*$ becomes a current capital expense, (h_j^c being the new debt issue to new capital expenditure ratio for period j <u>only</u>).

Given $h_j^*, N_j^* = h_j^*(1-m_j^*)K_j^*$; where m_j^* is the Z-year average rate on Federal grants, weighted by $\Delta K_j^*/K_j^*$. This result can be simply demonstrated: since $h_j^* = N_j^*/(1-m_j^*)K_j^*, (N_j^*/(1-m_j^*)K_j^*)(1-m_j^*)K_j^* = N_j^*$. We have thus arrived at one of the ultimate objectives --a value for the desired supply of general obligation bonds.

A Discussion of the Dynamics

It is unlikely in reality that the Z-dimensional g* vector will not change throughout the lifetime of the capital stock going into the production of the g* vector. New capital must be financed every year since the capital from past decisions wears out, and $\sum_{i=1}^{n} y_i$, m, $^a/b$, or $\overline{AC}$ might change. There will be a corresponding change in the need for the productive services of inputs. When the median voter wants to raise the g* vector, he/she is expressing a willingness to pay more taxes during each pay period in order to acquire more services from state and local government labor, capital, and materials. The additional tax money volunteered to capital services is $((1-m)(r_N+{}^1/Z)h^c+(1-m)(1-h^c))\ (k^*-k^*_{-1})$ for the current period and $(1-m)(r_N+{}^1/Z)h^c(k^*-k^*_{-1})$ during each period for the remaining lifetime of the new capital. $(1-m)h^c*(K^*-K^*_{-1})$ of state and local debt would be approved by a referendum.

If voters decide they want less g*, fewer capital services will be demanded, or $k^*<k^*_{-1}$ and $(1-m)P_{cs}(k^*-k^*_{-1})<0$. There is a restriction on this inequality: voters are not so myopic in their decisions to employ capital services that future capital demands will diminish faster than capital depreciates --$K^*_{-1}-K^*\leq({}^1/Z)K_{-1}$. Such a restriction is not unrealistic; voters can closely approximate future income and wants, and make the public spending decision in the same way they make private spending decision. This information is then allowed for when making current decisions. With this restriction, the adjustment of the actual captial stock to its desired level could take place very quickly. There are, however, other constraints on behavior.

Institutional Constraints

Most states place legal constraints other than referendums on the amount of bonds a locality can issue. If $(1-m^*)h^*K^*$ exceeds a legal limit, g must be cut back. This constraint of course creates a non-optimal provision of x and g. The voter would gain more utility with more state and local debt, and more g. Assuming that the referendum constraint on local government behavior is strictly enforced, this argument submits that the added constraint of bond issue limitations is suboptimal and unnecessary. Nevertheless, these limits are real and must be accounted for when analyzing tax-exempt bond supply.

Other than the referendum requirement, the most common legal restriction on state and local bond issues is a ceiling on the nominal rate of return on state and local government bonds ($\bar{r}_N'$). Under conditions where the ceiling is above the market rate, conventional wisdom asserts there is a negative relationship between r_N' and N. If borrowing needs or inflation lead voters to expect $r_N' = r_N + \pi^*$ to rise above the ceiling, they may want to borrow before the rate required to get funds is legally unacceptable. On the other hand, once a rise in π^* has pushed r_N' above $\bar{r}_N'$, voters have waited too long to borrow, debt finance must wait until the ceiling is raised, the inflation rate falls, or the market pushes r_N' back down.

Figure 4-4 illustrates. Beginning at point A, if π^* rises, bond supply will shift to S'. So ceteris paribus (voters attempt to beat the inflationary impact on the demand for tax-exempts) the quantity of bonds supplied will rise to point B, where further supply is legally restrained. However, eventually the rise in π^* will also cause tax-exempt bond demand to decrease to D'. So when voters procrastinate, the volume of issues falls to point C. Furthermore, should the market seek a rate above the ceiling, such as point D, bond suppliers can not respond by offering higher rates.

In review, a negative relationship is expected to exist between r_N' and h, but the ceiling sometimes creates distorted non-market rates where the relationship may appear temporarily positive (due to a π^* increase), or the relationship may appear to blow-up above the ceiling rate. This ceiling, of course also can create sub-optimal levels of debt.

Disregarding the legal limitations on borrowing, the mere fact that the price of capital is expected to rise with inflation gives a further incentive to buy capital as soon as possible. If current funds are not available, the capital expenditure must be debt financed. In a similar

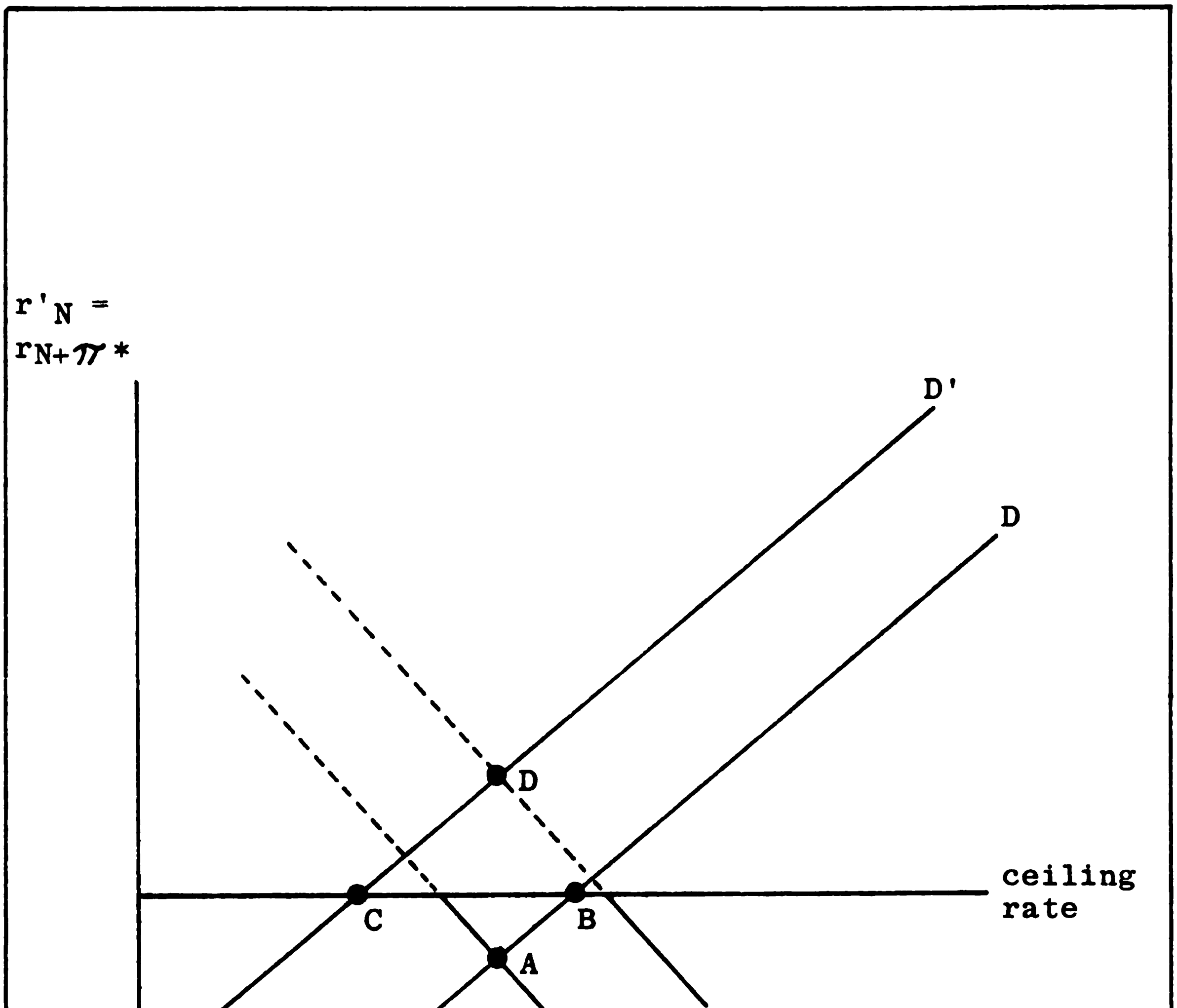

Figure 4-4

vein, if revenues cannot keep pace with this inflation, more borrowing is necessary. Too much of such borrowing can cause severe consequences on fiscal finances. Greytak has done a thorough study on this impact, showing borrowing needs rising, as the differential between capital expenditures and revenues has risen because of inflation (Greytak and Jump, 1975).

Summary

In summary, equilibrium $h_j^* = h_j^*(\pi_j^*, r_{Nj}+\pi_j^*, \bar{r}_{Nj}'$, the voter's rate of time preference); and $k_j^* = q\sum_{i=1}^{n} y_{ij}/(1-m_j)(1+{}^a/b)P_{csj}$. The desired amount of general obligation bonds outstanding if the legal constraints are not binding is: $N_j^* = (1-m_j^*)h_j^*K_j^*$. If the legalities are constraining, $N_j^* > N_{\bar{r}_N', j}$ (where $N_{\bar{r}_N'}$ is the bond supply when the ceiling rate is binding).

To recapitulate, a voting model has been developed to explain the determination of general obligation bond supply. The central thesis is that voters decide how much of their income will be spent on state and local capital services during each period. This involves not only choosing the size of the state and local capital stock, but also the method of financing the capital stock. This formulation of a tax-exempt bond model differs from formulations where bond supply is a consequence of a balance sheet where expenditures exceed revenues. Much economic behavior is overlooked in these earlier models, as the capital stock is seen simply as an independent variable determing debt needs. More important is the determination of capital needs as a derived demand for state and local government services. This model provides a linkage from individual demand to capital needs to bond supply.

The Empirical Specification

Specification of tax-exempt bond supply involves two equations. The state and local capital stock (K) must be specified; and the fraction of state and local capital financed by debt (h) must be specified.

The Desired Capital Stock

The theoretical value for the desired flow of state and local capital services, as determined previously is:

$$k^* = (\sum_{i=1}^{n} y_i)q/(1-m)(1+{}^{a}/b)P_{cs};$$

where $\sum_{i=1}^{n} y_i$ is net state and local income, and m is the matching rate on Federal grants. This rate is an aggregate average of all rates across the country. On a Micro basis, there are a whole range of rates which range from project specific to general grants. General grants are really transfers of income, but these grants enter into this variable as a 100% matching rate. At the same time some projects are completely unfunded by Federal money and add to the aggregate average at a 0% matching rate.

q is a production parameter, and a and b are utility parameters. Recall, however, k* is based on restrictive assumptions --1) the utility function and production function of a representative locality have been given specific functional forms which may or may not be correct; 2) in the aggregate, a, b, and q must be the same in every locality; and 3) demographic variants are held constant. Given these restrictions, the model implies that the elasticity of k* with respect to $\sum_{i=1}^{n} y_i$ equals 1, and with respect to (1-m) and P_{cs} equals -1. Testing the null hypothesis that these elasticities are 1 and -1 is not a constructive exercise, however, because it is unrealistic to maintain the aforementioned restrictions.

A more constructive empirical test is to retain the basic theoretical structure, but relax the restrictions and estimate the sensitivity of k* to its most important determinants. To do this, the following equation is posed;

$$k^* = \beta_0 \left(\sum_{i=1}^{n} y_i\right)^{\beta_1} d^{\beta_2} 1^{\beta_3} \varepsilon/(1-m)^{\beta_4} P_{cs}^{\beta_5}.$$

Provision of capital services requires a capital stock, K*, which is assumed to be roughly proportional to the desired flow of capital services; hence K* depends on the same variables as k* times a constant. The above expression of k* suggests a specification for K* of the form:

$$K^* = \beta_0 \sum_{i=1}^{n} y_i^{\beta_1} d^{\beta_2} 1^{\beta_3} \varepsilon/(1-m)^{\beta_4} P_{cs}^{\beta_5}.$$

ε is an error term in which large errors are associated with large values of K. The production and utility parameters $(q/(1+{}^{a}/b)$ are now subsumed into the constant term β_0, and alternative forms of the utility function and production function are permissible since the elasticities of K* are not postulated at unity. The sensitivity of K* with respect to each of the independent variables can easily be estimated by the β's, as this functional form is easily converted into a linear model:

$$\ln K^* = \ln \beta_0 + \beta_1 \ln(\sum_{i=1}^{n} y_i) + \beta_2 \ln d + \beta_3 \ln l$$
$$-\beta_4 \ln (1-m) - \beta_5 \ln P_{cs} + \ln \varepsilon.$$

The variables l and d reintroduce demographic variables into the model. As total population rises, more people must share the local public good, so g must also rise to keep utility standards up. Presumably, this is possible because each individual has some income, so as total population rises, $\sum_{i=1}^{n} y_i$ also rises. Since public goods can be partly shared without a loss in consumption to each individual (with a pure public good, there is no individual loss in consumption due to sharing), a rise in total population does not raise K* as much as it would if g could not be shared. The degree of sharing depends on the inherent publicness of state and local goods and upon the intensity of congestion which can diminish individual participation in the consumption of state and local goods. To account for the demographic impact on K*, a density dummy and an age-composition factor are used. This allows for demographic adjustments without seriously altering the theoretical formulation.

d is a dummy variable --1 from 1959 to 1970 and 2 from 1971 to 1977. This dummy is necessary for several reasons. As a proxy for density, the dummy separates the years where the country's fifteen largest SMSA's had some population growth from the years they had zero or negative population growth. Secondly, this falling growth rate among large SMSA's was accompanied by several fiscal crises, which made it more difficult for municipalities to find city investors. Also in the 70's the price of construction rose faster than the general price indices. In reaction to these events, many local governments turned to leasing rather than purchasing local capital. Sometimes local governments out and out returned certain services to the private sector.

l is a population factor for school age children. It is equal to the current year's annual fraction of the total population older than 4 years and younger than 16 years divided by the same fraction in 1963. When l rises, demand for state and local goods should also rise since this group requires more state and local public services. Thus l to some extent also reflects changing tastes over time.

Since the actual level of capital cannot be immediately brought to the desired level of capital, the specification is revised further:

$$K_t/K_{t-1} = (K_t{}^*/K_{t-1})^{\lambda},$$

where the left isde is the actual ratio of present state and local capital over the level in the previous period, and the right side shows the degree to which the desired ratio has adjusted to the actual ratio. λ, the adjustment parameter, is greater than zero and less than one. The value of λ is somewhat distorted in reality since the level of the capital stock cannot be reduced by more than the amount that it depreciates.

Given $K_t{}^*$ previously obtained,

$$K_t/K_{t-1} = (\beta_0(\sum_{i=1}^{n} y_i)^{\beta_1} d^{\beta_2} 1^{\beta_3} \varepsilon/(1-m)^{\beta_4} P_{cs}{}^{\beta_5} K_{t-1})^{\lambda}, \tag{7}$$

and taking logarithms transforms to

$$\ln K_t - \ln K_{t-1} = \lambda \ln \beta_0 + \lambda\beta_1 \ln (\sum_{i=1}^{n} y_i) + \lambda\beta_2 \ln d + \lambda\beta_3 \ln 1$$
$$-\lambda\beta_4 \ln (1-m) - \lambda\beta_5 \ln P_{cs} - \lambda \ln K_{t-1}$$
$$+\lambda \ln \varepsilon_t \tag{8a}$$

and

$$\ln K_t = \gamma_0 + \gamma_1 \ln \sum_{i=1}^{n} y_i + \gamma_2 \ln d + \gamma_3 \ln 1 - \gamma_4 \ln (1-m)$$
$$-\gamma_5 \ln P_{cs} + \gamma_6 \ln K_{t-1} + e_t. \tag{8b}$$

The Fraction of Capital Financed by Debt

It is also necessary to determine what fraction of the non-Federally funded capital stock is financed by state and local debt. Several variables, discussed in the theoretical section, contribute to the size of this fraction, denoted h. Several linear estimating equations involving these variables are proposed below:

$$\ln h = \ln \beta_0 + \beta_1 \ln ({}^{g}/y) + \beta_2 \ln r_N' + \varepsilon \quad (9)$$

$$\ln h = \ln \beta_0 + \beta_1 \ln ({}^{g}/y) + \beta_2 \ln r_N + \beta_3 \ln \pi^* + \varepsilon \quad (10)$$

$$h = \beta_0 + \beta_1 ({}^{g}/y) + \beta_2 r_N' + \varepsilon \quad (11)$$

$$h = \beta_0 + \beta_1 ({}^{g}/y) + \beta_2 r_N + \beta_3 \pi^* + \varepsilon \quad (12)$$

${}^{g}/y$ is the ratio of state and local expenditures to permanent income (a weighted average of past incomes). This variable is employed to capture the tastes of voters. More explicitly, the fraction of income they wish to place in state and local goods as opposed to private goods and Federal goods is estimated with this ratio. Permanent income is more relevant than current income because, as stated in the theory, current decisions affect consumption over many time periods. The relationship between ${}^{g}/y$ and h is possibly non-linear. At some point voters will no longer wish to sacrifice private goods for more state and local good consumption, hence greater consumption of state and local goods must be funded almost exclusively through debt --h would then begin to rise exponentially as ${}^{g}/y$ rises.

r_N', discussed earlier, is the tax-exempt bond rate. Recall, there is a ceiling on this rate. h is expected to fall as r_N' rises. Once the market rate begins to rise above state and local ceilings, h will probably fall dramatically, as many localities lose their legal borrowing rights. This situation is not completely predictable since localities modify their behavior in many ways in order to deal with the disequilibria created by the rate ceiling.

r_N and π^*, discussed previously, breakdown the r_N' component of the equation. Beyond this breakdown, π^* on its own has potential effects on h. These effects were discussed in the theoretical section. Unfortunately, for measuring purposes, π^* can have effects which counter one another.

General Obligation Bond Supply

Combining the equations specified in the last two sections, general obligation bond supply can be estimated:

$$N_{0t} = (1-m_t^*)h_t K_t.$$

Note that 1-m plays a part in the determination of K*. Once K* is determined, Federal grants pay for 1-m of the capital expenditure, so 1-m enters the picture again, only as a simple fraction which shows which part of the capital expenditure the state and local governments need not pay. Figure 4-5 illustrates. K_1^* is the amount of state and local capital desired if no grants are offered. The state

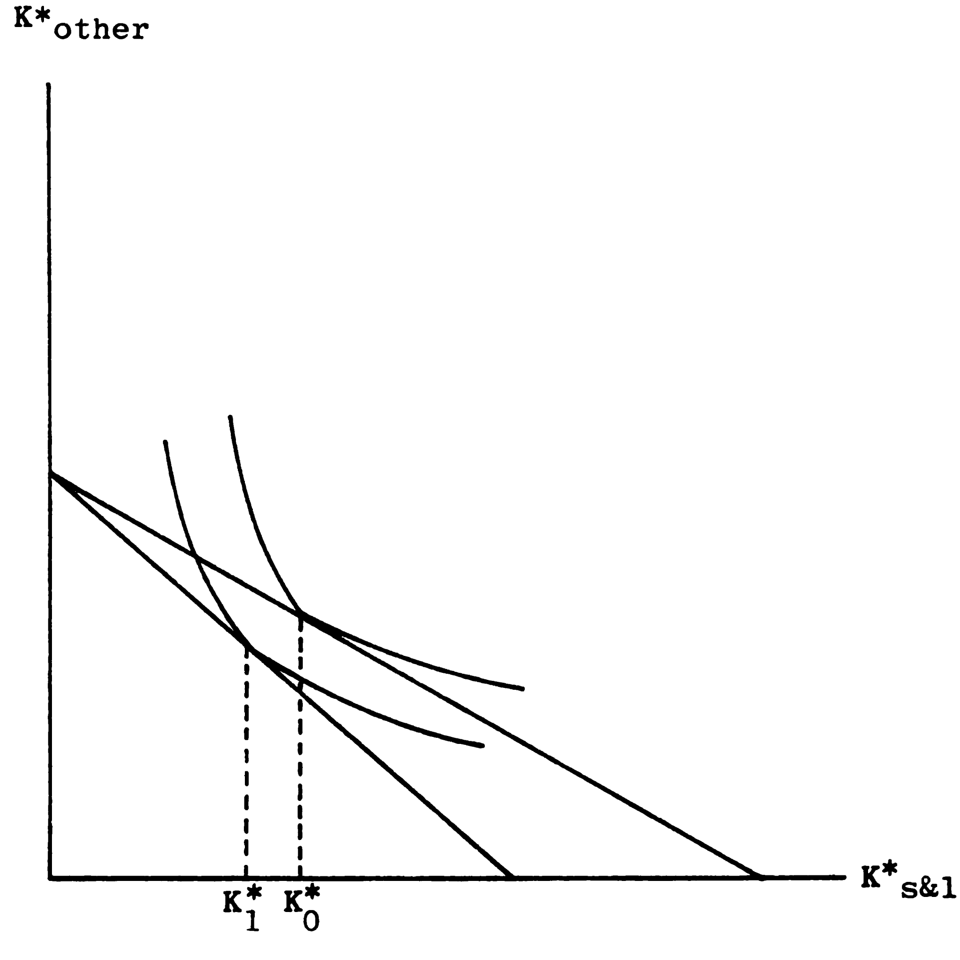

Figure 4-5

and local governments must pay K_1* for this capital. If grants are offered, the state and local governments desire K_0* of state and local capital. They must pay $(1-m)K_0$* for this capital. K_1* and $(1-m)K_0$* are not necessarily equal. The grant affects the amount state and local governments are willing to pay.

Finally, K is the real value of capital, so the N solved for is the real desired supply of general obligation bonds.

Results

Equations 8 - 12 are estimated using the method of ordinary least squares. Since the h equation and K equation have no independent variables in common, identification is not a problem. The estimates are:

$$\ln K_t = \underset{(-.73)}{-.265846} + \underset{(1.78)}{.124876} \ln \sum_{i=1}^{n} y_i - \underset{(-1.99)}{.0184991} \ln d + \underset{(.85)}{.0562207} \ln 1$$

$$- \underset{(-1.47)}{.0375442} \ln P_{cs} - \underset{(-.27)}{.0353040} \ln (1-m) + \underset{(16.85)}{.896869} \ln K_{t-1} \quad (13)$$

R^2 = .9998 $\quad$ F = 9979.58 $\quad$ DW = 2.20

$$\ln h = \underset{(.04)}{.00969004} + \underset{(3.68)}{.479134} \ln(^g/y) - \underset{(-9.74)}{.219280} \ln r_N' \quad (14)$$

R^2 = .9220 $\quad$ F = 70.97 $\quad$ DW = 2.14

$$\ln h = \underset{(-2.00)}{-.687951} + \underset{(1.31)}{.224856} \ln(^g/y) - \underset{(-1.14)}{.0147338} \ln r_N - \underset{(-7.24)}{.129184} \ln \pi^* \quad (15)$$

R^2 = .8943 $\quad$ F = 31.04 $\quad$ DW = 1.18

$$h = .211842 + .928104\ ({}^{g}/y) - .0126417\ r_N' \qquad (16)$$

$$(5.74) \quad (3.45) \quad (-10.17)$$

$$R^2 = .9253 \quad F = 74.37 \quad DW = 2.07$$

$$h = .237376 + .693258\ ({}^{g}/y) - .00977768\ r_N - .0121014\ \pi^* \qquad (17)$$

$$(5.36) \quad (1.97) \quad (-3.23) \quad (9.00)$$

$$R^2 = .9320 \quad F = 50.24 \quad DW = 1.74$$

All of the coefficients in equation 13 have the expected a priori sign with reasonably strong t-statistics. The F statistic is significant, the R^2 is exceptionally high, and the DW statistic is acceptable. The coefficient associated with $\ln K_{t-1}$ is nearly .9, indicating that λ, the adjustment parameter, is about .1. Capital stock adjustment to its desired level is not particularly rapid, which is not a surprise since the political process of setting up voting procedures requires time.

Of further note ln (1-m) tests with a weak negative significance --its t-statistic is -.27. This weak sign is probably due to a shift in tastes. In recent years many people feel they have become satiated with public goods. They view many public goods as inferior. Consequently, more and more grant money is used to reduce state and local taxes, and thus total real state and local capital spending. A shift in tastes has probably caused a clear relationship between Federal grants and state and local capital spending to look weaker than it really is. (Approval of Proposition

13 in California is the kind of voter behavior that suggests public attitudes towards state and local public goods has been changing.)

Equations 14, 16, and 17 are statistically strong on every count, while equation 15 has a low DW statistic. All coefficients show the expected _a priori_ sign and strong supporting t-statistics.

It was suspected that a strong negative relationship between r_N and h might not result because of the disequilibrium behavior induced by the rate ceiling. An increase in the π^* component of r_N' clearly causes r_N' to go over the ceiling, and thus reduce h. Conversely, when π^* falls, r_N' might then fall below the ceiling rate, allowing h to rise. r_N in the meantime may rise or not change, but the withheld desire to issue tax-exempts that may build up while r_N' exceeds the rate ceiling is unleashed when π^* falls. Hence a rising h might be associated with a rising r_N. This effect has not proved out to be important. But splitting r_N' into r_N and π^* helps to isolate this possible effect, even though it is minor.

Finally, the results show that the linear specification estimates h more accurately than the logarithmic specification. Possibly the rate ceiling to some extent linearizes the relationship.

These estimates can be used to predict total tax-exempt bond supply, after estimates of revenue bond supply are obtained.

Revenue Bond Supply

Specification

The winds of public feeling toward the size of government have a subjective influence on public officials' view of the number of natural monopolies present and the amount that local governments should spend in the operation of these industries. In periods or locations where there is discontent with private provisions of important community goods, then public enterprises should be popular, and the number and level of public enterprises sizeable. These goods usually are not public goods and can be supplied on a *quid pro quo* basis; allocative efficiency precludes ability to pay as a revenue rationale for these endeavors. Thus, local governments, theoretically, try to produce Pareto efficient amounts of these goods; an objective the private sector cannot accomplish. This means consumers should pay the average cost for a unit of good. A local official then must --just as the manager of a private monopoly-- determine optimal production methods and optimal amounts of production. Unlike private managers, the local officials do not try to maximize profits; they attempt to maximize their office holding capacities.

Revenue or non-guaranteed bonds are used to help finance the investment projects of natural monopolies run by local governments. Since revenue bonds are supposed to be retired out of the revenues earned from the project they finance, statutory or constitutional limitations, including voter approval, are not required prior to their issuance. Therefore, non-guaranteed bonds can be issued by elected officials without directly representing the will of their constituency. The issuance of non-guaranteed bonds is essentially a discretionary action by local officials. It is the utility of local officials then that is critical in the decision to issue this kind of bond.

Presumably, financial prudence and acumen are present in this decision, although in practice the utility of an official may direct him/her away from sound financial undertakings. For this model, it is assumed that local government officials do not intentionally make reckless decisions; they borrow to undertake projects only after they have received sound financial advice and fully expect future earnings to cover costs. But the primary characteristic of an official's utility is the desire to be re-elected. This usually means supplying many government services which satisfy his/her electorate, while holding taxes down. If he/she blatantly fails to accomplish one or both of these conflicting objectives, he/she need not be concerned about future government services since someone else will be in office. Hence we should expect at the time a borrowing decision is made that local officials favor present consumption of government services above future consumption. On this basis, determining the amount of non-guaranteed local government bonds issued is a simple utility maximization problem.

In reality the present versus future consumption decision extends over many time periods; here, for simplicity of exposition, only two time periods are analyzed. Nevertheless, the model retains the essence of a multi-period model. The utility function of an elected official can be expressed:

$$U = Ag_1^a g_2^b$$

where $a > b$ since officials prefer current consumption to future consumption. g_1 and g_2 represent real government services in time periods one and two respectively. g_1 is the average amount of public enterprise production per year over the next two years. Incumbent officials place high priority on this production since most local officials have at most two years to act before they are up for re-election. g_2 is the average amount of production per year across the official's desired time in office. Most officials hope to be in office possibly ten more years, but cannot realistically put too much value on public enterprise production beyond that point.

Scrupulous officials look at actual time spans when observing predicted project returns, even though their interests do not necessarily coincide with this span of time. Still, choosing a set time limit for all public enterprises, in this case ten years, simplifies the model considerably, especially when designing an empirical specification.

The expenditures on g_1 and g_2 are eventually paid for out of user fees. The official's budget constraint is:

$$I_1 + I_2/(1+r_N)^4 + m(g_1+g_2/(1+r_N)^4)$$
$$= g_1 + g_2/(1+r_N)^4, \text{ which reduces to}$$
$$I_1 + I_2/(1+r_N)^4 = (1-m)g_1 + (1-m)g_2/(1+r_N)4; \qquad (18)$$

the present value of the expected returns must equal the present value of state and local expenditures on these projects, with I_1 and I_2 being the real expected returns from the project. User fees during the current year measure returns during the first period. Expected user fees four years hereafter are used to measure the average income during the course of the succeeding eight years. The fourth year is used since it is the median year of the projected eight year time span which the officials are assumed to base their present decisions upon.

r_N (the real rate of return on tax-exempt bonds) is the discount rate used since this is the rate that must be paid to borrow for public enterprise projects. Again m is the matching rate on Federal grants. Note that the budget constraint implicitly assumes that officials expect the future matching rate to equal the current rate.

As long as an official acts within this constraint, his/her behavior must be considered prudent. This is not to say his/her rate of time preference is the same as the body he/she represents.

Maximizing the official's utility function with respect to the budget constraint yields the following condition:

$$\lambda = ag_2 = bg_1(1+r_N)^4, \tag{19}$$

a standard rate of time preference condition. Substituting this expression into the officials' budget constraint yields the desired amount of local government services derived from public enterprises over the current period

$$g_1^* = \frac{\left(\frac{a}{a+b}\right) I_1}{(1-m)} + \frac{\left(\frac{a}{a+b}\right) I_2}{(1-m)(1+r)^4} . \tag{20}$$

This expression can be used to corroborate the earlier hypothesis that $a > b$. Letting $\beta = a/a+b$, the following regression equation would follow:

$$g_1^* = \beta\left[\frac{I_1}{(1-m)} + \frac{I_2}{(1-m)(1+r)^4}\right] + \varepsilon, \tag{21}$$

where I_1, I_2, m, and r are exogenous variables. To support the hypothesis that $a > b$, then $\hat{\beta} > \frac{1}{2}$. However, it is not the purpose of this effort to uncover the exact utility function of public officials; hence the β in equation 21 is not estimated.

It is important to show how public officials' behavior affects revenue bond supply. The volume of revenue bond issues resultant from the desired spending above is:

$$\Delta N_f = g_1^* - mg_1^* - I_1 = (1-m)g_1^* - I_1. \qquad (22)$$

In estimating ΔN_f the (1-m) which appears in equation 22 will not cancel out the (1-m) component of g_1^*. Such a cancellation is proper only if the previously postulated utility function of local officials is correct. This correctness of course has not been determined. Thus (1-m) may be wrapped up in the preference parameters of some alternate utility function.

Thus substituting g_1^* into equation 5 yields:

$$\Delta N_f = (1-m)\left[\frac{\left(\frac{a}{a+b}\right)I_1}{(1-m)} + \frac{\left(\frac{a}{a+b}\right)I_2}{(1-m)(1+r)^4}\right] - I_1. \qquad (23)$$

As discussed above, if the utility function is correct, the $\hat{\beta}$ of equation 21 would provide the information needed to estimate ΔN_f. However, the above relationship among the exogenous variables and utility parameters is conditional and not confirmed. But it is clear that these variables in some functional form determine ΔN_f, or:

$$\Delta N_f = \Delta N_f(I_1, I_2, (1-m), (1+r)^4, \text{utility parameters}).(24)$$

A linear specification of this function is as valid as any other proposed and it can be easily estimated.

Hence:

$$\Delta N_f = \beta_0 + \beta_1 I_1 + \beta_2 I_2 + \beta_3(1-m) + \beta_4(1+r)^4 + \varepsilon, \quad (25)$$

where the utility parameters are embodied in the betas.

Since the remainder of the complete model observes total bonds outstanding rather than net issues, it follows that the revenue bond component of the model should do the same. This modification is easily accomplished by using the inter-period change identity:

$$N_f = \Delta N_f + N_{-1}^{f}. \quad (26)$$

The major potential difficulty expected when estimating either equation 21 or equation 25 is the calculation of a macroeconomic measurement of the expected future returns derived from user fees placed on public enterprise projects. The following method of measurement is proposed.

$$I_2 = I_1 \cdot (1+(LY-LY_{-1})/LY_{-1})^4/(1+\pi^*)^4 \quad (27)$$

where I_1 again denotes current user fees, LY denotes local income, and π^* shows the expected rate of inflation. This variable is based on the idea that the flow of user fees grows at the same rate as local income. If it does not accurately reflect expected income, then an alternative specification may be called for.

A possible indicator of future user fees, which is not itself a measure of user fees, is the interperiod change in user fees. Thus equation 25 can be respecified with changes in user fees substituted for I_2. This formulation retains the preceeding theoretical basis, but avoids measuring and specifically defining expected future returns which may be an impossibility:

$$\Delta N_f = \beta_0 + \beta_1 I_1 + \beta_2 \Delta I_1 + \beta_3(1-m) + \beta_4(1+r_N)^4 + \varepsilon. \quad (28)$$

I_1, as equation 23 shows, may be positively or negatively related to revenue bond issues. High levels of user fees can spawn higher demand for public enterprise projects which create more financing needs, and high levels of user fees mean there is more current income available to government enterprise projects, thus reducing debt needs. The net effect depends upon how much the level of current user fees affects demand for new projects.

I_2 and its relationship with revenue bond issues is also shown in equation 23. When future income is expected to be high <u>relative</u> to current income, officials will feel safe in raising the amount of bond issues; hence a positive relationship is clear. Since a macro-measure of expected future income is typically based on current measures, this variable can present problems because it is the <u>relative</u> relationship between current and future income that is important. The substitution of ΔI_1 into the equation is an effort to overcome this difficulty.

ΔI_1 is expected to be positively related to revenue bond issues. Local officials, often newly-elected, in their quest for local government services and voter satisfaction tend to be optimistic in their estimates of future income. Consequently, they perceive increases in user fees to be a sign of rising public demand for local services --a rising demand which will produce even greater revenues in the future.

r_N is expected to have a negative relationship with revenue bond issues. When borrowing costs rise, less borrowing is feasible. This negative relationship may, however, be contaminated by an interdependency between general obligation bonds and revenue bonds. As bond rates begin to exceed the legal ceiling on general obligation bonds, officials may shift their funds to general obligation projects and borrow to cover their revenue project needs.

The relationship between 1-m and revenue bond issues is indeterminant. When 1-m rises, due to a drop in the matching rate on Federal grants, local public expenditures become relatively more costly than private expenditures; hence private goods or Federal goods are substituted for local goods. If the elasticity of demand of local officials for public enterprise projects is low, total expenditures will rise creating <u>greater</u> debt needs. If the elasticity is high, total expenditure will fall and debt needs may be eased. A rise in 1-m also means fewer current funds are available to purchase whatever level of local expenditures is desired; hence more local debt may be needed to replace the lost Federal payments. The net result of these two opposing results depends upon the officials' elasticity of demand. Clearly, if the elasticity is low, 1-m is inversely related to revenue bond issues. But if the elasticity is high, a reduction in expenditures consequent to a rise in 1-m may outweigh the loss in Federal money and thus reduce debt issues.

The model as it stands does not directly estimate the demand elasticity of local officials. However, if the regression coefficient of 1-m in the above model is negative and significant, it strongly suggests that the elasticity is high. If the coefficient is positive, either the elasticity is low; or the elasticity is high and a loss in Federal money outweighs a reduction in expenditures --the model can not conclusively reveal which of these circumstances occurs. An insignificant coefficient suggests two possibilities. One, the elasticity is neither high nor low --a rise in 1-m lowers desired local purchases by an amount approximately equal to lost Federal money, so no bond issues are called for. Second, Federal grants do not influence revenue bond issues.

Recalling equation 22, it was noted that with the originally postulated utility function, 1-m cancelled out of the analysis completely. This occurred because the utility function had no elasticity components for local goods versus other goods; the parameters showed only the rate of time preference for local goods. However, in this context, the debt needs arising from the effects of grants on desired local expenditures may be exactly offset by the amount of Federal funding available. Consequently, the model will also be tested after dropping 1-m from equation 25.

Although several specifications are posed to estimate revenue bond supply, the foundation of each specification is the same. The amount of present and potential future user fees are important variables. The borrowing rate is important, and the rate on Federal grants might influence debt decisions. Finally, either explicitly or implicitly embedded (depending upon the specification) in a set of coefficients is the officials' rate of time preference, which is expected to boost revenue bond issues above the amount issued if officials were indifferent between present and future state and local government goods and services.

Results

Equation 25, not unexpectedly, was not statistically strong. There are two possible reasons for this lack of strength. First, as mentioned before, finding a good measurement of expected future income earned on public enterprises is quite difficult, maybe even impossible with the data limitations on state and local government aggregate financial time-series statistics. Second, state and local government officials may not behave rationally, or in any consistent pattern from which a general relationship can be demonstrated; there may be no stable utility function for them.

In either event the independent variables proposed in these equations do appear to influence revenue bond supply. The results from equation 25 are shown below:

$$\Delta N_f = \underset{(.26)}{12575} - \underset{(-.385)}{.716395 I_1} + \underset{(2.83)}{.301847 I_2} + \underset{(.28)}{11635.3(1-m)} - \underset{(-.37)}{7558.60(1+r)^4},$$

$$R^2 = .6569,\ F = 4.31,\ DW = 2.26$$

Dropping 1-m, the results are as follows:

$$\Delta N_f = \underset{(1.12)}{24990.8} - \underset{(-4.43)}{.738999 I_1} + \underset{(3.53)}{.284207 I_2} - \underset{(-.45)}{8926.65(1+r)^4},$$

$$R^2 = .6537,\ F = 6.29,\ DW = 2.24$$

All of the _a priori_ relationships are corroborated. $\hat{\beta}_1$ is negative which suggests that when current fees are high, the correspondingly high amounts of local expenditures are covered with these fees, rather than with debt issues. $\hat{\beta}_2$ is positive --local officials borrow when they foresee high future returns. $\hat{\beta}_3$ is positive, but insignificant, which means the elasticity of demand for local services is probably not high. $\hat{\beta}_4$ is negative as expected; its t-statistic, however, is low, but this is no surprise. The interdependency with general obligation bond issues, as previously discussed, has most likely reduced the strength of this relationship. Finally, the R^2 and F statistics do not verify that the model as a whole is highly descriptive.

The respecification set forth in equation 28, however, does lend strong support to the basic foundation of the model. Its estimates are:

$$\begin{aligned}\Delta N_f = {} & \underset{(2.16)}{136593} - \underset{(-2.13)}{.653335 I_1} + \underset{(16.04)}{1.90052 \Delta I_1} \\ & - \underset{(-.94)}{72476.9(1-m)} - \underset{(-1.83)}{54581.0(1+r_N)^4}\end{aligned}$$

$$R^2 = .9732,\ F = 90.93,\ DW = 1.86;$$

and dropping (1-m):

$$\Delta N_f = \underset{(2.81)}{84256.9} - \underset{(-2.86)}{.395571 I_1} + \underset{(16.13)}{1.88611 \Delta I_1} - \underset{(-2.77)}{69536.1(1+r_N)^4}$$

$$R^2 = .9709,\ F = 122.21,\ DW = 1.65;$$

and finally simplifying $(1+r_N)^4$ to observe the direct r_N relationship:

$$\Delta N_f = \underset{(1.12)}{79509.9} - \underset{(-2.15)}{.650734 I_1} + \underset{(16.23)}{1.89812 \Delta I_1}$$
$$- \underset{(-.91)}{69452.5(1-m)} - \underset{(-1.93)}{2311.92 r_N} \qquad (29)$$
$$R^2 = .9740,\ F = 93.48,\ DE = 1.85.$$

The respecified model, which does not use a prior growth rate as an indicator of future user fee income, tests statistically strong. All a priori relationships are as expected, and the R^2 and F statistics suggest a well-fitted model.

Summary

The interesting aspect of the revenue bond model when compared to the general obligation model is the amorphous nature of the budget constraint in the revenue bond model. The budget constraint is an outlook of future income variable with a heavy political bias to overpredict future income levels. The independent variable ΔI_1 estimates the relationship between revenue bond supply and local political bosses' views of future user fee income and present needs. Since there is no specific budget constraint underlying this relationship, there is no guarantee that revenue bonds can be paid off when their time comes. We have then in revenue bond equation 29 an estimate of bond supply with a high potential for fiscal insolvency. In the literature search, this researcher was unable to find any empirical studies specifically relating to revenue bonds and the ability of local governments to redeem them when due. Work is scant possibly because, as already noted in developing the present model, obtaining reliable data presents a severe problem. Nevertheless, more study in this area would be of immense practical value.

Finally, it should be noted that in this model non-guaranteed bonds can be used to finance current expenditures other than capital expenses. Therefore, they are riskier than general obligation bonds. Additionally, if returns from user fees are not as high as expected, officials are tempted to raise taxes to cover repayment of debt and thus maintain the locality's credit rating. This is a dangerous kind of situation which localities should avoid since it may lead to a fiscal crisis and the loss of voter control over local government finance. This kind of situation is also difficult to capture in an economic model since constraints are broken, and the rules of rational economic behavior are not necessarily followed. Nevertheless, this model still offers a good approximation of how <u>total</u> tax-exempt bond supply is determined --the supply of general obligation bonds is determined by the median voter (h^*K^* decision); and the supply of non-guaranteed bonds is determined essentially by the rate of time preference of local officials.

The model with all of its components provides a behavioral analysis of aggregate tax-exempt bond supply. With these estimates established, the following chapter will trace through the effects of changes in the exogenous variables.

CHAPTER V

THE DEMAND-SUPPLY SYSTEM

So far the demand and supply of tax-exempts have been analyzed independently. Equally necessary is an analysis of the workings of the municipal bond market model as a demand-supply system. In short, the equations estimated in the previous chapters must be supplemented by an identity which states that the sources of demand equal the sources of supply. This system of equations can then be solved for the quantity of bonds outstanding and the real rate on tax-exempts given the values of the exogenous variables. With these equilibrium values established, multipliers of the quantity of municipal bonds outstanding and the real rate of return on tax-exempts with respect to the exogenous variables can be determined. A discussion of these multipliers allows the display of the model's operation as a demand-supply representation of the municipal bond market.

The System of Equations

The system contains five equations --two demand-side equations, two supply-side equations, and a demand equal supply identity. Each of the sectoral equations includes the real rate of return on tax-exempts plus several exogenous variables. More formally:

Household demand = NDH(RRNA, exogenous variables 1);

Bank demand = NDB(RRNA, exogenous variables 2);

General obligation supply = NSO (RRNA, exogenous variables 3);

Revenue supply = NSR(RRNA, exogenous variables 4); and,

NDH + NDB = NSO + NSR.

Hence the system is composed of 5 equations and 5 unknown --NDH, NDB, NSO, NSR, and RRNA.

Using the estimated regression equations, the system is explicitly stated in Chart 1 with symbols denoted in Chart 2. Lines 1 - 4 show household demand; lines 5 - 10 show bank demand; line 11 shows other demand; line 12 shows revenue bond supply; and lines 13 - 15 show general obligation bond supply. Since the Cochrane-Orcutt method was used to estimate the demand equations, they contain lagged values and the constant value rho which is .9665051 in the non-bank equation and -.1679364 in the bank equation. The equations have also been somewhat modified in order to locate and isolate RRNA.

Recall from Chapter 3 that the non-bank public demand equation contains the variable TYBIL (observed in equation 22, Table 3-4, Chapter 3). TYBIL is the amount of taxable income for all individuals in marginal tax brackets greater than or equal to tax bracket T, where T is the marginal tax

Chart 1. The Demand-Supply System

```
(-.0097149342 + .9665051 * F4PH5(-1) + .00000309464 * TYBIL(-1) + .009568134 * RRNA/RC + .009568134 * EXPA/RC  (1)
+ .0086578723 * T(-1) + .0513227 * TRSD5 - .000399464 * DRKRD3 + .00269436 * RRNA - .00269436 * RST  (2)
+ .0471366 * F4PH5(-1) - .9665051 * (.0513227 * TRSD5(-1) - .000399464 * DRKRD3(-1) + .00269436 * DRNRS(-1)  (3)
+ .00000341793 * TYBIL(-1) + .0471366 * F4PH5(-2))) * W5X3R  (4)
+ (.0275880 * 1.1679364 + (-1.1679364) * F4BNOF(-1) - .00146863 * WTU - .00438540 * RLU - .00438540 * (CALC1)  (5)
+ .00585403 * RSMU + .00585403 * (CALC2) + .00000000682248 * YBP61 - .00146863 * RRNA  (6)
+ .00645944 * LOP + .00463987 * DDUNLR + .617828 * F4BNOF(-1) - (-.1679364) * (-.00146863 * WTU(-1)  (7)
- .00438540 * RLU(-1) - .00438540 * (CALC1(-1)) + .00585403 * RSMU(-1) + .00585403 * (CALC2(-1))  (8)
+ .00000000682248 * YBP61(-1) - .00146863 * RRNA(-1) + .00645944 * LOP(-1) + .00463987 * DDUNLR(-1)  (9)
+ .617828 * F4BNOF(-2))) * RDEPMR  (10)
+ D3  (11)
= RNSR(-1) + 79509.8 - .650734 * RUSR + 1.89812 * DRUSR - 69452.5 * NM1 - 2311.92 * RRNA  (12)
+ ((.766557) * (RLINC ** .124876) * (OSPOPF ** .0562207) * (RKGNL(-1) ** .896869)  (13)
* (EDUM12 ** - .0184991) * (NM1 ** - .0353040) * ((3.85 + RRNA) ** - .0375442))  (14)
* ((.237376 + .693258 * AEXLI - .0121014 * EXPA - .00977768 * RRNA) * NM1S)  (15)
```

Chart 2. Glossary to Chart 1

F4PH5 = the fraction of non-bank wealth placed in tax-exempts.

TYBIL = taxable income in tax brackets where the marginal tax rate is greater than or equal to that tax rate in which investors are indifferent between tax-exempts and corporate bonds.

RRNA = the real rate of return on tax-exempts.

RC = the rate of return on corporate bonds.

EXPA = the expected inflation rate.

T = the tax bracket where investors are indifferent between corporate bonds and tax-exempts.

TRSD5 = the income to wealth ratio.

DRKRD3 = the difference between rate of return on capital and rate of return on deposits.

RST = the real rate of return on long-term Federal securities (after taxes).

DRNRS = the difference between the rate on tax-exempts and the rate on Federal securities.

W5X3R = the real value of net private wealth.

F4BNOF = the fraction of bank deposits placed in tax-exempts.

WTU = the tax rate for banks times the weighted rate of return on deposits.

RLU = the real after tax rate of return on bank loans.

CALC1 $= \frac{1}{4} \sum_{i=1}^{4} (RRNA + WTU - RLU)_{-i}$

RSMU = the real after tax rate of return on medium-term Federal securities.

CALC2 $= \frac{1}{4} \sum_{i=1}^{4} (RRNA + WTU - RSMU)$

YBP61 = the real bank income.

Chart 2 (cont'd.)

LOP = the leasing operation dummy.

DDUNLR = the second difference of the unemployment rate.

RDEPMR = the real value of bank deposits less required reserves less free reserves.

D3 = other bank demand.

DRUSR = the change in the real value of state and local user fees.

M1 = 1 - the matching rate on Federal grants.

M1S = the average of M1 over lifetime of capital; weighted by the capital stock contribution of that year.

RUSR = the real value of state and local user fees.

RNSR = the real value of revenue bonds outstanding.

RLINC = real state and local income.

EDUM12 = the exponential value of the density dummy variable.

OSPOPF = the age-distribution population factor.

AEXLI = the ratio of state and local government spending to local income.

rate at which an investor is indifferent between tax-exempts and corporate bonds. T is determined in the following way. When the nominal rate of return on tax-exempts --RNA-- is equal to the after tax rates of return on corporate bonds --(1-T)RC--, or RNA = (1-T)RC, then the investor is indifferent between tax-exempts and corporate bonds. Thus the tax rate which makes the investor indifferent between the two assets is where T = 1 - (RNA/RC).

When T rises, TYBIL falls and fewer investors benefit by having their wealth in tax-exempts, i.e. there is less taxable income seeking municipal bonds as a tax shelter. T changes when 1 - (RNA/RC) changes; RNA thus affects tax-exempt demand through the TYBIL channel. In order to capture this influence, T = 1 - RNA/RC is regressed on TYBIL. Using ordinary least squares, the Durbin-Watson statistic strongly indicated the presence of serial-correlation. The relationship between T and TYBIL was then reestimated using the Cochrane-Orcutt procedure. The statistical results show a constant of 1041.91, a regression coefficient on T of -2797.7, a rho value of .9054133, and an R^2 of .8879.

1 - (RNA/RC) is then substituted into the T in the estimated TYBIL function. This estimated TYBIL function is then substituted into TYBIL in the original non-bank demand equation. With these substitutions, non-bank demand has RNA/RC as one of its arguments, where RNA = RRNA plus the expected inflation rate. With these adjustments, the effect of RRNA on non-bank demand caused by a change in RRNA

relative to the corporate bond rate is considered when solving the whole system for equilibrium RRNA. Lines 1 - 4 of Chart 1 show the non-bank demand equation consequent to these substitutions and reduction of variables.

Bank demand as mentioned is also specified using the Cochrane-Orcutt procedure. The equation shown in Chart 1 is a slightly altered reexpression of equation 19 from Table 3-2 in Chapter 3. In Chart 1 the variables X25 and X35M of equation 19 are broken into their component parts. X25 is set equal to (RRNA + WTU - RLU) - CALCI, and X35M is set equal to (RRNA + WTU - RSMU) - CALCII. These substitutions with simplification result in lines 5 - 10.

The supply equations are exactly as they appear in previous chapters.

Upon simplification, an equilibrium solution for RRNA can be determined. The supply equation can be simplified to:

(C1 * RRNA + C2) * (3.85 + RRNA) ** -.0375442
- 2311.92 * RRNA + PS

Demand can be simplified to:

DN = PTDA + (-.00146863 * RDEPMR + .009568134
* W5X3R/RC + .00269436 * W5X3R) * RRNA.

With supply equal to demand, the following implicit function results:

F = (C1 * RRNA + C2) * (3.85 + RRNA) ** - .0375442
+ C3 * RRNA + C4; where (1)

C1 = - .00977768 * NM1S * PQ1;

C2 = PQ1 * PQ2;

C3 = - 2311.92 - .099568134 * W5X3R/RC - .00269436
* W5X3R + .00146863 * RDEPMR;

C4 = PS - PDTA;

PQ1 = (lines 13 and 14) * (3.85 + RRNA) ** .0375442;

PQ2 = (line 15) + .00977768 * RRNA * NM1S;

PS = (line 12) + 2311.92 * RRNA;

PTDA = (lines 1 - 11) - (.00146863 * RDEPMR
+ .009568134 * W5X3R/RC + .00269436 * W5X3R)
* RRNA.

Since equation 1 cannot be solved for RRNA by hand, a numerical approximation is necessary. An easy scheme for finding roots is the Newton-Raphson method (Flanders, 1970, pp. 207-215). To compute equilibrium RRNA, the equation of the tangent line from some initial guess of RRNA --$RRNA_0$-- must be written. The initial guess used here is $RRNA_0$ = - (C4 + C2)/(C1 + C3) --the solution for RRNA that would result if the exponent of RRNA, -.0375442, is set at zero. The equation of the tangent line is: $F'(RRNA_0) = F(RRNA) - F(RRNA_0)/RRNA - RRNA_0$. The root of the tangent line is ($RRNA_1$, 0), where

$$RRNA1 = RRNA_0 - (F(RRNA_0)/F'(RRNA_0)).$$

Using RRNA1 as an initial guess, the procedure is then repeated. Once $RRNA_{i+1}$ - $RRNA_i$ is less than .000001, the process stops and $RRNA_{i+1}$ is used as the equilibrium value of RRNA.

Given values for the exogenous variables in any selected year, the equilibrium rate of return (RRNAE) for that year can be determined. The results for the years 1964 to 1976 are shown in Table 5-1.

With the equilibrium RRNA solved the equilibrium levels of NDH, NDB, NSO, and NSR can be found simply by putting the equilibrium RRNA into the appropriate equation. At the same time, for any given year the equilibrium quantity of total municipal bonds outstanding can be determined. The equilibrium quantities for the years 1964 to 1976 are also shown in Table 5-1. The predicted or equilibrium rates of return are always less than a percent away from the actual rate and are sometimes less than a tenth of a percent. When considering that RRNA depends on inflationary expectations which vary widely between individuals and create considerable uncertainty concerning what the real rate should be, the closeness of the predicted values to the actual values lends strong support to the validity of the model.

The Multipliers

To find the changes in the equilibrium value of RRNA (denoted RRNAE) with respect to a unit change in an

Table 5-1. Equilibrium Supply and Rate of Return

	Equilibrium RRNA (%)	Actual RRNA (%)	Equilibrium NS (millions)	Actual NS (millions)
1964	.70	1.38	123,566	120,378
1965	.93	1.52	129,140	126,753
1966	.89	1.65	134,233	131,578
1967	.95	1.24	139,237	134,966
1968	1.05	1.48	141,855	136,528
1969	1.16	2.04	143,391	142,373
1970	1.29	1.96	148,300	143,843
1971	.49	.86	153,437	149,569
1972	.25	.34	158,901	159,098
1973	-.01	-.04	163,054	163,143
1974	-.31	-.19	161,108	163,723
1975	-.47	-.54	160,092	158,388
1976	-.01	.19	166,856	165,304
1977	-.94	-1.29	169,742	172,762

exogenous variable requires the application of the implicit-function rule to equation 1. More specifically: $\partial RRNAE / \partial \text{exogenous variable} = - \partial F / \partial \text{exogenous variable} / \partial F / \partial RRNAE$. The mathematical solutions to these multipliers are shown in Chart 3, where the $\partial F / \partial RRNAE$ is denoted by DERIV. The corresponding solutions for the years 1964 to 1976 are shown in Table 5-2.

A change in the equilibrium quantity of tax-exempt bonds with respect to a unit change in an exogenous variable can also be easily determined with the use of previously formulated aprtial derivatives. The multiplier can be calculated with the use of the equilibrium demand function (ND*) or the equilibrium supply function (NS*) since they are equal in equilibrium. For instance, if an exogenous variable (denoted ev) appears only on the demand side, so that ND* = ND(RRNAE(ev), ev) and NS* = NS(RRNAE(ev)), then $\partial ND^* / \partial ev = \partial DN / \partial RRNAE * \partial RRNAE / \partial ev + \partial ND / \partial ev$, and $\partial NS^* / \partial ev = \partial NS / \partial RRNAE * \partial RRNAE / \partial ev$.

Applying the above methodology, the quantity multipliers are shown in Chart 4. In Table 5-3 the arithmetically computed values of the quantity multipliers are shown again for the years 1964-1976.

Examination of the Multipliers

A brief examination of the multipliers shown in Tables 5-2 and 5-3 demonstrates how the model can be used to

Chart 3. Rate of Return Multipliers

```
DRDEX = (.009568134 * W5X3R/RC + .0121014 * NM1S * PQ1 * (3.85 + RRNAE) ** - .0375442)
        /DERIV

DRDRC = (-.009568134 * EXPA * W5X3R - .009568134 * W5X3R * RRNAE)/((RC ** 2)*DERIV)

DRDTRD = (.0513227 * W5X3R)/DERIV

DRDRST = (-.00269436 * W5X3R)/DERIV

DRDW = ((.009568134 * RRNAE/RC) * .00269436 * RRNAE + (PD1H/W5X3R))/DERIV

DRDRL = (-.00438540 * RDEPMR)/DERIV

DRDRSM = (.00585403 * RDEPMR)/DERIV

DRDYB = (.00000682248 * RDEPMR)/DERIV

DRDDD = (.00463987 * RDEPMR)/DERIV

DRDDB = ((-.00146863 * RRNAE) + (PD2B/RDEPMR))/DERIV

DRDD3 = 1/DERIV

DRDUS = .650734/DERIV

DRDM1 = (.0353040 * .00977768 * (NM1S - .1 * NM1) * (PQ1 * NM1 ** .0353040) * RRNAE * (3.85
        + RRNAE) ** -.0375442 * NM1 ** -1.0353040 - .964696 * .00977768
        * (PQ1 * NM1 ** .0353040) * RRNAE * (3.85 + RRNAE) ** -.0375442 * .1
```

Chart 3 (cont'd.)

```
        * NM1 ** -.0353040 - .0353040 * (PQ1 * NM1 ** .0353040) * (3.85 + RRNAE) ** - .0375442
        * (PQ2/NM1S) * (NM1S - .1 * NM1) * NM1 ** -1.0353040 + .964696 * (PQ1 * NM1 ** .0353040)
        * (3.85 + RRNAE) ** - .0375442 * (PQ2/NM1S) * .1 * NM1 ** - .0353040 - 69452.5)
        /(-DERIV)
DRDLI = (.124876 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
        *PQ1 * RLINC ** - .124876 * RLINC ** - .875124 + .124876 * PQ1
        * RLINC ** - .124876 * (3.85 + RRNAE) ** - .0375442 * PQ2
        * RLINC ** - .875124)/(-DERIV)
DRDOS = (.0562207 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
        * PQ1 * OSPOPF ** - .0562207 * OSPOPF ** - .9437793 + .0562207 * PQ1
        * OSPOPF ** - .0562207 * (3.85 + RRNAE) ** - .0375442 * PQ2
        *OSPOPF ** - .9437793)/(-DERIV)
DRDDUM = (-.0184991 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
         * PQ1 * EDUM12 ** .0184991 * EDUM12 ** - 1.184991 - .0184991 * PQ1
         * EDUM12 ** .0184991 * (3.85 + RRNAE) ** - .0375442 * PQ2
         * EDUM12 ** -1.0184991)/(-DERIV)
```

Chart 3 (cont'd.)

```
DRDXI = (PQ1 * (3.85 + RRNAE) ** - .0375442 * NM1S * .693258)/(-DERIV)

DRDDUS = -1.89812/DERIV
```

Table 5-2. Rate of Return Multipliers Computed for the Years 1964-1977

Year	DRDEX	DRDRC	DRDTRD	DRDRST	DRDW	DRDRL
1964	-0.527439	0.119374	-5.15034	0.270384	-.423094E-05	0.126280
1965	-0.531632	0.128537	-5.37290	0.282069	-.394167E-05	0.129302
1966	-0.534118	0.142112	-5.47946	0.287663	-.361918E-05	0.129485
1967	-0.533407	0.134585	-5.45406	0.286330	-.432395E-05	0.138904
1968	-0.532704	0.128811	-5.59899	0.293938	-.390246E-05	0.142062
1969	-0.525199	0.136874	-6.00489	0.315247	-.331799E-05	0.140188
1970	-0.530689	0.119480	-5.80007	0.304494	-.366563E-05	0.142399
1971	-0.539657	.682719E-01	-5.17650	0.271758	-.516848E-05	0.157250
1972	-0.538903	.783465E-01	-5.37553	0.282207	-.422131E-05	0.160495
1973	-0.546378	.878954E-01	-5.30968	0.278750	-.404654E-05	0.159010
1974	-0.560821	.833633E-01	-4.87395	0.255875	-.477603E-05	0.170105
1975	-0.587558	.675030E-01	-4.07458	0.213909	-.664320E-05	0.191281
1976	-0.592626	.548329E-01	-4.17577	0.219221	-.687549E-05	0.188988
1977	-0.577415	.596834E-01	-4.11890	0.216236	-.581320E-05	0.165802

Table 5-2 (cont'd.)

Year	DRDRSM	DRDYB	DRDDD	DRDDE	DRDD3	DRDUS
1964	-0.168570	-.196457E-03	-0.133607	-.149712E-04	-.104111E-03	-.677483E-04
1965	-0.172604	-.201158E-03	-0.136805	-.146461E-04	-.992732E-04	-.646004E-04
1966	-0.172849	-.201443E-03	-0.136999	-.152699E-04	-.961300E-04	-.625551E-04
1967	-0.185422	-.216096E-03	-0.146964	-.165016E-04	-.992389E-04	-.645781E-04
1968	-0.189637	-.221009E-03	-0.150305	-.169221E-04	-.979228E-04	-.637217E-04
1969	-0.187135	-.218094E-03	-0.148322	-.161228E-04	-.929735E-04	-.605010E-04
1970	-0.190087	-.221534E-03	-0.150662	-.192446E-04	-.974945E-04	-.634430E-04
1971	-0.209912	-.244639E-03	-0.166375	-.212897E-04	-.104267E-03	-.678502E-04
1972	-0.214243	-.249686E-03	-0.169808	-.201404E-04	-.985387E-04	-.641225E-04
1973	-0.212261	-.247376E-03	-0.168237	-.200469E-04	-.949842E-04	-.618094E-04
1974	-0.227072	-.264637E-03	-0.179976	-.200105E-04	-.989459E-04	-.643875E-04
1975	-0.255339	-.297580E-03	-0.202380	-.217479E-04	-.107999E-03	-.702789E-04
1976	-0.252279	-.294014E-03	-0.199955	-.207193E-04	-.107106E-03	-.696974E-04
1977	-0.221327	-.257942E-03	-0.175423	-.192887E-04	-.989655E-04	-.644002E-04

Table 5-2 (cont'd.)

Year	DRDDUS	DRDM1	DRDLI	DRDOS	DRDDUM	DRDXI
1964	.197614E-03	-6.66781	.152225E-05	0.384087	-.532306E-01	18.0461
1965	.188432E-03	-6.33733	.141104E-05	0.376249	-.523392E-01	17.8993
1966	.182466E-03	-6.11965	.133112E-05	0.370818	-.518934E-01	18.1203
1967	.188367E-03	-6.29822	.135870E-05	0.392100	-.549720E-01	19.5253
1968	.185869E-03	-6.20040	.131281E-05	0.395293	-.553739E-01	20.1176
1969	.176475E-03	-5.87297	.120349E-05	0.383418	-.534894E-01	19.9876
1970	.185056E-03	-6.15221	.125275E-05	0.410947	-.566845E-01	21.8811
1971	.197912E-03	-6.52598	.138808E-05	0.481983	-.649936E-01	24.5462
1972	.187038E-03	-6.14951	.129021E-05	0.477347	-.232125E-01	23.8194
1973	.180291E-03	05.91654	.120029E-05	0.479714	-.227134E-01	23.8974
1974	.187811E-03	-6.16498	.121950E-05	0.497116	-.229195E-01	25.6696
1975	.204996E-03	-6.73807	.131409E-05	0.543283	-.244664E-01	28.7425
1976	.203300E-03	-6.63070	.133003E-05	0.587411	-.260883E-01	29.2307
1977	.187848E-03	-6.10588	.120908E-05	0.570921	-.243610E-01	28.0339

Chart 4. Quantity Multipliers

```
DNSDR = - 2311.92 - .00977768 * NM1S * PQ1 * (3.85 + RRNAE) ** - .0375442

        + (-.00977768 * NM1S * PQ1 * RRNAE + PQ1 * PQ2) * (-.0375442 * (3.85 + RRNAE) ** - 1.0375442)

DNDDR = - .00146863 * RDEPMR + .009568134 * W5X3R/RC + .00269436 * W5X3R

DNEDEX = .009568134 * W5X3R/RC + DNDDR * DRDEX

DNEDRC = ((-.009568134 * EXPA * W5X3R - .009568134 * W5X3R * RRNAE)/(RC ** 2))

         + DNDDR * DRDRC

DNEDTRD = (.0513227 * W5X3R) + DNDDR * DRDTRD

DNEDRT = DNSDR * DRDRST

DNEDW = (.009568134 * RRNAE/RC) + .00269436 * RRNAE + (PD1H/W5X3R) + DNDDR * DRDW

DNEDRL = (-.00438540 * RDEPMR) + DNDDR * DRDRL

DNEDRSM = (.00585403 * RDEPMR) + DNDDR * DRDRSM

DNEDYB = (.00000682248 * RDEPMR) + DNDDR * DRDYB

DNEDDD = (.00463987 * RDEPMR) + DNDDR * DRDDD

DNEDDE = ((-.00146863 * RRNAE) + (PD2B/RDEPMR)) + DNDDR * DRDDE

DNEDD3 = 1 + DNDDR * DRDD3

DNDRU = - .650734 + DNSDR * DRDUS
```

Chart 4 (cont'd.)

```
DNDDU = 1.89812 + DNSDR * DRDDUS

DNDM1 = (.0353040 * .00977768 * (NM1S - .1 * NM1) * (PQ1 * NM1 ** .0353040) * RRNAE * (3.85
        + RRNAE) ** - .0375442 * NM1 ** - 1.0353040 - .964696 * .00977768
        * (PQ1 * NM1 ** .0353040) * RRNAE * (3.85 + RRNAE) ** - .0375442 * .1
        * NM1 ** - .0353040 - .0353040 * (PQ1 * NM1 ** .0353040) * (3.85 + RRNAE) ** - .0375442
        * (PQ2/NM1S) * (NM1S - .1 * NM1) * NM1 ** - 1.0353040 + .964696 * (PQ1 * NM1 ** .0353040)
        * (3.85 + RRNAE) ** - .0375442 * (PQ2/NM1S) * .1 * NM1 ** - .0353040 - 69452.5)
        + DNSDR * DRUM1

DNDLI = (.124876 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
        * PQ1 * RLINC ** - .124876 * RLINC ** - .875124 + .124876 * PQ1
        * RLINC ** - .124876 * (3.85 + RRNAE) ** - .0375442 * PQ2
        * RLINC ** - .875124) + DNSDR * DRDLI

DNDOS = (.0562207 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
        * PQ1 * OSPOPF ** - .0562207 * OSPOPF ** - .9437793 + .0562207 * PQ1
        * OSPOPF ** - .0562207 * (3.85 + RRNAE) ** - .0375442 * PQ2
        * OSPOPF ** - .9437793) + DNSDR * DRDOS
```

Chart 4 (cont'd.)

```
DNDUM = (-.0184991 * (-.00977768) * NM1S * RRNAE * (3.85 + RRNAE) ** - .0375442
        * PQ1 * EDUM12 ** .0184991 * EDUM12 ** - 1.184991 - .0184991 * PQ1
        * EDUM12 ** .0184991 * (3.85 + RRNAE) ** - .0375442 * PQ2
        * EDUM12 ** - 1.0184991) + DNSDR * DRDDUM
DNDXI = (PQ1 * (3.85 + RRNAE) ** - .0375442 * NM1S * .693258) + DNSDR * DRDXI
```

Table 5-3. Quantity Multipliers Computed for the Years 1964-1977

Year	DNSDR	DNDDR	DNEDEX	DNEDRC	DNEDTR	DNEDRT
1964	-5374.40	4231.31	-191.336	-641.501	27677.2	-1453.16
1965	-5460.56	4613.04	-244.548	-701.835	29337.0	-1540.25
1966	-5595.91	4807.16	-301.777	-795.178	30659.9	-1609.74
1967	-5720.37	4357.05	-383.543	-769.778	31195.3	-1637.91
1968	-5842.58	4369.74	-473.927	-752.561	32711.4	-1717.36
1969	-5973.49	4781.98	-615.271	-817.655	35871.8	-1883.12
1970	-6096.79	4159.64	-681.892	-728.510	35365.0	-1856.44
1971	-6422.42	3167.62	-643.107	-438.519	33249.3	-1745.34
1972	-6580.62	3567.88	-673.325	-515.553	35373.2	-1857.09
1973	-6794.35	3734.59	-679.974	-597.116	36071.2	-1893.92
1974	-6958.50	3149.64	-627.014	-579.949	33907.5	-1780.50
1975	-7076.14	2182.27	-487.452	-477.721	28835.9	-1513.65
1976	-7112.41	2225.01	-549.448	-389.947	29696.2	-1559.19
1977	-7589.38	2513.71	-561.643	-453.046	31265.8	-1641.09

Table 5-3 (cont'd.)

Year	DNEDW	DNEDRL	DNEDRS	DNEDYB	DNEDDD	DNEDDE	DNDUM
1964	.227365E-01	-678.611	905.871	1.05573	717.988	.804530E-01	-225.206
1965	.215222E-01	-706.011	972.447	1.09836	746.978	.799701E-01	-241.423
1966	.202509E-01	-724.524	967.161	1.12716	766.566	.854416E-01	-249.435
1967	.247314E-01	-794.481	1060.55	1.23600	840.583	.943832E-01	-239.476
1968	.227997E-01	-829.979	1107.93	1.29122	878.140	.988655E-01	-241.959
1969	.198209E-01	-837.448	1117.90	1.30284	886.043	.963141E-01	-255.800
1970	.223506E-01	-868.258	1159.03	1.35077	918.640	0.117341	-235.819
1971	.331978E-01	-1010.04	1348.29	1.57134	1068.65	0.136746	-205.921
1972	.277780E-01	-1056.12	1409.81	1.64304	1117.41	0.132532	-82.8149
1973	.274901E-01	-1080.23	1441.99	1.68054	1142.91	0.136188	-84.8056
1974	.332263E-01	-1183.40	1579.71	1.84105	1252.07	0.139211	-72.1515
1975	.470142E-01	-1353.70	1807.04	2.10599	1432.25	0.153910	-53.4142
1976	.488955E-01	-1344.00	1794.09	2.09090	1421.99	0.147347	-58.0242
1977	.441269E-01	-1258.57	1680.06	1.95799	1331.60	0.146417	-61.2714

Table 5-3 (cont'd.)

Year	DNEDD3	DNDRU	DNDDU	DNDM1	DNDLI	DNDOS	DNDXI
1964	0.559476	-0.286628	0.836061	-28210.0	.644028E-02	1624.99	76348.9
1965	0.542049	-0.297980	0.869174	-29231.9	.650864E-02	1735.51	82563.4
1966	0.537888	-0.300682	0.877056	-29415.2	.639828E-02	1782.40	87098.5
1967	0.567611	-0.281323	0.820589	-27437.1	.591893E-02	1708.11	85058.5
1968	0.572103	-0.278435	0.812164	-27093.0	.573639E-02	1727.25	87904.9
1969	0.555402	-0.289332	0.843950	-28086.1	.575542E-02	1833.61	95586.1
1970	0.594458	-0.263935	0.769871	-25594.4	.521171E-02	1709.62	91029.8
1971	0.669721	-0.214971	0.627048	-20676.4	.439790E-02	1527.08	77770.3
1972	0.648426	-0.228768	0.667292	-21939.5	.460304E-02	1703.02	84979.9
1973	0.645273	-0.230779	0.673158	-22090.8	.448154E-02	1791.12	89226.4
1974	0.688356	-0.202694	0.591236	-19407.6	.383902E-02	1564.94	80809.0
1975	0.764316	-0.153431	0.447540	-14710.3	.286887E-02	1186.08	62749.6
1976	0.761689	-0.155017	0.452169	-14747.6	.295818E-02	1306.49	65013.3
1977	0.751229	-0.161976	0.472467	-15357.2	.304102E-02	1435.95	70509.3

SYMBOL GLOSSARY TO MULTIPLIERS

Rate of Return Multipliers

DRDEX: expected inflation rate

DRDRC: rate of return on corporate bonds

DRDTRD: income to wealth ratio

DRDRST: after-tax rate of return on short-term Federal securities

DRDW: wealth

DRDRL: after-tax rate of return on bank loans

DRDRSM: after-tax rate of return on medium-term Federal securities

DRDYB: bank income

DRDDD: second difference of the unemployment rate

DRDDE: bank deposits

DRDD3: other demand

DRDUS: user fees

DRDDUS: change in user fees

DRDM1: one minus the matching rate on Federal grants

DRDLI: state and local income

DRDOS: age-distribution population factor

DRDDUM: density dummy

DRDXI: local spending to local income ratio

Equilibrium Supply Multipliers

DNEDEX: expected inflation rate

DNEDRC: rate of return on corporate bonds

DNEDTRP: income to wealth ratio

DNEDRT: after-tax rate of return on short-term Federal securities

DNEDW: wealth

DNEDRL: after-tax rate of return on bank loans

DNEDRSM: after-tax rate of return on medium-term Federal securities

DNEDYB: bank income

DNEDDD: second difference of the unemployment rate

DNEDDE: bank deposits

DNEDD3: other demand

DNDRU: user fees

DNDDU: change in user fees

DNDM1: one minus the matching rate on Federal grants

DNDLI: state and local income

DNDOS: age-distribution population factor

DNDUM: density dummy

DNDXI: local spending to local income ratio

Supply and Demand Multipliers

DNSDR: change in supply with respect to a change in the rate of return on tax-exempts

DNDDR: change in demand with respect to a change in the rate of return on tax-exempts observe occurrences in the municipal bond market in reaction to changes in its environment.

The external forces which most influence the demand side of the tax-exempt market probably come from the markets of substitute assets. The non-bank private sector, recall, perceives corporate bonds and long-term government securities as such substitutes. When the rates on these assets change, there are appropriate reactions which occur in the tax-exempt market. The tables show that a 1% increase in RC will bring an increase in RRNAE between .06% and .14% and a decrease in equilibrium supply (NS*) between $400 and $800 million. Similarly, an increase in RST of 1% causes an increase in RRNAE between .21 and .31% and about a $1700 million decrease in NS*. In the banking sector, a similar result occurs when the rate on bank loans (RLU) rises --a 1% increase causes an increase in RRNAE between .12% and .18% and about a $1000 million decrease in NS*.

A dissimilar result occurs in the bank sector when the rate on medium length treasury securities (RMS) rises. Thinking back to the banking model and the variable X35M, we found that a rise in RSM may indicate to loan officers that they should move into tax-exempts since commercial loan demand may soon be drying up. Hence we find a 1% rise in RSM causes a drop in RRNA of about .20% and typically a $1200 million increase in NS*. The interaction between sectors is clearly in evidence here. The rates on long and mid-term Treasury securities generally move in tandem. Thus as the Treasury security rates change, demand picks up in one sector and demand diminishes in the other sector.

RC and RLU tend to move in tandem also. Hence two leftward shifts in demand will occur if both of these variables rise. The magnitude of these shifts is given by the multipliers. The shift caused by the RLU increase represents a loss of bank demand only. The movement back along the demand curve to equilibrium will come primarily from household demand as RRNA rises relative to the original RC increase. Thus some of the household demand lost through the rise in RC is reclaimed because of forces occurring in the banking sector.

Of course, these effects are only short run, as this is a partial equilibrium model. A change in RRNA will also be felt in the other asset markets, causing further changes in other asset rates and again influencing the municipal bond market. The final settling point depends on the structure of all the asset markets. Specifically determining such a structure, although the general structure is discussed in the demand chapter of this thesis, is beyond the scope of this study.

Two other demand-side variables are also interesting to look at. A .01 rise in TRSD5 (the ratio of income to wealth) lowers RRNAE about .05% and raises NS* by $30 to $36 million. An increase in bank income of $1 million lowers RRNA about .00024%, but note the effect on NS*. Its increase rises monotonically through the years from 1.06 million to 2.11 million. This trend is probably partly a reflection of increasingly aggressive investment policy by banks in recent years. The trend shows a reversal in 1975, suggesting a return to less aggressive policy.

Finally, on the demand side, the wealth constraint and the bank deposit constraint multipliers support the earlier hypothesis that over time a larger and larger fraction of wealth will be placed in tax-exempts as more and more investors are pushed into higher tax brackets. $\partial ND^*/\partial W5X3R$ rises from .023 in 1964 to .049 in 1975. This fraction is its highest in those years with the greatest inflation rate.

On the supply-side several multipliers also show interesting results. An increase in user fees of $1 million is seen to generally decrease revenue bond supply by about $.2 million; i.e. more current income reduces debt needs. A $1 million increase in the change in user fees (DRUSR) evokes a large increase in NS* --about $.85 million in the early years and about $.50 million in the later years. This result strongly suggests that officials are quick to borrow and spend in the present if they see indications of future income rising. This outcome is of course consistent with the original hypothesis that officials tend to favor current over future state and local good consumption.

A drop in the matching rate on Federal grants of .01 raises M1 by .01, decreases RRNA about .06%, and generally lowers NS* by about $200 million. The trend in recent years has been for the matching rate to rise --i.e. fiscal federalism policies. The multipliers indicate that the overall effect of these policies is to raise state and local debt. The lower price of state and local goods induces additional expenditures requiring debt needs in excess of the additional funds supplied by Federal grants.

The dummy variable (EDUM 12) indicating diminishing municipal density and the purchase of capital services via leasing, as expected has had a strong impact on the tax-exempt market. The reduction in density from the 1960's to the 1970's has lowered RRNAE by at least .06% and NS* by about $150 million.

The other demographic variable, OSPOPF, also affects the market, but not as importantly. A .01 increase in OSPOPF raises NS* by about $17 or $18 million.

Changes in state and local income to some degree reflect demographics also. More income is often the result of more people. Subsuming this population effect on income, the multipliers indicate that a .01 increase in state and local income raises RRNAE by about .001 and NS* by about $3 million.

The expenditure to permanent income ratio (AEXLI) has a strong influence on H (the fraction of non-Federally funded capital financed with debt). An increase of .001 in this ratio raises RRNAE generally between .018 and .029%, and NS* about $70 to $90 million.

The only exogenous variable which appears in both supply and demand is the expected rate of inflation --EXPA. Chart 1 indicates a rightward shift in demand and leftward shift in supply consequent to a rise in EXPA. Both of these events tend to reduce RRNAE. In fact, the multiplier suggests that a decrease of about .50% generally results from a 1% increase in EXPA.

Although supply and demand shift in opposite directions, it is observed that in the time span shown, the shift in supply always exceeds the shift in demand. Throughout the period, a rise in EXPA has caused a fall in NS*. This result is consistent with the discussion of inflation within the section "Institutional Constraints" in Chapter 4.

This brief examination of the supply-demand determined multipliers thus demonstrates how all of the equations fit together as a neoclassical model of the municipal bond market.

In conclusion, the above review of the model's implications shows that a behavioral approach to the analysis of tax-exempt bonds allows for more inferences and economic insights than the simpler *ad hoc* or empirically convenient approaches employed previously.

CHAPTER VI

CONCLUSION

In the final chapter, conclusions drawn from each section will be summarized, and extensions of the model beyond previous works will be reviewed. The model will then be utilized to help weigh the political and economic ramifications resulting from legal changes or policy changes associated with state and local government debt. This discussion is followed by a general appraisal of the complete model.

It was found that the proposed bank-demand model, based on bank officers' expectations of future economic conditions and rates of return, tested statistically strong. Of further importance, the model offers more economic content than prior models. It is a dynamic behavioral model involving variables easy to measure and easy for the economic actors (the bank officers) to respond to. It is also easy to modify to institutional changes in its environment while retaining its essential theoretical composition.

One such major institutional change occurred with the 1970 amendments to the Bank Holding Company Act which made it easier for banking organizations to enter the equipment leasing business by making leasing a permissible activity of nonbanking affiliates of bank holding companies. Since

1970, the leasing activities of large banks has risen dramatically. (Comptroller of the Currency, Annual Reports). This change in the banking environment can be accounted for by inserting the rate of return on leasing operations relative to other substitutes in the bank demand equation. As discussed earlier, a dummy variable was not an appropriate modification to allow for leasing operations. The above modification, however, is superior, as it provides a variable which the economic actors can respond to. This alteration has not been made in the current model, but an updated model should incorproate these changes.

The institutional environment has also been altered in recent years by the tax treatment of thrift institutions (saving and loan associations and mutual savings banks), in particular the 1962 Revenue Act and the Tax Reform Act of 1969 which revoked a large percentage of one of the thrifts major tax shelters. These tax changes in conjunction with other market conditions, such as the leasing activities of bank holding companies, have made the rate of return on tax-exempts competitive with the rates on other assets held by thrifts. Thrifts of course behave very similarly to banks and a model incorporating thrifts could be a necessary emendation in the future.

Similarly, institutional changes may occur elsewhere which bring the need to more closely model other groups, such as insurance companies. These modifications can be made simply and with only a minor restyling of the original rate of return --profit approach model. In short, this model presents a general organizational approach to analyze financial intermediaries which requires only minor modifications to environmental conditions.

The non-bank demand empirical specification permitted measurement of the effects of inflation on the fraction of net assets held in tax-exempts. It was shown that with the recent inflationary experience, the progressive tax structure has induced a systematic rise in the fraction of wealth held in tax-exempts. This empirical conclusion verifies the theoretical contention put forth in the theoretical model that the progressive tax structure lowers the after tax rates of return on assets and brings about substitution into tax-exempt assets.

Presently, there is a movement to place a price index on the income tax. If successful, inflation would no longer raise tax-exempt demand. The nominal income variable in the empirical specification would have to be replaced by real income. In this event it is expected, analogously to inflationary effects, that the progressive tax system with real income growth would systematically raise tax-exempt demand.

Either with or without indexation a systematic rise in tax-exempt demand accompanies the progressive tax system, as more individuals move into higher tax rate classifications.

This trend strengthens a political block which opposes elimination of the tax-exemption. As more middle income individuals enter the tax-exempt market, they will favor any tax advantage they can get, with very little interest in the inefficient and inequitable aspects of the exemption which some smart-ass economist might point to.

In the 1980's other revisions in the Federal tax structure have been advocated. Some of these proposals, if enacted, would have a dramatic impact on the tax-exempt bond market. One such proposal is the replacement of the progressive tax system with a proportional income tax rate.

Adoption of a proportional income tax rate would require a relatively minor reformulation of the model developed here. Specifically, in the non-bank private demand sector the tax rate applied to taxable bonds would become the proportional tax rate rather than the tax rate of the "marginal investor."

In the empirical specification, the variable TYBIL would no longer be relevant. There would no longer be a group of investors with a special need for sheltering; all tax-payers would have equal sheltering needs. If the rate of return on tax-exempts is greater than one minus the proportional tax rate times the rate of return on equal quality taxable bonds, then <u>all</u> investors would find it in their interest to shift their assets into tax-exempts. Conversely, if the rate on tax-exempts is less than one minus the proportional tax rate times the rate on taxable bonds, then all investors would gain by moving their assets into taxable bonds. With the progressive system, only marginal groups of investors find it beneficial to shift between taxables and tax-exempts. Given a proportional tax rate, a more appropriate specification for non-bank private demand would replace TYBIL with the ratio of the rate of return on tax-exempts to the rate of return on equal quality corporate bonds.

The key implication of this revision is that the effect of the progressive tax system on the fraction of wealth held in tax-exempts as wealth rises is eliminated. As the level of wealth rises over time, there will no longer be a systematic increase in the fraction of this wealth held in tax-exempts. As far as municipalities are concerned this loss of potential future demand would, other things being equal, increase future borrowing costs.

Another alternative to the progressive tax system has also been advanced recently. This is the consumption tax. The adoption of a consumption tax in place of an income tax would render the tax-exemption on municipal bonds meaningless. All bonds would be tax-exempt. Municipalities would have to borrow at the same higher rates as corporations, the Federal government, or any other borrower.

The effects of such a change on this model are significant, but not severely ruinous. On the supply side of the model, the only effect is a higher price of capital services. On the demand side, most of the demand-determining variables are still relevant. The main revision would be to delete the tax rates from the rates of return on assets. The minor revision would be to change the title from a "tax-exempt bond model" to a "municipal bond model."

In keeping with the demand model, the supply model was developed in the neoclassical tradition, where the welfare of the individual is revered. The general obligation model places the welfare of the median voter at its foundation. The median voter voluntarily pays for a flow of state and local capital services which maximizes his/her welfare. Paying for these services may involve debt, but interest and amortization of the debt are covered each period so that on a current account no deficit is run. Businesses operate this way and many government units by legal decree must operate this way. This may appear to be deficit spending when observing a balance sheet statement of total expenditures and revenues, where expenditures less revenues equals the deficit. But the model of this study reveals the error in this logic and sterility of prior models which used the balance-sheet method to determine tax-exempt bond supply.

Recall Ott and Ott (1975) acknowledged the need to place capital costs on a current account, but deferred doing so because the price of capital services which the median voter is willing to pay might not be equal to debt retirement plus interest. They consequently opted to use the *ad hoc* balance-sheet approach to tax-exempt bond determination. The model herein rejected this methodology. The price of the capital services for local capital was defined and became integral to the theoretically derived desired capital stock and amount of state and local debt. The empirical work strongly supported this theoretical approach despite possible disparities in the actual and expected price of capital services from period to period.

It is this price of local capital services which invoked Peckman's statement, "It (the tax-exemption) reduces investment in productive enterprises by diverting risk or venture capital from the private sector. It distorts the allocation of resources within the private sector, and between the public and public and private sectors when state and local governments issue tax-exempt securities to finance such 'business' enterprises." (Peckman, 1966, p. 93). In other words the exemption allows the rate on tax-exempts --a component of the price of local capital services-- to be less than the rates for other borrowers. With a lower price of capital services on the flow of state and local goods, citizens will choose more state and local goods than is socially optimal.

The above argument was used for some time to advocate the elimination of the exemption. Finally: "The 1969 conflict again proved that the state and local governments have enough power to protect the exemption and that the change can now come only through a compromise." (Huefner, 1972, p. 7). From this time forward, the Peckman argument was no longer a primary issue in the debate. The double payment inefficiencies and inequities as articulated by Fortune became a greater issue. Once the ultimate need to compromise was recognized, then it was also recognized that elimination of the exemption would mean some other kind of subsidy must be forthcoming to induce municipalities to relinquish their tax-exempt financial instrument. These other subsidies of course distort resource allocations in much the same way as the tax-exemption. Thus the resource allocation argument is lost in the compromise debate; it has been replaced by the double payment argument.

The model of this study could be useful in estimating the allocative effects of grants. Prior models were unequipped to do this. They could only measure reductions in the double payments. Recall the model estimated desired capital needs where the price of capital services included the rate of return on tax-exempt bonds. These capital desires were also related to the matching grant rate. Any number of experiments could be run using various trade-offs between the grant rate and price of capital services. The resulting desired capital stock could then be compared to what Peckman might consider a socially optimal level of state and local capital. At the same time, any trade-off of the tax-exemption for a subsidy must be acceptable to both Federal and local governments. If not politically feasible, any economic justification for a specific action would remain barren.

Returning again to the revenue bond model, it should be mentioned that this was a difficult pioneer effort. The model did succeed in three important ways. First, it introduced a new decision-maker (the politician) and allowed the voter model to operate on its own without contamination from a separate decision-making body. Second, an empirical model was finally achieved with the desired properties: the budget constraint was highly flexible, allowing for biased political estimates of future user fees; and the equation showed some relation to the general obligation model in that as borrowing rates rose and voters rejected further general obligation bond issues, revenue bond issues picked up the desired borrowing needs of officials. And third, the estimated equation was statistically significant.

The model in its entirety also has useful prognostic capabilities. For instance, the impact of reducing Federal grants while simultaneously reducing marginal tax rates can be estimated. The earlier multiplier analysis reveals that decreasing Federal grants decreases tax-exempt bond supply. Lowering the tax rates raises the after-tax rate of return of substitute assets, thus demand also decreases. The magnitude of these shifts can be determined through close investigation of the appropriate multipliers. Qualitatively, it is clear that the level of tax-exempt bond supply will fall, while the change in the tax-exempt rate of return is indeterminant.

In closing, it is appropriate to relate this study's model to the current "problems" facing state and local governments. Concern has been expressed in recent years by many individuals that state and local governments are often having difficulty marketing their debt. Furthermore, there is a constant fear that demand for tax-exempts may be insufficient to keep the interest rate on tax-exempts low enough for state and local governments to issue debt at levels they feel are necessary. In short state and local government administrators need to know how much the supply of state and local debt will shift in the future, and they need to know how much demand will shift in the future. This knowledge should give them some indication of future borrowing costs. With estimates of the future values for the independent variables, this study's model can be used to estimate future supply and demand curves. With this accomplished, future tax-exempt rates of return can be estimated.

This model thus offers no solution to state and local governments, but given the institutional environment and the competitive nature of financial markets and political battles, it can provide a reliable estimate of future conditions. It is a neoclassical model which accepts the market as it is and is flexible enough to change when environmental parameters change. It is also an optimistic model. It indicates that if the present turn against state and local expenditures is creating consternation among local government officials, this is not too serious because it merely indicates the individual voter is expressing the current desire to spend elsewhere. If tax-exempt rates are presently high or revenue bonds can't be marketed, then this should be taken as an indicator that resources should be used outside the local government sector, or that capital funds are scarce everywhere and bids must be determined where resources are needed most. In the final judgment, this model in the neoclassical tradition emphasizes the desires of individuals, not groups, such as local governments. Thus any rise or fall in the strength of the tax-exempt bond market reflects individual desires and choices either in a thriving economy with fewer constraints or a faltering economy with greater constraints.

APPENDIX

APPENDIX

Data Sources

The various sectoral demands for tax-exempts can be found in the Flow of Funds Accounts, Federal Reserve Board of Governors.

Taxable income by income tax rate bracket is in Statistics of Income: Individual Income Tax Returns, Internal Revenue Service.

The rates of return are in the Survey of Current Business, Department of Commerce; the Federal Reserve Bulletin, Board of Governors; and An Analytical Record of Yields and Yield Spreads, Solomon Brothers.

Saving, National Product, and stockholder's equity are in the Economic Report of the President, Council of Economic Advisors.

Bank deposit, bank reserves, currency Federal debt, reserve requirements, regulation Q, bank lending rates, the earning to price ratio on equity, the discount rate, and unemployment rate are all found in the Federal Reserve Bulletin, Board of Governors.

Bank income is in Federal Deposit Insurance Corporation Bulletin.

Density measures come from the Statistical Abstract of the U.S.

Population and local income measures are found in the Economic Report of the President, the Council of Economic Advisors.

All other supply-side data is taken from Governmental Finances: Vol. 3, No. 5, Compendium of Government Finance, and Vol. 6, No. 4, Historical Statistics on Governmental Finances and Employment, U.S. Department of Commerce, Bureau of the Census.

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