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TAXES, FIRM FINANCIAL POLICY AND THE COST OF CAPITAL: AN EMPIRICAL ANALYSIS

Alan J. Auerbach

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1050 Massachusetts Avenue
Cambridge MA 02138

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ABSTRACT

This paper develops a theoretical model of firm behavior consistent with the maximization of shareholder utility, and derives empirically testable implications of different theories of equity finance. Using data on firm earnings and previous investment and financial behavior, we assess whether firms treat new share issues as a more expensive source of finance than retentions, and whether such behavior varies across firms according to the composition of their shareholders.

Our results strongly support the hypothesis that firms perceive a higher cost of capital when issuing new shares, and that the cost of capital varies significantly across firms having different estimated tax clienteles, as theory would predict.

Alan J. Auerbach
National Bureau of Economic Research
1050 Massachusetts Avenue
Cambridge, MA 02138

617/868-3927

I. INTRODUCTION

The observed financial behavior of firms, particularly their policy of distributing substantial dividends in the face of unfavorable tax treatment, has proved difficult to model in a consistent way. The basic problem is that the simplest theoretical models dictate outcomes that are clearly at variance with reality. This has led investigators to adopt one of three strategies in dealing with the problem:

(1) Reality is wrong; firms don't *really* behave as we think they do.

(2) Firms and/or investors are irrational. Firms do not act in the true interests of their shareholders, either because shareholders misperceive these interests or because firms do.

(3) There are constraints, some possibly obscured from ready identification, that prevent rational firms and investors from behaving as the simple theory would have them do.

All of these positions present difficulties for their adherents, though there may be an element of truth in each. However, the welfare implications of each with respect to tax changes is very distinct. Hence, it is important that the roots of financial behavior be ascertained.

The purpose of this paper is to develop a theoretical model of firm behavior consistent with the maximization of shareholder utility, and derive empirically testable implications of the different theories of equity finance outlined below. In particular, we wish to assess, using data on firm earnings and previous investment behavior, whether firms treat new share issues as a more expensive source of finance than retentions, consistent with the tax treatment of dividends, and whether such behavior varies across firms according to the composition of their shareholders. By using a panel of several firms observed over twenty years, we have the capacity to control for effects that characterize firms but not their year to year changes in policy. This is particularly important in the current context, allowing us to overcome many of the criticisms leveled at related efforts in the past.

We begin with a brief review of the related empirical literature in the next section. Section III presents a discussion of the data used in the paper, and some summary statistics of the financial behavior of the companies in our sample. Section IV develops a theoretical model of shareholder equilibrium and firm behavior, and Section V adapts this model to a dynamic context to permit empirical estimation. Section VI presents such empirical results and offers some concluding comments.

II. Related Literature

The modern theory of financial and investment behavior begins with the work of Modigliani and Miller (1958, 1963) and Miller and Modigliani (1961), who showed that in the absence of taxes, in a rational world without constraints, firm financial policy is irrelevant: neither the debt equity ratio nor the source of new equity capital (retentions versus new shares) has any effect on the wealth of a firm's shareholders. The presence of the corporate tax, and interest deductibility, leads to the result that firms should finance entirely with debt.

That firms do not borrow to finance all new investment has been explained in a number of ways. First of all, with personal taxes, it is the relative tax advantage of debt, over that enjoyed by the individual, that matters.[1] Since individuals also face a higher tax rate on debt than equity income (capital gains being lightly taxed), the total tax advantage to debt is lower. Added to this is the fact that, without a perfect loss offset, the expected corporate income tax deduction for interest payments declines with leverage.[2] Thus, especially in the presence of a progressive income tax structure and individuals with different personal tax preferences for equity versus debt, tax factors need not require all-debt finance. Two other costs of debt relate to bankruptcy. Increased leverage may make bankruptcy, with potentially high social costs, more likely. In addition, the prospect of bankruptcy in some states of the world introduces a moral hazard to the firm's investment decision.[3] It is encouraged to undertake risky projects it might otherwise eschew in order to decrease the expected payment to bondholders. The higher the firm's leverage, the greater the moral hazard and, presumably, the higher the cost to the firm of debt finance.

Thus, there are a number of possible reasons for observed corporate leverage decisions, although they may not be entirely satisfactory. Less explicable are the dividend policies that firms follow. Most firms pay dividends. In the U.S. in 1981, dividends of corporations were 63.1 billion dollars, exceeding the 49.5 billion dollars of earnings retained.[4] Since dividends are subject to full personal taxation, while capital gains associated with retentions are subject, in the U.S., to a 60 percent exclusion from taxation, and taxed only at realization, this is a puzzling result. Hence, each of the approaches mentioned above has been used to construct an explanation.

Miller and Scholes (1978) advanced the theory that no one pays taxes on dividends, at the margin, and so there is no disincentive faced by firms distributing them. Their argument was based on various aspects of the Internal

Revenue Code, including one that limits the use of interest deductions against non-capital income. This argument is ingenious but refuted by empirical evidence. As shown by Feenberg (1981), only 2 1/2 percent of dividends received in the U.S. in 1977 went to investors facing the limitation discussed by Miller and Scholes, forming a rather low upper bound on the extent of such behavior. Moreover, the Miller-Scholes argument cannot even be applied to the dividend paying behavior in countries such as the United Kingdom, where personal investors do not have the benefit of interest deductibility.

The "irrationality" approach may be attributed to the work of Black and Scholes (1973, 1974) and Fama (1974), who look, respectively, at the valuation response of investors to dividends and the choice of the firm among different sources of finance. In these empirical studies, the results are taken to imply that firms and individuals behave as the Modigliani-Miller theory would predict for a <u>taxless</u> world. There is no suggestion that such behavior is rational when taxes are present, merely that it continues to occur. While a sampling of investment letters and corporate reports may evoke sympathy for such a position, it seems at variance with the general, empirically supported presumption that capital markets are generally efficent and investors behave rationally.

Finally, there are the explanations of dividend behavior based on constraints. If firms are inhibited from repurchasing their own shares, or those of others, and therefore can only pass earnings out of the corporation as dividends, then the market should capitalize this fact. Since earnings retained and reinvested must eventually be distributed, the dividend tax can never be avoided. This will lead to firm indifference in the distribution or retention of dividends, and to a capitalization of the dividend disadvantage in the price of the firm's shares.[5] An important implication of this view is that the dividend tax, if not anticipated, is a lump sum tax on the value of corporate equity. A problem with this "capitalization" or "new" view is that some firms in the U.S. do repurchase their shares, and others issue new shares while continuing to distribute dividends.[6]

An explanation of this behavior could stem from an additional constraint requiring firms not to alter their dividend policy in the short run. This might be the result of a signalling model (e.g., Bhattacharya (1979)) in which firms observed cutting their dividends are perceived to be in financial trouble. Thus, firms might be forced to issue new shares to raise funds in periods of high investment. This theory does not offer convincing evidence of the existence of the kind of managerial incentives needed to support such a signalling equilibrium, but it is well known that firm dividend policy is extremely stable. As opposed to the capitalization result, this "double taxation" or "classical" view suggests that, since new equity source funds must come not from dividends but from new shares, the issue of which does not generate a reduction in current taxes, the dividend tax will influence investment, and will not be capitalized into the value of existing equity. Another way of distinguishing between these two views of dividend tax incidence is the long run value of Tobin's q, the ratio of market value to asset cost for the firm. The capitalization model predicts a q below unity, reflecting the tax savings associated with investment through retention. The classical model predicts a long run q of one. The lower q in the first case is the mechanism through which the future dividend taxes are capitalized and hence not borne by new investments.[7]

The empirical literature dealing with the effect of taxes on financial structure, particularly equity policy, may be divided fairly neatly into two categories: those that deal with the behavior of firms, and those that deal with the market response by investors to the behavior of firms. The current investigation will be of the former type. While one might infer from results about investor behavior what the optimal behavior of firms would be, it does not follow that this is the way firms actually behave. Thus, both types of study are required to assess the effects of taxation.

Most of the work on market pricing by investors has concentrated on the relative valuation of equity returns coming in the form of dividends and capital gains. The typical question asked is how the market value of a firm's shares changes on the day it goes ex dividend -- the date on which the owner for purposes of dividend payment is determined. The results generally show that, controlling for fluctuations in the market return, stock prices drop by significantly less than the value of the dividend, perhaps only 80 percent on average.[8] In addition, there is a significant variation in this discount according to the dividend payout of the firm.[9] These results have been taken to indicate that tax effects are present in the discounting of dividends, and that investor tax clienteles exist with respect to firm dividend behavior.

While these studies have been criticized on various grounds,[10] they have an important limitation even if interpreted correctly: they tell us nothing about the behavior of firms in response to taxes. As shown in Auerbach (1982b), the equation used to estimate ex dividend day effects is consistent with both the "capitalization" view that firms obtain their equity capital through retentions, and the "double-taxation" view that new shares provide the funds for new investment and dividends are fixed in the short run. In fact, one could also derive the equation based on a model of totally random irrational firm behavior. It merely reflects the equilibrium response to the dividend payment, when it occurs.

Studies of firm behavior have focused on three questions: the interrelationship among a firm's dividend and investment policy, the reaction of a firm's investment policy to changes in its market value, and the changes in a firm's earnings in years following investments financed by different methods.

Two papers examining the first of these questions, with different conclusions, are by Dhrymes and Kurz (1967) and Fama (1974). Though the empirical methodology differs between the papers, each uses simultaneous equation methods to ask whether changes in dividends influence investment, and whether changes in investment influence dividends. As suggested by Fama, the view that taxes don't influence firm behavior is consistent with a surge in investment causing a reduction in dividends, since according to that view dividend policy is irrelevant. The key relationship involves the effect of dividends on investment. Here, since without taxes real and financial decisions are separate, there should be no effect. Fama finds that there is none, but Dhrymes and Kurz find that there is a sigificantly negative effect, as would be predicted if firms consider new shares to be more expensive for tax reasons. However, the estimation procedures differ between the studies, and one can raise serious questions about the econometrics of each. For example, Fama uses current profits and lagged dividends as the instruments for current dividends in the time series investment equation he fits separately for a large number of firms. Profits qualifies as an instrument only because it is excluded from the investment equation. Yet, if dividends act as a signal of future profitability, an increase in current profits may increase both dividends and investment. Moreover, if firms do consider retentions to be a cheaper form of finance due to tax considerations, an increase in profits may lower the marginal cost of capital and lead to more investment. Hence, for these two reasons, the procedure used would lead to an upward bias in the dividend coefficient. Indeed, one suspects from the findings in the investment literature of a positive effect of "cash flow" on investment (e.g., Coen (1968)) that the fitted values of dividends from the first stage regressions have a coefficient in the second stage that includes a significant positive effect of the omitted profits variable. Thus, the observed insignificant coefficients need not be inconsistent with the results of Dhrymes and Kurz.

Poterba and Summers (1981) use the q model of investment as an indirect test of the "capitalization" versus the "double-tax" view of firm behavior. Since the two theories predict different long-run values of the ratio of market value to replacement value of assets, they predict different investment behavior for firms that, responding optimally to costs of adjustment, set investment equal to a function of the gap between the current value of q and the long-run value of q (Abel (1979), Hayashi (1981)). Poterba and Summers estimate an aggregate time series q investment equation, with the q variable being a weighted average of these corresponding to the "double-tax" and "capitalization" theories. By estimating the weights jointly with the other parameters of the equation, they find that the best fit is obtained when essentially all the weight is given to the "double-tax" q. While this result does seem damaging to the "capitalization" view, there are a number of difficulties in interpreting it. First of all, the "double-tax" q derived by Poterba and Summers is precisely the "no tax" q: the same expression would be obtained if all personal taxes were zero or, in keeping with the "irrationality" hypothesis, ignored by firms. Second, a number of assumptions, including constant returns to scale and capital stock homogeneity, as well as convex adjustment costs, are required for the estimated equations to be valid. Our empirical findings below suggest the existence of large "firm effects" in rates of return, which is not consistent with this view of the world. Finally, common sense intervenes to remind us that firms do not issue shares, or repurchase shares, in every or even most years.[11]

A third type of study has directly estimated the change in earnings attributable to previous investment financed by different sources. Baumol et al (1970) used the technique, followed by others, of regressing, over a cross section of firms, a weighted average change in earnings plus interest on an average of previous amounts of retained earnings, debt issues and new share issues. The rationale was that if firms face different costs of capital for different sources of funds, they will use the least expensive source first, using the more expensive one if very profitable investments present themselves. Such profitability should show up in subsequent earnings. The results of Baumol et al suggested that new shares were a substantially more expensive source of funds than retentions or debt, although taxes were not suggested by the authors to lie behind this finding. However, the coefficients of all three independent variables were very unstable over different cross sections, the exact specification estimated was not drawn from any explicit model of firm behavior, and the estimation procedure did not control adequately for simultaneity biases likely to be present. For these and other reasons, a number of authors criticized both the paper's methodology and its conclusions.

Our empirical approach will extend that of Baumol et al, but with a number of important differences. First, we begin by devising an estimable model from an examination of firm behavior based on the maximization of stockholder utility in the presence of constraints. Then, using data corrected for inflation, we use time series cross section methods in an attempt to control for firm differences. The use of panel data also allows us to test for the influence of taxes on firm behavior not only in the aggregate, but across firms according to their tax clientele, as dictated by the theory. The empirical results in Section VI strongly support the hypothesis that firms perceive a higher cost of capital when issuing new shares, and that the cost of capital varies significantly across firms having different estimated tax clienteles, in a manner consistent with these differences.

III. The Data

Our sample consists of 274 firms, this being the subsample of the 436 firms considered in Auerbach (1982b) for which observations for all variables used are available for the entire twenty-year estimation period 1958-1977. The data set contains information on daily stock prices and returns obtained from the CRSP (Center for Research in Securities Prices) data file. Annual balance sheet and income statement information comes from Standard and Poor's Compustat file. The main adjustments made to the data before use involved the conversion of book values of assets and liabilities into market values, and the corresponding correction of earnings. All such stocks and flows were deflated to obtain real quantities.

In this section, we describe these adjustments, and also present some statistics on the pattern of new share issues that will be useful in guiding the modelling of firm behavior in subsequent sections of the paper.

A. Data Adjustment

1. Long-Term Debt

Because of fluctuations in long-term interest rates, the market value of long-term debt may differ from its book value. To correct for this, we must know the maturity structure of debt and the interest rate at which each component was issued.

Following the techniques of Braniard, Shoven and Weiss (1980) and Salinger and Summers (1981), we assume

a. all new issues of long-term debt have a maturity of 20 years;

b. the coupon rate on each bond is the BAA rate prevailing in the year of issue; and

c. In 1958,[12] the maturity distribution of bonds in each firm was proportional to the maturity distribution of aggregate outstanding issues.[13]

New issues of debt after 1958 were calculated by subtracting the estimated book value of retirements of 20 year old debt from the change in the book value of all debt. If such a number was negative, indicating additional retirements, we assumed that new issues were zero and that the oldest outstanding issues were retired until the change in book value was accounted for.

2. Inventories

Most firms use the LIFO (last-in, first-out) accounting method or the FIFO (first-in, first-out) method. Roughly speaking, the first method correctly states inventory changes, while the second correctly states inventory stocks. A small number of firms use more than one method. For such firms, we assumed that only what was listed as the predominant method was used.[14]

For FIFO inventories, we assume that stocks at the end of period t are valued at current period prices. This amounts to assuming that inventories turn over at least once a year, so that all inventories on the books at the end of any year were purchased during that year. Thus, the corrected change in inventories at current prices equals:

$$(3.1) \qquad INV_t - INV_{t-1} \frac{P_t}{P_{t-1}}$$

where P_t is the price level in period t (the producer price index was used for this) and INV_t is the book value of inventories at the end of year t. Since book earnings include the change in book inventories, the inventory valuation adjustment of $(\frac{P_t - P_{t-1}}{P_{t-1}}) INV_{t-1}$ must be subtracted to obtain correct earnings.

For LIFO firms, if book inventories increase, then all goods sold during the year are treated as if purchased during the year, and no correction to earnings is necessary. If inventories are depleted, then, to the extent of this depletion, goods purchased in earlier years are taken from the books, and an adjustment is required. We assume that such "unlayering" goes back only to the previous year, so that earnings must be adjusted by subtracting

$$(3.2) \qquad (INV_{t-1} - INV_t) \quad (\frac{P_t - P_{t-1}}{P_{t-1}})$$

which is positive for $P_t > P_{t-1}$.

3. Depreciation

Book depreciation of physical assets is inaccurate for two reasons. The first is that depreciation figures are based on historic asset costs, and thus do not reflect changes in asset prices due to inflation. Second, the depreciation figure may not reflect the actual pattern of economic depreciation. We correct only for the first of these problems.[15] The method used calculates that rate of declining balance (exponential) depreciation δ that, when applied to a perpetual inventory calculation for updating capital stocks beginning with the 1958 book value of net plant and equipment, yields the stated 1977 book value of net plant and equipment. That is, if K_t^b is the net book capital stock at the end of period t, we begin with the stated value of K_{1958}^b, and calculate that value of δ which, when used successively over t in the calculation

$$(3.3) \qquad K_t^b = (1-\delta)\, K_{t-1}^b + I_t$$

where I_t is gross period t investment, yields the stated value of K_{1977}^b. We then assume that all assets purchased by the firm actually do depreciate at rate δ, and use this to obtain actual real capital stocks according to a formula similar to (3.3):

$$(3.4) \qquad K_t = (1-\delta)K_{t-1} + I_t/P_t$$

where P_t is the capital goods price index. It is assumed in this calculation that $K_{1958} = K_{1958}^b$.

If all assets were written off, and actually did depreciate, at rate δ, this would be the correct procedure to follow. Actually, assets are commonly written off using the straight-line method, and asset lives differ. The constant rate declining balance depreciation is meant to approximate an average rate of depreciation of the firm's mix of assets. The use of beginning and end of sample period net capital stocks, rather than simply adding up actual book depreciation over the period, corrects for the fact that some assets are scrapped, representing depreciation but not showing up in depreciation allowances.[16]

4. Earnings

Using the above calculations, we derive two useful earnings measures:

a. Earnings before interest and taxes (EBIT) equals after-tax book earnings, corrected for the adjustments to depreciation and inventories, plus interest payments, plus income taxes.[17]

b. Earnings before interest and after taxes equals EBIT, less actual taxes, and less the taxes implicitly saved by the deduction of actual interest payments.[18]

These two measures tell us how much of a return, before and after taxes, a firm has available for the owners of its securities.

5. Other Variables

Two variables measuring firm characteristics are taken from calculations, based on the same data set, done in Auerbach (1982b). These are the coefficients α_1 and α_2 from the firm time series regressions (performed on daily data):

$$g_t = \alpha_0 + \alpha_1 d_t + \alpha_2 r_t + \alpha_3 R_t + \varepsilon_t \qquad (3.5)$$

where g_t is the observed percent change in share price, d_t is the dividend per dollar of shares, r_t is the percent change in the Standard and Poor's stock index, and R_t is the treasury bill rate. $(1+\alpha_1)$ is intended to represent the "implicit" tax rate of the firm's stockholder clientele, while α_2 is the standard measure of the firm's "beta", or the volatility of its return with respect to the market. The interpretation of $(1 + \alpha_1)$ as a tax rate derives from the fact that investors should be indifferent between dividends and capital gains except for differences in their tax treatment. Thus, any dependence of the total return g + d on its composition can be attributed to taxes. In particular, if all investors faced a differential tax rate $(1 + \alpha_1)$ on dividends, equation (3.5) would describe the movement in stock prices. This interpretation can be extended to the case of heterogeneous investors who form tax clienteles, causing α_1 to differ across firms. For further discussion and analysis, see Auerbach (1982b).

B. The Pattern of New Share Issues

It is unnecessary to perform sophisticated regressions to get a general idea of the equity policy firms use in financing investment. In general, the characteristics of firm behavior do not fit neatly into a "double-tax" or "capitalization" framework: firms rarely issue new shares, but do not exhaust retentions first when they do so. In fact, there is no noticable depression in dividends associated with the issuance of new shares.

Of the 274 firms in our sample, 54 did not engage in issues of new shares[19] at all during the entire fifteen year period 1963-1977, and 45 did do only in one year. Only 104 firms issued new shares in more than 2 years, and only 15 in more than 7 years. On the other hand, less than ten percent of all firms issuing new shares in years following one in which no new shares were issued cut their dividend from the previous year, and more than two-thirds actually <u>increased</u> their dividends at least five percent.

How is it that firms vary their dividend very little, yet rarely find it necessary to issue new shares. One explanation is debt: firms can adjust their borrowing to cover short run fluctuations in earnings or investment needs. However, this procedure only can be sustained without the frequent issuance of new shares if the dividend is fundamentally in accordance with the firm's earnings prospects. Otherwise, the debt-equity ratio will rise steadily or new shares will be required. Indirect evidence that firms behave in this way is provided by the following regression.

We constructed three variables for each firm: the average over the period 1973-1977 of investment relative to net capital, I, the <u>ratio</u> of this variable to its value for the period 1958-1972, $I/\bar{I}$, and the average ratio of the value of new shares issued to investment for the period 1973-1977, N/I. A regression of the last variable on the first two, across firms, yields the resulting coefficients:

$$N/I = \underset{(0.54)}{.03} + \underset{(0.98)}{.30\,I} + \underset{(1.82)}{.10\,(I/\bar{I})} \qquad \bar{R}^2 = .031$$

where the numbers in parenthesis are t - statistics. This suggests that new share issues play an increased role in financing a firm's investment when its investment, relative to its capital stock, is higher than normal, not simply high. This, in turn, seems to support the view that firms do adapt their dividend payout rate to avoid regular issues of new shares.

These results are consistent with a theory that is a hybrid of the "double-tax" and "capitalization" views, incorporating both the short-run rigidity of dividends and the aversion to issuing new shares. It is important that these characteristics be incorporated into the model to be estimated below.

IV. <u>Portfolio Equilibrium and Optimal Firm Behavior</u>

The model presented below is based on that used in Auerbach and King (1982), and Auerbach (1982b). It extends the work of these papers by considering the firm's investment decision as well as its financial policy, and by a more explicit treatment of the nature of equity finance. These complications are required if we are to model the behavior of firms as well as that of investors. The reader not interested in the derivation may proceed directly to the summary provided in subsection D.

We consider a two period model with H investors and L firms. Each firm i has a fixed endowment of resources at the beginning of period 1, labelled $\bar{Y}_i$. This may be thought of as the firm's cash flow from previous investments. The firm makes four simultaneous decisions at the beginning of period 1:

(1) how much of the endowment to pay out to existing stockholders as a dividend, D_i ;

(2) how much to borrow, B_i ;

(3) how much to raise by selling new shares, N_i ; and

(4) how much to invest in productive assets, X_i .

Only three of these decisions are independent, since they are related by the cash flow constraint

$$(4.1) \qquad \bar{Y}_i + B_i + N_i = X_i + D_i$$

In period 2, the firm realizes the cash flow from its investment, repays its debt with interest,[20] and distributes the remaining cash as a dividend. The firm's stochastic investment return, $\tilde{Z}_i$, is governed by the relationship:

$$(4.2) \qquad \tilde{Z}_i = f(X_i) \cdot \tilde{S}_i$$

where $f(\cdot)$ is a concave function[21] and $\tilde{S}_i$ is a random variable with mean M_i, variance σ_{ii} and covariance σ_{ij} with the random variable underlying firm j's return, $\tilde{S}_j$. Thus, the mean, variance and covariance with the return of firm j of the return $\tilde{Z}_i$ is:

(4.3a) $\mu_i = f(X_i)M_i$

(4.3b) $C_{ii} = [f(X_i)]^2\sigma_{ii}$

(4.3c) $C_{ij} = f(X_i)f(X_j)\sigma_{ij}$

Each individual investor h enters period 1 with a wealth endowment W^h that includes an exogenous component $\bar{W}^h$ plus shares and dividends in the various firms.[22] Once the firms announce their financial and investment policies, investors trade securities, purchasing, in addition to corporate debt and equity, two kinds of government debt, taxable and nontaxable (municipal). Since all debt is riskless, taxable government debt is a perfect substitute for corporate debt, and must carry the same interest rate. Municipal debt will carry a lower interest rate because of its favorable tax treatment.[23]

We ignore capital gains taxes, and assume investor h faces an income tax rate t^h on interest and dividend income. The budget constraint facing investor h is:

(4.4) $$B^h + \hat{B}^h + \sum_{i=1}^{L} n_i^h E_i = W^h = \bar{W}^h + \sum_{i=1}^{L} \bar{n}_i^h (E_i + (1-t^h)D_i - N_i)$$

where $\bar{n}_i^h$ and n_i^h are individual h's fractional holdings of the (pre-new issue) equity, before and after trading,[24] E_i is the value of firm i's equity, and B^h and $\hat{B^h}$ are individual h's purchases a taxable and nontaxable debt, respectivley.

Investors seek by trading to maximize a utility function based on the mean and variance of terminal wealth, $U^h(\mu^h,(\sigma^h)^2)$. If we denote by R the interest rate on taxable debt, $\hat{R}$ the rate on municipal debt, and t_c the corporate tax rate, then the mean and variance U^h and $(\sigma^h)^2$ may be expressed:

$$(4.5a) \qquad \mu^h = [W^h - \sum_i n_i^h E_i - \hat{B}^h] R(1-t^h) + \hat{R}\hat{B}^h + \sum_i n_i^h(\mu_i - RB_i)(1-t_c)(1-t^h)$$

$$(4.5b) \qquad (\sigma^h)^2 = \sum_{ij}\sum n_i^h n_j^h C_{ij}\,(1-t_c)^2(1-t^h)^2$$

where μ_i, C_{ij} and B_i are the firm variables defined above.

Without the existence of constraints on investor behavior, no equilibrium could exist. For example, the presence of individuals endowed with different relative tax rates on taxable and tax exempt debt would present unlimited arbitrage possibilities not affected by changes in interest rates. For simplicity, we assume that individuals face nonnegativity constraints with respect to their purchases of each type of debt,

$$(4.6a) \qquad W^h - \sum_i n_i^h E_i - \hat{B}^h \geq 0$$

$$(4.6b) \qquad \hat{B}^h \geq 0$$

This is meant, to correspond to such "real world" restrictions on borrowing to invest in municipal debt and on issuing municipal debt.[25]

If we attach the multipliers λ_1^h and λ_2^h to the constraints (4.6a) and (4.6b), respectively, we obtain the Lagrangian:

$$h = U^h(\mu^h,(\sigma^h)^2) + \lambda_1^h(W^h - \sum_i n_i^h E_i - \hat{B}^h) + \lambda_2^h \hat{B}^h$$

which yields (using (4.5)) the first-order conditions:

$$(4.7a) \quad U_1^h\,[-R(1-t^h)E_i + (\mu_i - RB_i)(1-t_c)(1-t^h)]$$

$$+\, U_2^h \sum_j n_i^h C_{ij}(1-t_c)^2(1-t^h)^2 - \lambda_1^h E_i = 0 \quad (i=1,..,L)$$

$$(4.7b) \quad U_1^h\,[-R(1-t^h) + \hat{R}] + \lambda_2^h - \lambda_1^h = 0$$

Since each investor will hold at most one form of debt unless $\hat{R} = (1-t^h)R$ (see (4.7b)), it is useful to rewrite these conditions as

$$(4.8) \quad (\mu_i - RB_i)A^h - RE_iG^h = \Sigma\, n_i^h C_{ij} \quad (i=1,..,L)$$

where

$$A^h = \frac{1}{\gamma^h(1-t_c)(1-t^h)}$$

$$G^h = (1-\lambda^h)A^h/T^h$$

$$T^h = (1-t_c)(1-t^h)/(1-\hat{t}^h)$$

$$\hat{t}^h = \text{Min}\,(t^h,\ 1 - \hat{R}/R)$$

$$\lambda^h = \begin{cases} \dfrac{\lambda_1^h}{U_1^h R(1-\hat{t}^h)} & \text{if } \hat{t^h} = t^h \\[2ex] \dfrac{\lambda_2^h}{U_1^h R(1-\hat{t}^h)} & \text{if } \hat{t^h} < t^h \end{cases}$$

$$\gamma^h = -\gamma\frac{U_2^h}{U_1^h}$$

The term γ^h represents the investor's risk aversion, T^h represents the investor's "tax preference" for equity versus his preferred form of debt, with $\hat{t}^h$ the tax rate (explicit or implicit) on such debt.

Summing (4.8) over individuals for a given i, and solving for E^i, we obtain:

$$(4.9) \qquad E^i = \left(\frac{A}{G}\right) \left[\frac{\mu_i - \frac{1}{A} C_i}{R} - B_i\right]$$

where

$$A = \sum_{h=1}^{H} A^h$$

$$G = \sum_{h=1}^{H} G^h$$

$$C_i = \sum_{j=1}^{L} C_{ij}$$

Since $A^h/G^h = T^h/(1-\lambda^h)$, A/G may be thought of as the "market's" tax preference for equity, taking account of constraints. C_i is the firm's covariance with the market, and $\frac{1}{A}$ the "price of risk", both in accordance with the standard results of the capital asset pricing model.

The actual values of the interest rates R and $\hat{R}$ depend on the behavior of firms as well as the supplies of both types of government debt. Since we are concerned with the optimizing behavior of individual firms, we simply take these as fixed. Likewise we will not discuss the role of taxes in influencing portfolio composition. For this, the reader is referred to Auerbach and King (1982) and Auerbach (1982b).

The individual competitive firm takes individual preferences and constraints and market prices as given. What objectives should guide the firm's decisions? One obvious possibility is market value maximization: the maximization of the value of securities plus concurrent distributions. However, value maximization has been criticized on three grounds:

(1) if there is incomplete spanning of markets, such a policy would not be the generally agreed on aim of stockholders, even in the absence of taxes;

(2) in the presence of taxes, even more stringent "tax" spanning is required;[26] and

(3) value maximization differs from the presumed objective of wealth maximization.[27]

Because of the specification of multiplicative uncertainty in (4.2), the first of these criticisms does not apply here. This was first shown by Diamond (1967). The other arguments suggest that investors may differ with respect to what they would wish firms to do, and that firms seeking to act in "the interest of their stockholders", would behave differently according to who these stockholders are.

To explore this issue further, we calculate the effect on the utility of investor h of a change in the various financial and investment policies of an arbitrary firm, k. In particular, we consider the effect of an increase in investment financed by debt, retentions or new shares. Before we begin, it is helpful to note that the mean of investor h's portfolio may be rewritten, using the definition of $\hat{t}^h$:

$$(4.10) \qquad \mu^h = [W^h - \sum_i n_i^h E_i] R(1-\hat{t}^h) + \sum_i n_i^h(\mu_i - RB_i)(1-t_c)(1-t^h)$$

We now proceed to consider the effects of firm policies.

A. Debt

The derivative of U^h with respect to B_k (with $\frac{dX_k}{dB_k} = 1$) is:

(4.11)
$$\frac{dU^h}{dB_k} = U_1^h \frac{d\mu^h}{dB_k} + U_2^h \frac{d(\sigma^h)^2}{dB_k}$$

$$= U_1^h \Big[R(1-\hat{t}^h)\frac{dW^h}{dB_k} - R(1-\hat{t}^h)\sum_i n_i^h \frac{dE_i}{dB_k} + \sum_i ((\mu_i - RB_i)(1-t_c)(1-t^h) - RE_i(1-\hat{t}^h))\frac{dn_i^h}{dB_k}$$

$$+ n_k^h (1-t_c)(1-t^h) \left(\frac{d\mu_k}{dB_k} - R\right)\Big]$$

$$+ U_2^h (1-t_c)^2(1-t^h)^2 \Big[2 \sum_i \frac{dn_i^h}{dB_k} \sum_j n_j^h C_{ij} + 2\, n_k^h \sum_j n_j^h \frac{dC_{kj}}{dB_k}\Big]$$

$$= U_1^h(1-\hat{t}^h) \Big[R\frac{dW^h}{dB_k} - R\sum_i n_i^h \frac{dE_i}{dB_k} + \Big(\sum_i (\mu_i - RB_i)T^h - RE_i - \frac{T^h}{A^h}\sum_j n_j^h C_{ij}\Big)\frac{dn_i^h}{dB_k}$$

$$+ n_k^h \Big(T^h\Big(\frac{d\mu_k}{dB_k} - R\Big) - \frac{T^h}{A^h}\sum_j n_j^h \frac{dC_{kj}}{dB_k}\Big)\Big]$$

Using (4.8), we obtain:

(4.12)
$$\frac{dU^h}{dB_k} = U_i^h(1-\hat{t}^h) \Big[R\frac{dW^h}{dB_k} - R\sum_i n_i^h \frac{dE_i}{dB_k} + R\Big(\frac{T^h}{A^h}G^h - 1\Big)\sum_i E_i \frac{dn_i^h}{dB_k}$$

$$+ n_k^h \Big(T^h\Big(\frac{d\mu_k}{dB_k} - R\Big) - \frac{T^h}{A^h}\sum_j n_j^h \frac{dC_{kj}}{dB_k}\Big)\Big]$$

$$= U_1^h(1-\hat{t}^h) \Big[R\frac{dW^h}{dB_k} - R\frac{T^h}{A^h}G^h \sum n_i^h \frac{dE_i}{dB_k} + R\Big(\frac{T^h}{A^h}G^h - 1\Big)\frac{d(\sum_i E_i n_i^h)}{dB_k}$$

$$+ n_k^h T^h \Big(\Big(\frac{d\mu_k}{dB_k} - R\Big) - \frac{1}{A^h}\sum_j n_j^h \frac{dC_{kj}}{dB_k}\Big)\Big]$$

Since $\frac{T^h}{A^h}G^h = 1$ unless $\lambda^h > 0$, in which case $\sum_i E_i n_i^h = W^h$, this expression becomes:

(4.13) $$\frac{dU^h}{dB_k} = U_1^h(1-\hat{t}^h)\ [R\ \frac{T^h}{A^h}\ G^h\ \frac{dW^h}{dB_k} - R\ \frac{T^h}{A^h}\ G^h \sum_i n_i^h\ \frac{dE_i}{dB_k} + n_k^h T^h\ ((\frac{d\mu_k}{dB_k} - R) - \frac{1}{A^h} \sum_j n_j^h\ \frac{dC_{kj}}{dB_k})]$$

To understand this expression, note that

(4.14) $$\sum_i n_i^h \frac{dE_i}{dB_k} = \frac{1}{R}\ [n_k^h\ (\frac{A}{G})\ \ (\frac{d\mu_k}{dB_k} - R) - \frac{1}{G} \sum_i n_i^h\ \frac{dC_{ki}}{dB_k}]$$

So that (4.13) becomes:

(4.15) $$\frac{dU^h}{dB_k} = U_1^h\ (1-\hat{t}^h)\ \frac{T^h G^h}{A^h}\ \ [R\ \frac{dW^h}{dB_k} - n_k^h\ (\frac{d\mu_k}{dB_k} - R)\ (\frac{A}{G} - \frac{A^h}{G^h}) + (\frac{1}{G} - \frac{n_k^h}{G^h}) \sum_i n_i^h\ \frac{dC_{ki}}{dB_k}]$$

The last two items in brackets represent the fact that investor h places a different value on the two components of the yield to the new investment, the excess return $(\frac{d\mu_k}{dB_k} - R)$ and the risk $\sum_i n_i^h \frac{dC_{ki}}{dB_k}$, than the market does, unless $\frac{A}{G} = \frac{A^h}{G^h}$ and $\frac{1}{G} = \frac{n_k^h}{G^h}$. Each of these conditions is satisfied if $\frac{A}{G} = \frac{A^h}{G^h}$, for then[8] $n_k^h = \frac{G^h}{G}$ for all k. Otherwise, wealth maximization will not maximixe the investor's utility, since his constraint-modified tax preference for debt versus equity differs from that of the market; his utility will be improved if he has a greater preference for debt than the market, and the firms he wishes to hold issue more debt, decreasing the price of the securities he demands.

In general, from the definition of W^h in (4.4), expression (4.13) becomes:

$$(4.16)\qquad \frac{dU^h}{dB_k} = U_1^h\,(1-\hat{t}^h)\,\frac{T^hG^h}{A^h}\,\left[R\sum_i(\bar{n}_i^h-n_i^h)\,\frac{dE_i}{dB_k} + n_k^h\left(\frac{A^h}{G^h}\right)\left(\frac{d\mu_k}{dB_k} - \frac{1}{A^h}\sum_j n_j^h\,\frac{dC_{kj}}{dB_k} - R\right)\right]$$

While equation (4.16) suggests that stockholders will disagree concerning what the firm should do, it is difficult to analyze the problem in full generality, for it would be necessary to know the composition of ex ante and ex post stockholder groups. In a dynamic context, one would also have to consider the formation of expectations concerning the effects of current firm policy on future ones, through their effect on clientele composition. One simpler approach is to ask what firm behavior would be consistent with a stable voting equilibrium, assuming one exists. That is, what behavior would be consistent with a majority vote of stockholders when no trading occurs i.e. $\bar{n}^h = n^h$? In such a case, the first term in (4.16) disappears, and firm k chooses its debt policy to maximize the "implicit" value of the wealth of its majority stockholders, its "clientele". In particular, it should accept an initial investment project if the marginal risk-adjusted return, $\left(\frac{d\mu_k}{dB_k} - \frac{1}{A^h}\sum_j n_j^h\,\frac{dC_{kj}}{dB_k}\right)$ exceeds the interest rate, R, where the risk adjustment depends on the covariance of the new risk with the portfolios of its shareholders, not the "market" portfolio.

B. Retentions

Proceeding as before, we obtain (for $\frac{dX_k}{dD_k} = -1$)

$$(4.17)\qquad -\frac{dU^h}{dD_k} = U_1^h(1-\hat{t}^h)\left[-R\,\frac{dW^h}{dD_k} + R\sum_i n_i^h\,\frac{dE_i}{dD_k} - R\left(\frac{T^h}{A^h}G^h-1\right)\sum_i E_i\,\frac{dn_i^h}{dD_k}\right.$$

$$\left. - n_k^h\,T^h\,\frac{d\mu_k}{dD_k} + \frac{T^h}{A^h}\sum_j n_j^h\,\frac{dC_{kj}}{dD_k}\right]$$

which, after a couple of steps, yields the analogue of (4.16):

$$(4.18)\qquad -\frac{dU^h}{dD_k} = -U_1^h(1-\hat{t}^h)\,\frac{T^hG^h}{A^h}\,\Big[R\sum_i(\bar{n}_i^h-n_i^h)\frac{dE_i}{dD_k} + n_k\Big(\frac{A^h}{G^h}\Big)\Big(\frac{d\mu_k}{dD_k} - \frac{1}{A^h}\sum_i n_j^h\frac{dC_{kj}}{dD_k} - R\,\frac{G^h(1-t^h)}{A^h}\Big)\Big]$$

Here, if $\bar{\underset{\sim}{n}}^h = \underset{\sim}{n}^h$, the investor's utility is maximized if the investment earns a risk-adjusted return of at least $R^r = R\,(\frac{G^h}{A^h})\,(1-t^h)$. For the individual not specialized in equity, $\lambda^h = 0$ and hence $R^r = R\,(\frac{1-\hat{t}^h}{1-t_c})$: the investor's net-of-tax opportunity cost, $R(1-\hat{t}^h)$, grossed up by the corporate rate.

C. New Issues

Here, the only difference is in the budget constraint (4.4): new share issues are not tax deductible. Thus, the analagous rate of return to those calculated above is $R^N = R\,(\frac{G^h}{A^h})$, or $R\,\frac{(1-\hat{t}^h)}{(1-t_c)(1-t^h)}$ for a diversified investor.

D. Summary

Our findings with respect to the cost of capital suggest that firms will never choose to issue new shares, and will use debt or retained earnings according to whether the tax rate faced by their stockholders, on interest income, $\hat{t}^h$, the minimum of their personal tax rate, t^h, and the "tax rate" on tax exempt debt implicit in its discount, is less than or greater than the corporate rate.[28] These findings are precisely those one would expect from the certainty case (King 1974) but here they have been extended to the situation where firms have different stockholder clienteles with different tax rates. It is possible, therefore, for different firms to find different financing schemes most attractive.

To explain the coexistence of different forms of finance, except in degenerate cases where the costs of two sources are equal, one must specify a structure of constraints facing the firm. Such constraints might include the inability to issue negative dividends, repurchase shares, or borrow more than a specified amount. As a result a firm might be forced to use a less favored source of funds after having exhausted its first source. In this context, one can think of firms as facing an upward sloping supply-of-funds schedule, with three components corresponding to the different sources of finance. Of use in our empirical analysis will be what the results of this section predict about the effects of a firm's tax clientele on the height of the various segments of the supply schedule. In particular, the cost of retentions, $R\ (\frac{1-\hat{t}^h}{1-t_c})$, should be nonincreasing with t^h, since

$$\frac{d\hat{t}^h}{dt^h} = \begin{cases} 1 & \text{if } \hat{t}^h = t^h \\ 0 & \text{if } \hat{t}^h < t^h \end{cases}$$

Likewise, the cost of new shares, $R\ \frac{(1-\hat{t}^h)}{(1-t_c)(1-t^h)}$, should be nondecreasing with t^h. The cost of debt should not depend on t^h.

What remains is for us to develop an empirical methodology for identifying these supply schedules and tax clienteles, a task to which we now turn.

V. A Dynamic Model of Firm Behavior

We wish to formulate a model consistent with the theory of Section IV and the actual evidence on patterns of finance cited in Section III. At the same time, this model must lend itself to empirical investigation.

Consider a firm that seeks to maximize the utility of its shareholders by accepting all projects that yield a return of $\rho = R(1 - \hat{t}^h)$, where R is the riskless interest rate and $\hat{t}^h$ is the effective tax rate on debt faced by these stockholders. Then (see Auerbach 1979b)), the firm's objective is to maximize

$$(5.1) \qquad w^* = \Sigma\,(1 + \rho)^{-t}[(1 - t^h)D_t + N_{t+1}]$$

where t^h is the tax on dividends, D_t is the dividend paid at the end of period t, and N_{t+1} is the new share issue at the beginning of period $t+1$.

At the beginning of each period, the firm borrows an amount B_t of one period debt, which returns an interest rate i_t at the end of the period. At the beginning of each period, the firm has a range of investment opportunities that offer a total return before tax of $f_t(X_t)$ at the end of the period, and $f_t\,(X_t)(1-\delta)^{(s-t)}$ at the end of each future period s, where $f_t(\cdot)$ is a concave function and X_t is the amount invested in period t. That is, each period, the firm may invest in different projects with decreasing returns, each of which depreciates exponentially over time at rate δ. We subscript the function $f_t(\cdot)$ to allow for fluctuations in investment opportunities that may force a firm temporarily away from its long run financial structure.[29]

If we assume that assets are accorded depreciation allowances in line with economic depreciation,[30] then the after-tax return before deductions of interest, and before depreciation, at the end of period t is

$$(5.2) \qquad G_t = \sum_{s<t} [(1 - t_c)f(X_s) + t_c\delta\, X_s]\;(1 - \delta)^{(t-s)}$$

while the net of depreciation after-tax return is:

$$(5.3) \qquad A_t = G_t - \sum_{s<t} \delta\, X_s(1 - \delta)^{(t-s)} = (1 - t_c)\sum_{s<t} [f(X_s) - \delta\, X_s](1 - \delta)^{(t-s)}$$

As a substitute for the explicit treatment of risk in this section, we assume that the interest rate on debt, i_t , is a convex, increasing function of the debt-capital ratio:

$$(5.4) \qquad i_t = i \left(\frac{B_t}{\sum_{s<t} X_s (1-\delta)^{(t-s)}} \right) \qquad i', i'' > 0$$

As discussed above, firms pay dividends in substantial amounts and at very stable rates. While this may be rationalized as an attempt to set the long run payout rate at one where the firm can grow internally and maintain its desired debt-equity ratio, there is still the puzzle of why, when temporary infusions of funds are required, dividends are not cut, and new shares are issued. For modelling purposes, we assume that there is some minimum payout rate of earnings, α , that firms must meet, by issuing new shares if necessary:

$$(5.5) \qquad D_t \geq \alpha (A_t - i_t(1 - t_c)B_t)$$

Likewise, to reflect the fact that, whether they can or cannot, firms do not repurchase shares in important amounts,[31] we assume the new share issues cannot be negative:

$$(5.6) \qquad N_t \geq 0$$

Using the firm's cash flow identity:

$$(5.7) \qquad G_{t-1} - i_{t-1}B_{t-1}(1 - t_c) + (B_t - B_{t-1}) + N_t = X_t + D_{t-1}$$

and letting η and μ be the Lagrange multipliers associated with the constants (5.5) and (5.6), we obtain the following first-order conditions with respect to to X_t, $(B_t - B_{t-1})$, and N_t:

$$(5.8a)\quad \sum_{s<t} (1+\rho)^{-(s-t+1)}(1-\delta)^{(s-t)} \left[(1-t^h + (1-\alpha)\eta_{s+1})\ (f_t(1-t_c) + t_c\delta + (1-t_c)i_s b_s{}^2) + \alpha\eta_{s+1}\delta\right] - \left[(1-t^h) + \eta_t\right] = 0$$

$$(5.8b)\quad -\sum_{s<t} (1+\rho)^{-(s-t+1)} \left[(1-t^h + (1-\alpha)\eta_{s+1})(i_s + i_s' b_s)(1-t_c)\right] + \left[(1-t^h) + \eta_t\right] = 0$$

$$(5.8c)\quad \eta_t + \mu_t - t_c = 0$$

where primed functions represent first derivatives.

While these expressions are complicated, they give simple, intuitive results for special cases. Consider steady states, first. Here, the two conditions are combined to yield (dropping subscripts):

$$(5.9a)\quad (f' - \delta) = c = bi + (1-b)\rho\ \frac{(1-th + \eta)}{(1-t_c)(1-th + (1-\alpha)\ \eta)}$$

$$(5.9b)\quad \frac{dc}{db} = 0$$

Expression (5.9b) says that the firm chooses the debt-assets ratio to minimize the cost of capital, c, to which it equates the net marginal product of new capital. The cost of capital itself is a weighted average of the cost of debt and the cost of equity, the latter of which depends on the value of η. Here, we may distinguish three regimes, as in Auerbach (1979a).[32]

If the dividend constraint is not binding ($\eta = 0$, $\mu = t^h$), then the firm draws its equity funds from retentions. This is reflected by the fact that when $\eta = 0$, the cost of equity finance is $\frac{\rho}{1-t_c} = R\ (\frac{1-\hat{t}^h}{1-t_c})$, the cost of retentions from the previous section. Note that it is independent of t^h, the personal tax rate on dividends. In this regime, the value of q, the ratio of equity value to asset replacement cost less debt, equals $(1-t^h)$.[33] If the new share constraint is not binding ($\eta = t^h$, $\mu = 0$), then firms are paying minimum dividends, and issuing new shares. Here, as in Section IV, the cost of equity finance is $\frac{\rho}{(1-t_c)(1-\alpha\ th)}$.[34] While the cost of capital is still minimized by the choice of b, the resulting optimal value of b, b_N, is higher than the value chosen in the first regime, b_r, since equity is more expensive and $i(\cdot)$ is a convex function. Because new shares come from after-personal-tax dollars, the value of the firm's q is one. This regime corresponds to the classical view of the corporate tax, where the cost of capital is directly influenced by the tax rate on dividends.

Finally, there is the intermediate case where the firm would, if allowed, reduce its dividend and repurchase shares. In this case, neither retentions nor new issues serve as the marginal source of equity; there is a shadow cost of equity capital that lies in between. Thus, marginal finance comes through debt. As b rises from b_r to b_N the cost of debt finance rises from the cost of retentions to that of new shares, with q rising simultaneously.[35]

Outside the steady state, analysis is more complicated by the effect of present behavior on future constraints. For example, new issues today impose a different cost according to whether the resulting extra earnings in future periods allow a reduction in new issues then, or simply an increase in dividends. To simplify matters, we consider a case where firm policy falls in the retentions regime in all future periods $(\eta = 0)$. The results, though messier, would carry over to any case in which η is assumed constant in the future.

With this simplification, equations (5.8a) and (5.8b) yield:

$$(5.10a) \quad (f_t' - \delta) = c_t = (1-a)c_r + a[b_t i_t + (1-b_t)(\rho + (1+\rho)(\frac{\eta_t}{1-th}))/(1-t_c)]$$

$$= (1-a)c_r + ag_t$$

(5.10b) $\frac{dc_t}{db_t} = 0$

where $a = (\frac{\rho+\delta}{1+\rho})$ and c_r is the constant future cost of capital. Now, the cost of capital, c_t, is a weighted average, based on future as well as current financial decisions, but the qualitative conclusions described above still hold. As η_t increases from zero, g_t and hence c_t rises from c_r and b_t rises from b_r, until at $b = b_N$ and $c = c_N$, new shares are issued.

Since such an increase in the cost of capital comes about due to increased investment, we may represent this as a "supply of funds" schedule, as in Figure 1. Which of the three segments of this schedule the firm will actually choose depends on its "demand" for funds: its marginal product of new capital. Three potential positions of the marginal product curve are also shown in Figure 1.

The heights of the retentions and new shares segments of the supply curve depend, in part, on what regime (and value of η) the firm will face in the future. Holding this factor constant, they still depend on the tax rate, $\hat{t}^h$, the firm perceives as belonging to its clientele. Following the results in the previous section, ρ, and hence the cost of capital along the first segment, should be non-increasing with $\hat{t}^h$. The cost of capital in the presence of new issues should be non-decreasing.

These results suggest that in periods when firms are observed to use more expensive forms of finance, the projects they undertake have a higher marginal product. These higher returns should be observed in future years. Because we do not observe marginal products, we must make some assumption about the shape of the return function $f(\cdot)$ to proceed with our empirical analysis. For simplicity, we assume that $f(\cdot)$ is quadratic:

(5.11) $f_t(X_t) = \phi_t X_t - \gamma X_t^2$

with γ constant and ϕ_t a shift parameter driving the productivity changes that occur over time.[36] Since $f_t'(X_t) = \phi_t - 2\gamma X_t$, it follows that the net, before-tax return in period t from investments made in period s is:

$$(5.12) \quad E_t^s = (1-\delta)^{(t-s)} f_s(X_s) = (1-\delta)^{(t-s)} (c_s X_s + \gamma X_s^2)$$

Thus, total net returns before interest and taxes in period t are:

$$(5.13) \quad E_t = \sum_{s<t} E_t^s = \sum_{s<t} (1-\delta)^{(t-s)} (c_s X_s + \gamma X_s^2)$$

If we imagine the firm as assuming that it will be "in the long run" in all future periods, we may write (5.13) as:

$$(5.14) \quad E_t = c_r K_t + \sum_{s<t} (1-\delta)^{(t-s)} a(g_s - c_r) X_s + \gamma \sum_{s<t} (1-\delta)^{(t-s)} X_s^2$$

where g_s is the current component of the cost of capital, as defined in (5.10a), and

$$(5.15) \quad K_t = \sum_{s<t} (1-\delta)^{(s-t)} X_s$$

is the capital stock of the firm in period t.

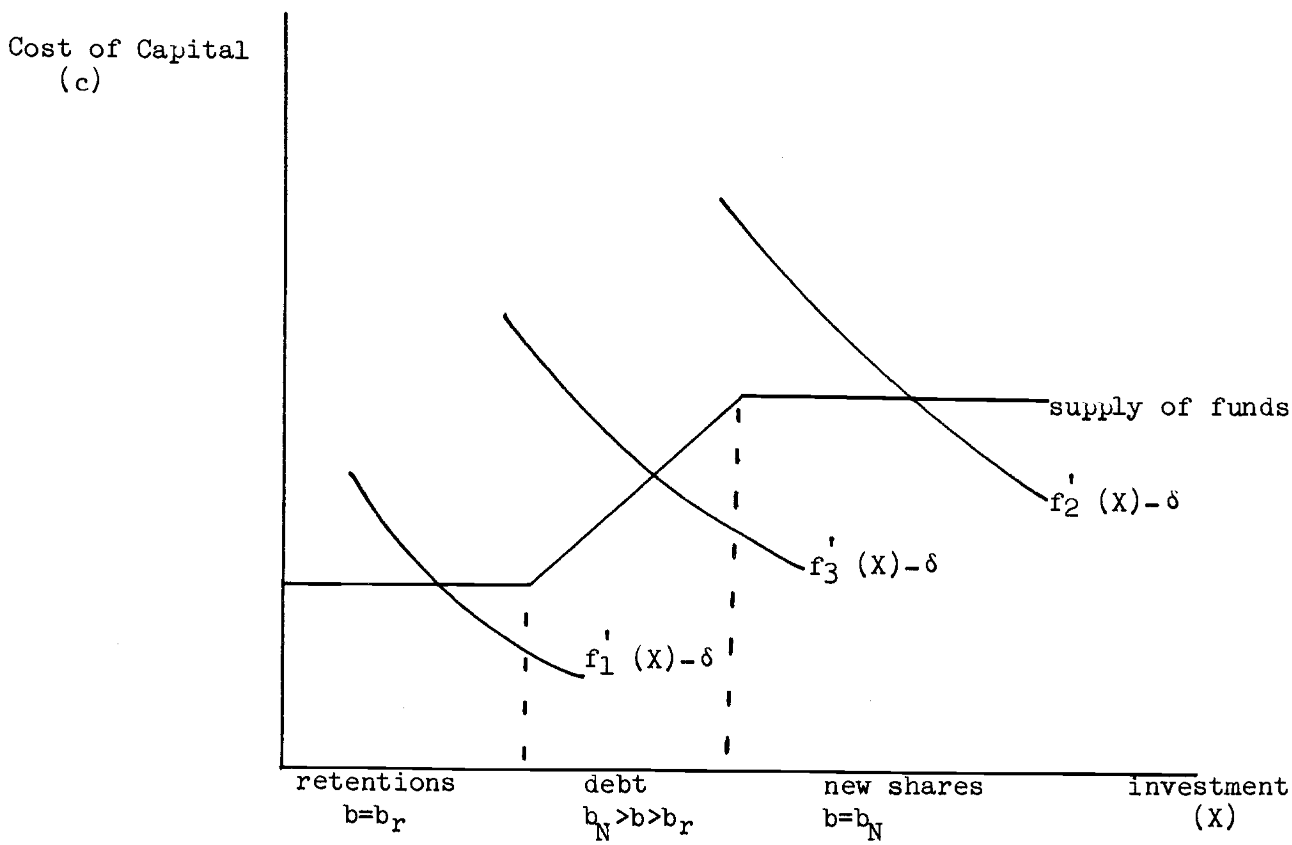
Equation (5.14) will form the basis for the empirical results of this paper. However, parameterization of c_r, g and the error structure of earnings is required before estimation can proceed.

VI. Empirical Results

Equation (5.14) expresses a relationship for each firm between net-of-depreciation, before tax returns in period t, E_t, and historical values of investment and the cost of capital. However, there are a number of practical

Figure 1

Supply of Funds Schedule



difficulties that we must overcome before estimating the parameters of this relationship.

First of all, the equation calls for an infinite history we do not have. For all firms, our observations begin only in 1958. By truncating, we omit the effects of pre-1958 values on each period's earnings. Since these effects die out at rate δ, one method of accounting for them would be to allow for firm effects that decay over time at rate δ.[37] Rather than do this, we begin our regressions in 1963, allowing several years of data for initial lagged values.

A second difficulty concerns our assumption that depreciation allowances follow economic depreciation. In reality, they do not. Over most of the sample period, investment in equipment qualified for an investment tax credit of 7 percent (raised to 10 percent in 1975), and depreciation allowances, while being accelerated in 1954, 1962 and again in 1971, were based on historic cost.[38] These characteristics caused the effective tax rate on corporate investment to be below the statutory rate, in the aggregate, and to differ across investments.[39] That is, the required before-tax rate of return needed to earn a given after-tax rate was lower than that described by (5.14), in which the statutory rate appears. This does not affect the shape of before-tax returns over time, merely their level. Therefore, (5.14) is still appropriate, but the cost of capital term on the right-hand side must be adjusted downward. In principle, this adjustment should be different for each firm, since the degree of deviation from a true income tax varies across assets. However, this is a difficult correction to make. One potential solution would be to multiply both sides of (5.14) by $(1-t_c)$, yielding an expression for the after-tax flows A_t (see (5.3)). This would solve the problem if firms all faced true income taxes, but at different rates, since the patterns over time of after-tax and before-tax flows would be the same. Unfortunately, the method of lowering taxes in practice is by changing the timing of after-tax flows corresponding to given before-tax flows. For example, accelerated depreciation allowances cause taxes to be shifted to later years, making the flow of after-tax earnings from a given investment decay at a rate faster than δ, at which before-tax earnings decay. Since this degree of shifting varies with the rate of effective taxation, a firm by firm adjustment of δ would still be required. Rather than attempt such corrections, we present estimates using as the dependent variable both before-tax and after-tax returns net of corrected depreciation, E_t and A_t, respectively.

Another problem concerns the unobservability of the cost of capital in each period. We assume the rate c_r is constant over time for each firm, and, following the theory of Section V, model the deviation of c_t from c_r, $a(g_s-c_r)$ (See (5.14)), as a linear function of the firm's debt-equity ratio in the beginning of that year and a dummy variable equal to one if the firm issued new shares in that year and zero otherwise.[40] The expected coefficients of each of these variables is positive, since the shadow price η_t rises from zero as debt rises above its optimal value, to t^h when new shares are issued. See (5.10a)).

Because our data does not fit into the beginning-of-period, end-of-period distinction of the previous section, period t earnings may occur before period t investment. Thus, we omit current investment from the right-hand side of the equation we estimate.

These various modifications give us the equation, based on (5.14):

$$(6.1) \qquad E_{it} = \alpha_1 K_{t-1} + \alpha_2 \sum_{s<t} (1-\delta)^{(t-s-1)} d^N_{is} X_{is} + \alpha_3 \sum_{s<t} (1-\delta)^{(t-s-1)} b_{is} X_{is}$$

$$+ \alpha_4 \sum_{s<t} (1-\delta)^{(t-s-1)} X^2_{is}$$

where d_{it}^{N} is the new share dummy variable and b_{it} the debt-equity ratio of firm i in period t, and the variables X_{it} and K_{it} represent firm i's investment in period t and capital stock at the end of period t. The term α_1 corresponds to the firm's "normal" cost of capital c_r, $(\alpha_2 d_{it}^{N} + \alpha_3 b_{it})$ is our parameterization of $a(g_s - c_r)$, and α_4 represents the decreasing returns to scale term γ (see (5.14)). To account for the fact that the theory predicts that c_r should fall with t^h, the firm's "clientele" tax rate, and that the additional cost of new shares, represented by α_3, should rise with t^h, we let α_1 and α_3 be linear functions of the estimated "implicit" tax rates of each firm, as described in Section III. To account for fact that we have not treated risk explicitly, we also let the estimate of the normal required return, α_1, depend on the firm's "beta", also described in Section III. Since we are looking at returns to debt plus equity, rather than debt, we multiply each firm's beta by the average ratio over the sample of equity to debt plus equity for the firm. To correct for potential heteroskedasticity, we divide the observations for each firm by a trend value of assets, V_{it}, equal to the beginning of sample period value of each firm's assets, inflated by the average annual growth rate in real assets for all firms between 1963 and 1977, 5.45 percent. We also assume that the decreasing cost term γ is proportional to $1/V_{it}$, rather than constant. This makes more sense for comparing firms of different size. This correction amounts to dividing the weighted sum of squared investment terms x_{is}^2 by V_{it} squared, rather than V_{it}.[41]

Finally, we must specify the error structure. Since many firms derive earnings from noncapital sources (rent, patents, etc.), firm effects should be accounted for. We used a fixed effects, rather than a random effects, specification, because the presence of higher earnings in any period would be predicted by our model to be correlated with all the right-hand side variables.[42] We also allow for fixed time effects.

We turn now to the results, shown in Tables 6.1 and 6.2 for the before-tax and after-tax earnings measures, respectively. (Variable definitions are provided in Table 6.3.) In each table, results without fixed effects removed are shown in the first two columns, while those with fixed effects removed are shown in the third and fourth. Once fixed effects are removed, the results generally support the model outlined in Section V the parameter values are reasonable in addition to having the correct sign.

Looking first at before-tax earnings in Table 6.1, we find in column (6.11) the results of a basic version of the model that does not allow for the various costs of capital measures to vary across firms. This model with firm and time effects removed is presented in column (6.13).

Comparing the two columns, we find that the allowance for fixed effects lowers the sum of squared residuals significantly,[43] and lowers the coefficient of new shares and the basic estimate of the cost of capital, the coefficient of K (the latter ceases to be significantly greater than zero). This may result from a positive relationship between firms with high earnings in general and firms that issue new shares. The coefficients in equation (6.13) suggest a normal before-tax real return of near zero, and a return of 16.0 percent before tax on assets purchased in years when new shares are issued. The effect of the decreasing returns term, K_2, is also significantly positive, as predicted. The leverage term K_b, which should have a positive coefficient, is insignificantly negative.

When firm tax and risk effects are introduced, in equations (6.12) and (6.14), the inclusion of fixed effects makes a big difference in the results.

Table 6.1

Estimation Results

Dependent Variable: E (Earnings Before Interest and Taxes)

Equation

Independent Variable	(6.11)	(6.12)	(6.13)	(6.14)
Intercept	.144 (33.24)	.139 (33.57)	*	*
K	.032 (3.11)	-.156 (-11.71)	.003 (1.54)	.0004 (.22)
Kt^h	--	.092 (9.52)	--	-.079 (5.96)
$K\beta$	--	.232 (17.83)	--	.235 (14.59)
K_N	.266 (23.83)	.297 (21.54)	.157 (21.30)	.137 (14.50)
K_Nt^h	--	-.112 (-4.24)	--	-.007 (-.42)
K_b	-.313 (-17.25)	-.259 (-14.81)	-.028 (-1.87)	-.096 (-6.05)
K_2	.194 (16.32)	.107 (8.52)	.060 (8.49)	-.069 (-6.19)
$\bar{R}^2$	.226	.308	--	--
SSE	55.48	49.61	14.32	13.59

t - statistics in parentheses

* firm and time effects subtracted

Table 6.2

<u>Estimation Results</u>

Dependent Variable: A (Earnings Before Interest, After Taxes)

Equation

Independent Variable	(6.21)	(6.22)	(6.23)	(6.24)
Intercept	.067 (27.92)	.064 (27.86)	*	*
K	.036 (6.41)	-.055 (-7.51)	.001 (1.45)	.0002 (.17)
Kt^h	--	.048 (8.87)	--	-.036 (-4.86)
K^b	--	.112 (15.52)	--	.123 (13.74)
K_N	.137 (22.37)	.152 (19.89)	.084 (20.61)	.073 (13.87)
$K_N t^h$	--	-.056 (-3.78)	--	-.002 (-.22)
K_b	-.193 (-19.37)	-.167 (-17.19)	-.030 (-3.59)	-.067 (-7.62)
K_2	.064 (9.81)	.022 (3.22)	.002 (0.63)	-.065 (-10.48)
$\bar{R}^2$	.188	.257	--	--
SSE	16.74	15.31	4.42	4.22

t - statistics in parentheses

* firm and time effects subtracted

Table 6.3

Variable Definitions

E - Earnings before interest and taxes; corrected

A - Earnings before interest, after taxes; E minus taxes, minus the corporate tax rate multiplied by nominal interest payments.

K - Net capital stock; equals the sum of previous investments times the fraction of each investment remaining:

$$K_t = \sum_{s \leq t} (1-\delta)^{-(t-s)} X_s$$

K_N - Net capital stock, weighted by new share dummy d_N in the year of investment:

$$K_{Nt} = \sum_{s \leq t} (1-\delta)^{-(t-s)} d_{Ns} X_s$$

K_b - Net capital stock, weighted by debt-equity ratio b in the year of investment:

$$K_{bt} = \sum_{s \leq t} (1-\delta)^{-(t-s)} b_s X_s$$

K_2 - Net capital stock, weighted by investment in the year of investment, divided by current trend assets:

$$K_{2t} = \frac{1}{V_t} \sum_{s \leq t} (1-\delta)^{-(t-s)} X_s^2$$

t^h - "Implicit" tax rate of the firm's clientele

β - The firm's "beta", multiplied by the firm's average ratio of equity to total market value.

Without fixed effects, (equation (6.12)) several of the variables are significant and of the wrong sign. However, with fixed effects removed (equation (6.14)), the coefficients are much more reaonable. The "normal" return (now a risk-free rate) is still insignificantly positive. However, the coefficient on $K\beta$ indicates that a firm with a β of 1 has a before-tax cost of capital of 23.3 percent. The coefficient on Kt^h indicates that the cost of retentions is significantly reduced by an increase in the clientele tax rate, as our theory predicts. However, the extra cost imposed by new share issuance is not significantly affected by t^h. The coefficients on K_b and K_2 are now significantly negative, for which we have no ready explanation.

The results for after-tax earnings are quite similar, with essentially all the coefficients in equation (6.24) being appropriately smaller than their counterparts in (6.14).

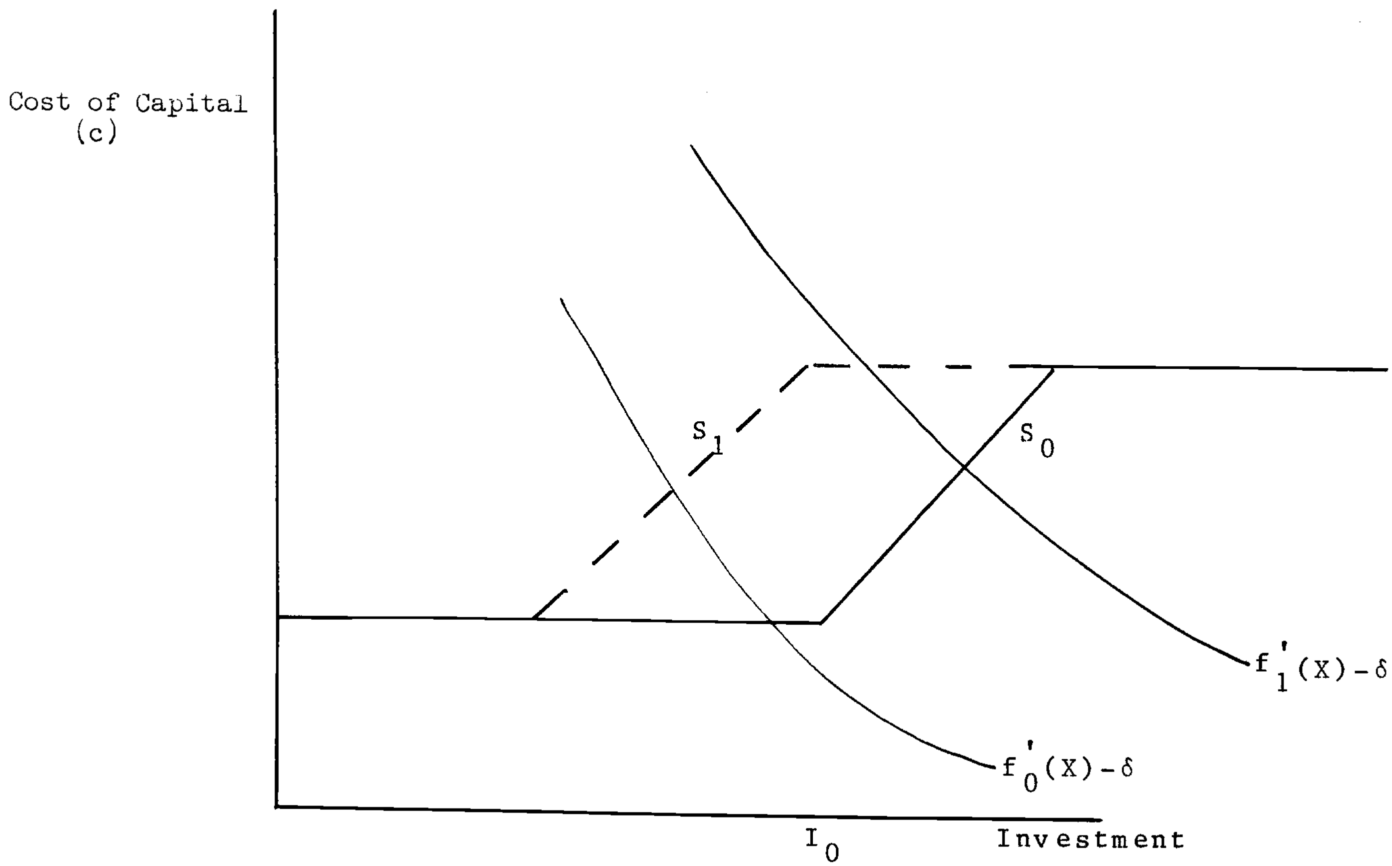
Some care must be exercised in interpreting these findings. There still remains a potential problem of simultaneity bias if the individual firm errors, purged of fixed effects, remain serially correlated. If the unexplained random component of earnings for a particular firm is positively autocorrelated, there are two potential sources of bias in the estimated coefficients. First, as long as dividends do not absorb the entire fluctuation in earnings, higher earnings makes available a greater pool of retentions, making the issue of new shares less likely, and possibly increasing the level of investment. This would tend to bias downward the coefficient of the new share term, K_N, and bias upward the coefficient of K and $K\beta$. On the other hand, higher earnings today may give the firm information on the profitability of its potential investment. If this information leads to greater investment today, then the future returns to investment, and hence the coefficient of the investment terms K and Kβ, will again be biased upward. The bias this effect induces in the new shares coefficient depends on how the left out profitability variable depends on the likelihood of new issues, given the level of investment. Under the hypothesis that the cost of capital does not increase when firms issue new shares, profitability can be summarized by the firm's real decisions - its level of investment. Its finan cial policy is irrelevant. New issues may increase with profitability, but variations in new issues independent of variations in investment can relate only to such things as the level of retentions, already discussed. Thus, if new shares are perceived by the firm to be no more expensive than retentions, only the first, downward bias in the new shares coefficient will be present. Therefore, our significantly positive coefficients in both before-tax and after-tax regressions represent strong evidence against such a hypothesis.

If new shares are perceived by the firm as more expensive, then the likelihood of new issues can increase with profitability, for a given level of investment. An example is shown in Figure 2, where lower retentions shift the supply of funds schedule to the left, from S_0 to S_1, and increased profitability shifts the marginal product curve up. Together, these shifts do not increase investment, but do cause the firm to issue new shares. Thus, a potential upward bias is present in the new shares coefficient, but only if new shares are perceived by the firm as more expensive, in accordance with our hypothesis.

To avoid these possible biases, we reestimated the earnings equations (6.13), (6.14), (6.23) and (6.24) with a correction for first-order serial correlation, assumed constant across firms. While correcting for potential simultaneity bias, such a technique may substantially reduce the explanatory power of a model in which the lag specification is uncertain. While we model

FIGURE 2

Variations in Supply and Demand



earnings to flow from investment at a geometrically declining rate beginning in the year after an investment, the exact pattern could vary substantially from this.[44] Such a specification error likely will be exacerbated by differencing. For example, if earnings don't respond until two years after an investment, the change in earnings in the year after an investment will be independent of the amount of the investment.

In light of this problem, the results in Table 6.4 offer impressive support for the existence of the tax effects just found. The coefficients of K_N and Kt^h remain quite significant in all specifications, while the coefficients on $K_N t^h$ remain insignificant. The fact that the coefficients of $K\beta$ are no longer significant may signal the presence in the original earnings regressions of the sort of upward biases discussed above.

In summary, our results support the hypothesis that new shares are perceived by firms to be more expensive than retentions as a means of finance. Moreover, the systematic variation of the cost of retentions with respect to indirect estimates of the personal tax rates of firm stockholders suggests that this differential is related to tax considerations (rather than transaction costs, for example). These results are not consistent with the view that personal taxes don't matter, which would predict no effect for Kth and (unless a nontax extra cost of new shares issues were envisioned) K_N, both of which have strongly significant coefficients. Nor do they support the view that firms always behave as if they were on the margin of issuing new shares, as the classifical or double-tax view would suggest. This would predict a zero coefficient for K_N, since whether firms actually <u>do</u> issue new shares would be irrelevant. It would also predict a positive coefficient for Kt^h, since the cost of new shares is nondecreasing with respect to t^h.

Table 6.4

Estimation Results

(With Correction for First-Order Autocorrelation)

	Equation			
Dependent Variable:	(6.33) Earnings Before Tax	(6.34) Earnings Before Tax	(6.43) Earnings After Tax	(6.44) Earnings After Tax
Independent Variable:				
K	-.019 (-.79)	.067 (1.61)	-.014 (-.98)	.042 (1.74)
Kt^h	--	-.105 (-3.82)	--	-.046 (-2.87)
K^b	--	-.059 (-1.28)	--	-.050 (-1.85)
K_N	.082 (5.63)	.085 (4.78)	.046 (5.43)	.046 (4.42)
$K_N t^h$	--	-.026 (-.82)	--	-.011 (-.59)
K_b	-.043 (-1.59)	-.037 (-1.36)	-.030 (-1.90)	-.029 (-1.79)
K_2	-.002 (-.17)	-.010 (-.61)	-.016 (-1.99)	-.017 (-1.86)
p*	.7	.7	.7	.7
SSE	6.57	6.52	2.21	2.20

t - statistics in parentheses

Firm and time effects removed in all equations

*Grid search technique used to calculate p, with grid size = .1

That new shares are issued while dividends are paid also contradicts the naive view that firms finance out of retentions whenever possible. However, our results do support a view that firms, facing various constraints, must in the short run behave in a manner not optimal in the long run, issuing new shares and, perhaps, too much debt instead of cutting dividends. To facilitate the application of our findings to the analysis of the welfare effects of changes in the tax policy toward corporate source income, a better understanding of these constraints is necessary.

Footnotes

1. See, for example, Farrar and Selwyn (1967), Brennan (1970), Miller (1977), Auerbach (1979b) and Auerbach and King (1982).

2. See DeAngelo and Masulis (1979) and, for an empirical investigation, Cordes and Sheffrin (1981).

3. See Myers (1977).

4. U.S. Economic Report of the President (1982), p. 327. The retentions figure includes inventory valuation and capital consumption adjustments.

5. See Auerbach (1979a) and Bradford (1981) for somewhat different models that generate this result.

6. See the evidence presented in Section III.

7. For further discussion of this distinction, see Poterba and Summers (1981).

8. See Litzenberger and Ramaswamy (1980), Green (1980) and Auerbach (1982b). The first of these studies utilizes monthly rather than daily data.

9. See the above studies, as well as the original investigation of ex dividend day price behavior by Elton and Gruber (1970).

10. See Miller and Scholes (1981), for example.

11. See the results in Section III below.

12. Most of our firms have such data going back to 1958, although for a few firms some of the years between 1958 and 1962 are missing. For such firms, we start with the first year after which observations are continuously available.

13. The data on aggregate outstanding issues are obtained from <u>Historical Statistics of the United States</u>, p. 1005

14. Our procedure allows for changes in the method used by a firm.

15. It is important to remember that book depreciation figures are distinct from depreciation allowances for tax purposes, which are greatly distorted and change over time with changes in the tax law.

16. An alternative method of estimating δ as the average of book depreciation divided by book net capital over the sample period was also evaluated. Its use in the empirical work produced similar results but a somewhat poorer fit than those reported in Section VI.

17. An alternative way of calculating this variable would be to add to earnings incorporating the debt adjustment described above the corrected returns to debt.

18. We assume for all firms that all interest payments were deducted at the standard marginal rate for corporations, .48 for essentially the entire period of estimation.

19. We use a cut-off of 2 percent of outstanding shares in this measure, since smaller new issues probably are related to such things as executive stock option plans, etc.

20. We assume debt is riskless, and that there is no bankruptcy.

21. The function $f(\cdot)$ is not subscripted by firm merely as a convenience. This assumption has no bearing on the results of this section.

22. The amount $\bar{W}^h$ may be thought of as interest plus labor income less consumption in period 1.

23. Although tax exempt municipal debt does not play a role in a number of countries, it is important in the U.S. For example, in 1980, according to the Economic Report of the President (1982), state and municipal bond offerings were 42.3 billion dollars, slightly greater than corporate issues of bonds and notes, which amounted to 40.9 billion dollars.

24. If new shares are issued by firm i, then $(E_i - N_i)$ represents the value of pre-existing shares of the firm, and $\bar{n}^h_i(E_i - N_i)$ the endowment of individual h in firm i.

25. We do not impose restrictions on short sales of equity, either in total or with respect to individual firms. While this could be done (as in Auerbach and King (1982) and Auerbach (1982b)) it unnecessarily complicates the present analysis.

26. See Auerbach and King (1982).

27. See Auerbach (1979b). Since dividends are taxed, each investor's wealth in the firm would equal the value of shares plus the after-tax current dividend.

28. It is important here to stress, again, that these results relate to the specific character of the U.S. tax system. In other tax systems, such as in the United Kingdom and Germany, new shares are not necessarily a dominated form of finance. See the description in King (1977).

29. As a simplification, we assume that the future return from investment made in period t is independent of investments made in periods $s > t$. Clearly, this type of separability is unlikely to hold in general. One would expect that unusually high profit opportunities would be eroded by future increases in related investments. To some extent, this is accomodated below by the assumption of geometric decay. The important feature we wish to model is that unusually profitable investments should produce noticeably high returns in the years immediately following. One could also derive this type of result from alternative models; for example, one with homogeneous capital goods but convex capital stock adjustment costs.

30. We will discuss below the effects of more general depreciation schedules.

31. While prohibited in the U.K., share repurchases do infrequently occur in the U.S. While not illegal, they are discouraged by a number of provisions in the Internal Revenue Code (see Auerbach (1979b)).

32. A similar steady state analysis for equity-financed firms is performed by Edwards and Keen (1981).

33. Auerbach (1979a). This follows directly from the fact that, at the margin, firms are indifferent between an extra dollar of after-tax dividends, $(1 - t^h)$, and an additional dollar of firm assets.

34. The term α was equal to one in the result above since second period retentions were zero.

35. In Auerbach (1979a), this regime was characterized by a zero change in investment with rising q, since only equity finance was considered.

36. In the equation actually estimated, we scale γ by a trend measure of firm size to make the equation comparable for firms of different size.

37. Such a procedure is described in Pakes and Griliches (1982).

38. For a discussion of such changes see Auerbach (1982a).

39. For historical values of such effective tax rates, see Auerbach and Jorgenson (1980) or Jorgenson and Sullivan (1982).

40. The cutoff for new shares here was 1 percent of existing shares. If firms issued any greater quantity of shares, the dummy was set equal to one. If the change was less, the dummy was set equal to zero. Negative share issues, or share repurchases, are relatively infrequent.

41. Estimates without this correction yielded somewhat different values for α_4, but had little effect on the other important coefficients.

42. See Mundlak (1978).

43. The F-test statistic equals $\frac{(55.48 - 14.32)/288}{55.48/4110} = 10.59$.

44. For example, Pakes and Griliches (1982) estimate unconstrained distributed lags of earnings on investment, assuming all firms' capital stocks have this same pattern of returns. They find the lag weights do not decline from the first year, but peak in the second. Application of their technique to the current problem would be complicated by the presumed differences in return patterns and the additional variables in the earnings regressions. However, further investigation in this direction would be quite useful.

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