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DIVIDEND AND SHARE CHANGES: IS THERE A FINANCING HIERARCHY?

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ABSTRACT

The most widely accepted empirical dividend model is that proposed by Lintner, who argued that firms smooth dividends over time. Many theoretical dividend models, however, either predict that dividends should be highly variable, or at least offer no support for the smoothing hypothesis. We use a switching regression model to test the Lintner model against an alternative which allows dividend behavior to differ depending upon whether or not firms are issuing shares. We reject the Lintner model, finding no evidence of dividend smoothing when firms are not issuing shares, and a high negative dividend growth rate when firms are issuing shares. This description of dividend behavior suggests the existence of a financing hierarchy in that the marginal source of finance differs over time. To further explore the financing hierarchy, we estimate logit models which explain the decisions by firms to change dividends, and to issue or repurchase shares. The results are consistent with the existence of a financing hierarchy.

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DIVIDEND AND SHARE CHANGES: IS THERE A FINANCING HIERARCHY?

1. INTRODUCTION

There are two major puzzles about corporate dividend behavior, both of which pertain simultaneously to the dividend decision on one hand, and the equity issue/repurchase decision on the other:

1. Why do firms issue shares and pay dividends simultaneously?

2. Why do firms pay dividends in lieu of repurchasing shares?

Dividend income is taxed more heavily than capital gains income in the U.S.; if investors and managers have symmetric information about the firm, this can be shown to imply that firms should never simultaneously issue equity and pay dividends; it also implies that, if possible, firms should repurchase shares in lieu of paying dividends.[1] Signalling models of dividends, such as those by Bhattacharya [1979] and John and Williams [1985] predict the simultaneous payment of dividends and issuance of equity, but present other theoretical and empirical difficulties.[2]

While tax and signalling stories are frequently invoked to explain corporate dividend behavior on a theoretical level, the most widely accepted empirical dividend model is the Lintner [1956] model. Lintner argued (based on survey evidence) that managers attempt to smooth dividends over time, with the goal of reaching a target long-run payout ratio. Subsequently, Fama and Babiak [1968] and Marsh and Merton [1985] estimated versions of the Lintner model, and concluded that it is a reasonable description of dividend behavior,[3] without, however, testing the model against a sharply delineated alternative hypothesis.

The central feature of the stylized Lintnerian description of dividend behavior is that dividends depend on earnings in a manner which is independent of other firm decisions. By contrast, tax and signalling models of dividends generally imply that dividend decisions should be determined jointly with share issue and other financial decisions.

In this paper we test a version of the Lintner model against the alternative hypothesis that dividend behavior is different when firms issue shares and when they do not. We reject the Lintner model in favor of this alternative; perhaps more surprisingly, we find no evidence that firms smooth dividends during periods when they are not issuing equity. When firms do issue equity, the dividend growth rate becomes sharply negative, lending support to theories of capital structure which predict that firms will pay lower dividends when they issue shares.

These results suggest the existence of a financing hierarchy, in which dividends serve as the marginal source of finance for the firm when cash flow is high relative to investments, while equity issues are the marginal source of finance at other times. To further explore this idea, we also estimate a model of the decisions to change dividends, and to issue and repurchase shares, and find further support for the financing hierarchy hypothesis.

The specific plan of the paper is as follows: in section 2 we discuss several tax and signalling models of dividends, and we argue that some of them have implications different than the Lintner model. In section 3 we discuss the data, which are drawn from a panel of firms obtained from the Annual Compustat file.

In Sections 4 and 5 we then study empirically both the dividend and share issue / repurchase decision of firms. In particular, since theory suggests that dividends and share issues should not be independent decisions, in Section 4 we estimate a switching regression which has the traditional

Lintner model as a special case. The regression allows coefficients to be different when firms issue equity. We find that when firms are not issuing equity, only lagged stock returns are a significant determinant of the change in dividends, while when firms do issue equity, stock returns become insignificant and the dividend growth rate becomes negative. Thus, dividend behavior is both statistically and economically different than that predicted by the Lintner model.

In Section 5, we estimate a multinomial logit model of the decision to issue, repurchase, or leave unchanged the number of shares, and a separate equation for increasing, decreasing, or leaving unchanged the dividend.[4] The empirical results show that corporate dividend and share decisions are broadly consistent with the following description of corporate financial behavior: profitable firms on the margin use dividends and debt as sources of finance, and the least profitable firms use equity issues as a last resort form of financing. This description is reminiscent of Myers's [1984] financing hierarchy, in which firms prefer internal to external finance, and debt to equity finance.

Section 6 concludes. There are two appendices. In one appendix we formalize the intuition about the behavior of a model in which equity issues are a last resort form of financing by analyzing a simple tax-based, dynamic financial policy model similar to that in Auerbach [1984]. Despite the simple structure of the model, the desire to avoid equity issues (which are costly for tax reasons) generates relatively rich behavior. The other appendix derives the coefficient standard errors for the switching regression model.

This paper is related to previous empirical studies both of debt-equity ratios and dividend policy. The paper closest in spirit to ours is Kalay and Shimrat [1985], who look at the behavior of dividends and earnings of firms which issue equity. They find evidence that, even though dividends are positive when firms issue equity, payout ratios and dividends are low for equity-issuing firms. This is similar to our result in Section 4 that, controlling for other determinants of dividends, the dividend growth rate is negative when firms issue equity. Other related dividend papers are Anderson [1985], Fama and Babiak [1968], and Marsh and Merton [1985].

There have been numerous empirical studies of debt-equity ratios;[5] most have either estimated a partial adjustment model of the debt-equity ratio (and possibly other financial ratios as well) or used a classificatory statistical method to group firms by debt-equity ratios. Most of the classificatory studies have studied the decision to issue one kind of security vs another, but have not considered the decision between issuing and not issuing as we do.[6] Also, although other papers have looked at the decision to issue equity, to our knowledge no one else has examined the stock repurchase decision in this kind of framework.[7]

The empirical tests in this paper focus on changes in financial policy rather than levels. Intuitively, active capital structure decisions made by management should be more revealing of managerial intentions than the passive changes that result from debt reaching maturity or the stock price changing.[8] For example, if the stock price rises and the debt to equity ratio thereby falls, the reason for the rise in the stock price may affect management's decision to issue additional debt or repurchase shares. Management may respond differently if a rise in the stock price reflects future growth opportunities as opposed to an increase in the market value of assets in place. By studying active financial policy changes, there is a greater chance of uncovering the decision variables used by financial managers.

2. THEORIES OF DIVIDEND AND SHARE POLICY

In this section we will briefly review the implications of some financial policy models, with the goal of understanding their empirical predictions about dividends and share policy. This review is meant to be suggestive, not exhaustive. The idea that there is a financing hierarchy, i.e. that at different times different sources of finance will be the marginal source of finance for the firm, is frequently present in dynamic models of capital structure, so we will use it as an organizing principle in the discussion. Unfortunately, while theoretical models are useful in thinking about capital structure issues, there exists no unified, comprehensive, testable model of financial policy. In addition, there are even different versions of the financing hierarchy story, based on taxes, information considerations, and agency considerations.

For many years, thinking about capital structure decisions was dominated by what Myers [1984] has termed "static" capital structure models. In this view of capital structure, the firm trades off a fixed cost of debt finance, such as bankruptcy cost, against the tax benefit of paying interest, and there is a fixed target capital structure. In these models the firm is like a balloon, for which all features become proportionally larger as the balloon is blown up. The marginal source of finance is implicitly taken to be the weighted average of its existing capital structure. Empirical work based on these models relies on the implication that there is a unique target capital structure (such as a desired dividend payout or debt-equity ratio) towards which managers aim.[9] It is implicit that changes in exogenous variables (such as the operating risk of the firm) will change the optimal capital structure, but there is no model of the adjustment process.

Myers [1984] has argued that these static models fail to explain many stylized (but largely undocumented) facts about corporate financing, which are better accounted for by dynamic capital structure models. One stylized fact is the existence of a so-called "financing hierarchy": firms appear to have lexicographic preferences for sources of financing, such as preferring internal to external finance and, once external finance is required, debt finance over equity finance.

The general notion that there is a financing hierarchy, i.e. that there are different costs associated with different forms of financing, generates a rich model of financial policy. For example, if equity issues are a last resort, managers will follow policies which minimize the chance of a future equity issue, such as retaining earnings (investing in marketable securities) and reducing debt outstanding.[10,11] The models of financial policy which we will discuss all imply that equity issues are a last resort form of financing.

Tax models (see, e.g. Auerbach [1984]) predict that equity issues are a financing source of last resort for tax reasons. A tax-based financial policy model is sketched in Appendix A. If the dividend tax rate exceeds the capital gains tax rate, cash inside the firm (which necessarily bears the dividend tax) is cheaper than cash outside the firm.[12] This implies that firms will attempt to reduce the chance of future equity issues, which can be accomplished with a reduction in current dividends or a reduction in current debt outstanding (thus preserving debt capacity for the future). When future equity issues are unlikely, firms can issue debt to the extent of debt capacity to take advantage of the tax advantage to debt.

This model has clear implications for dividend behavior. If future equity issues are likely, dividends will be set at a low level and hence they will be insensitive to earnings fluctuations. On the other hand, firms which are not likely to issue equity will use dividends as the marginal source of finance, and dividends will vary with current cash flow. Thus, profitable firms issue debt and use dividends as a marginal source of finance. Less profitable firms cut dividends, reduce debt (to minimize the chance of a future equity issue), and if faced with a current equity issue, cut dividends to zero and raise additional debt before issuing equity. Notice that the Lintner description of dividends is not supported by this model, since high cash flow firms will make no effort to smooth dividends. Low cash flow firms will pay non-varying and hence "smoothed" dividends.

The dividend signalling models of Bhattacharya [1978] and John and Williams [1985] also predict that equity issues are a financing source of last resort, but these models make different predictions about dividends. For example, John and Williams [1985] predict that firms will pay dividends only when issuing equity, i.e. when cash flows are low. High cash flow firms repurchase shares instead of paying dividends. This prediction of a strong negative relation between dividends and cash flow clearly contradicts the Lintner model as well as both casual empiricism and the more formal empiricism in Section 4. The model in Bhattacharya [1979] also predicts that firms will be observed to pay dividends and issue equity simultaneously, with an ambiguous relationship between the size of the dividend and the frequency of equity issues.[13] The Bhattacharya model is possibly consistent with the Lintner model, in that dividend policy may be independent of share issues.

Finally, Myers and Majluf [1984], in an application of the lemons model, also predict that firms will avoid share issues. As with the tax model, firms accumulate "financial slack" (investments in liquid assets) in preference to paying out dividends when the chance of an equity issue is high. Equity is issued only after debt capacity is exhausted. Although the model is not explicit about dividends, it appears likely that firms for which future equity issues are unlikely and which lacked non-negative NPV projects would make net payouts to shareholders.

Thus, recent capital structure models reach varying predictions about the relationship between dividends and equity issues; some are at odds with the Lintner model (the tax story and the John-Williams signalling story), while others (Bhattacharya) are possibly consistent with it.

The signalling models discussed do not include debt and thus do not make predictions about the debt-equity choice. The tax and Myers-Majluf models generate similar predictions about external financing, in that profitable firms use payments to share holders as the marginal source of finance, while unprofitable firms reduce these payments, issue debt, and issue equity as a last resort.

3. THE DATA

The Sample: The sample of firms was drawn from the 1984 Compustat Industrial data file, covering 1965-1984. We excluded a firm if:

1. The firm was primarily engaged in the banking or insurance industry, or was a public utility.
2. The firm had missing data for key variables between 1965 and 1984.
3. The fiscal year was not constant between 1971 and 1984.
4. The stock price data needed to compute fiscal year stock returns for non-December fiscal year firms was not available on CRSP for this period.

The resulting sample contained 423 firms, with data for 1971 to 1984. The cutoff at 1971 was necessary because we used the accounting statement of changes to infer capital structure changes, and the vast majority of firms only began reporting these numbers in 1971. Table 1 provides a listing of the number of sample firms in each two-digit SIC code classification. For most of our estimation procedures computer memory limitations[14] prevented using the full 14 years and 423 firms. Because of this we sorted the firms alphabetically and used the data for the first 287 firms (4018 observations in all) when we needed to truncate the sample.

To locate possible equity issues we screened the data items Sales and Purchases of Common and Preferred Stock (from the statement of changes categories in the Compustat file) to determine when firms neither issued nor repurchased shares. Unfortunately, a variety of different transactions can generate positive entries in these Compustat data items. Among these are primary equity issues (both common and preferred), warrant issues, debt-equity swaps, exercises of executive stock options and warrants, and acquisition-related transactions. As a further preliminary screen, we required that the reported equity issue be at least 3% of the firm's market value of equity the previous year. For every observation which passed this screen, we checked the annual report for the description of the transaction.

We excluded reported equity issues due to executive stock options and warrant exercises on the grounds that these represented equity issues beyond the firm's control, or in the case of executive options, issues occurring for fundamentally reasons fundamentally different than the reasons for ordinary stock issues. We noted which were swaps, but they are not automatically excluded.

The variables used in the estimation are described in Table 1.

One implication of the models discussed in Section 2 is that the optimal choice of debt and dividends will vary over time for a given firm. As a way of evaluating the proposition that financial policies are static over time, Table 3 provides measures of how financial policies vary across time for the individual firms in our sample.[15] All variables are defined in Table 2. Columns 1 through 4 display the average across firms of the range across time for each firm, for each of seven financial variables. For the average firm, the debt-to-market-value ratio varies by .26 over the 14 years. The next row shows that the variation in the ratio of debt to the book value of assets is almost as large, which demonstrates that the large amount of variation in the debt to market value ratio is not due to changes in the market value of equity. The dividend yield on average varies by 5.5 percentage points for a given firm. That this is not due solely to changes in the market value of equity is demonstrated in the next row, which displays the statistics for dividends per share divided by the average equity price over the 14 years. (Dividing by average price adjusts for differences in the number of shares per dollar of assets.)

Finally, the last three rows show that the amount of external financing undertaken (as reported in the statement of changes) is also quite variable. This is not surprising for changes in equity, which are rare events, but the deviation over time in the amount of debt financing (as a percent of total market value) is 20% of the market value of the firm, which is substantial. It seems clear that there is substantial variation over time and across firms in both patterns of financing and levels of various financial ratios.

Figures 1 and 2 depict the pattern of changes in dividends and shares which occur in our sample. Figure 1a shows that with but two exceptions (1971 and 1972) well over 50% of the firms in the sample change their dividend in any given year. Of the firms that change dividends, the vast majority raise them. On average only about 10% of the sample lowers dividends in any given year. Figure 1b shows that slightly under half of the firms in the sample did not lower their dividends once during the 14-year period. About 20 firms did not change dividends at all during this period. The modal number of years for a firm to not change dividends is two. Dividend changes seem fairly well distributed across firms.

As expected, equity changes are considerably rarer. Figure 2a shows that never do more than 20% of the firms report issues in a given year and repurchases are rarer still. From Figure 2b, 60% of firms show no repurchase activity during the whole period, and 30% never issue shares. Of those firms that do issue or repurchase, few do so more than twice during the period. If there appear to be too many share issues in Figure 2 (compare our numbers to the result in Kalay and Shimrat [1986] that the average unregulated firm issues equity once every fifty years), it should be kept in mind that the data include shares issued in mergers and acquisitions, and issues of preferred stock.

4. A DIRECT TEST OF THE RELATIONSHIP BETWEEN DIVIDENDS AND EQUITY

In this section we address the financing hierarchy question directly by examining the dividend policy of firms which are issuing equity. We estimate a model of dividend changes in the spirit of Fama and Babiak and Marsh and Merton, and ask whether the regression equation explaining dividends changes depends upon the equity policy the firm is pursuing. If equity is a last resort, then we should observe a decline in the dividend growth rate when shares are issued. We test the Lintner model by estimating a switching regression model with endogenous switching as in Lee and Trost [1978].

A. The Statistical Model

The model is specified as follows. Suppose there are two "regimes" for a firm. The current regime is determined by an endogenous variable, which we observe to be either zero or one, and which is a function of a set of variables Z:

$$(1) \qquad I = Z\gamma - u,$$

and that in regime i dividend policy obeys the equation

$$(2) \qquad \Delta D = X\beta i + \varepsilon_i \qquad \begin{aligned} i &= 1 \text{ if } Z\gamma > u \\ &= 2 \text{ if } Z\gamma < u. \end{aligned}$$

where X is a vector of explanatory variables. In our model, I represents the current equity policy of the firm, i.e. whether the firm is issuing or repurchasing shares. The firm is in regime 1 if $I > 0$ (issuing shares) and in regime 2 if $I \leq 0$ (repurchase or no change in shares). Assume that u, ε_1, and ε_2 are jointly normally distributed, and let Φ and ϕ denote the cumulative normal density and the normal density. We will write Φ and ϕ as shorthand for $\Phi(Z\gamma) = \text{prob}(u < Z\gamma) = \text{prob(regime 1)}$ and $\phi(Z\gamma)$ = the standard normal density evaluated at $Z\gamma$. Then, following Lee and Trost,

$$(3) \qquad E(\Delta D) = (X\beta_1 + E(\varepsilon_1 \mid u < Z\gamma))\,\text{Prob}(u < Z\gamma) + (X\beta_2 + E(\varepsilon_2 \mid u \geq Z\gamma))\,\text{Prob}(u \geq Z\gamma)$$

Using standard results on the truncated normal distribution,[16] this can be rewritten

$$E(\Delta D) = (X\beta_1 - \sigma_{1u}\phi/\Phi)\,\Phi + (X\beta_2 + \sigma_{2u}\phi/(1-\Phi))\,(1-\Phi)$$

$$= X\beta_2 + \Phi X(\beta_1 - \beta_2) + \phi(\sigma_{2u} - \sigma_{1u})$$

or

$$(4) \qquad \Delta D = X\beta_2 + \Phi X(\beta_1 - \beta_2) + \phi(\sigma_{2u} - \sigma_{1u}) + \eta.$$

(4) can be estimated using OLS, with estimates $\hat{\Phi}$ and $\hat{\phi}$ used in place of the true Φ and ϕ, which are unknown. We will discuss in a moment where these estimates come from. Let Y denote a dummy variable which equals one in regime 1 and 0 in regime 2. It is possible to show that if the estimated $\hat{\Phi}$ and $\hat{\phi}$ are used, then the error term, η, has the form

$$(5) \qquad \eta = Y\varepsilon_1 + (1-Y)\varepsilon_2 + (Y - \Phi)X(\beta_1 - \beta_2) + (\Phi - \hat{\Phi})X(\beta_1 - \beta_2) + (\phi - \hat{\phi})(\sigma_{2u} - \sigma_{1u}).$$

It is clear from examining the error term that the usual OLS standard errors will be incorrect. There are two reasons for this: first, because of the first three terms, the true error is conditionally heteroskedastic; second, the last two terms show that there is additional noise in the estimation process because $\hat{\phi}$ and $\hat{\Phi}$ are estimated, instead of known a priori. Lee, Maddala, and Trost [1978] show how to construct the correct covariance matrix for the estimated coefficients; we present the derivation in Appendix B.

Why is the switching regression necessary? If the event determining the switch (equity issues in this case) was exogenously determined (say by sunspots) then one could estimate (6) with dummy variable interaction terms, where the dummy would indicate whether or not the exogenous event occurred, and hence would indicate the regime. Equity issues are not exogenous, however, but are simultaneously determined with dividends, so that a dummy variable for equity issues as an explanatory variable would lead to simultaneous equations bias. The two-stage procedure used here is analogous to ordinary two-stage least squares, and $\hat{\Phi}$ is like the fitted right-hand side variable. Estimation of the switching regression (4) is performed in three steps:

1. Obtain an estimate $\hat{\gamma}$ of γ. We are interested in the dichotomous event $u > Z\gamma$ or $u < Z\gamma$. Thus, γ can be estimated using maximum likelihood probit on equation (1). Given this estimate of γ, construct $\hat{\Phi}$ and $\hat{\phi}$.

2. Run OLS on equation (4) using the estimated $\hat{\Phi}$ and $\hat{\phi}$.

3. Using the known form of the errors (equation (5)), construct the

estimated covariance matrix for the errors, Ω, and compute the coefficient variances as $(W'W)^{-1}W'\Omega W(W'W)^{-1}$, where W' is the matrix [X' PX' F'] (the matrix of regressors in (5)), with $P = \text{diag}[\hat{\Phi}]$ and $F = \text{diag}[\hat{\phi}]$. Appendix B describes computation of the covariance.

B. Results

The dividend model we estimate is based upon the Lintner model as estimated by Fama and Babiak [1968] and Marsh and Merton [1985]:

(6) $\Delta D = \beta_0 + \beta_1 D_{-1} + \beta_2 E_{-1} + \beta_3 r_{-1}$

where D are dividends, E are earnings per share, and r is the rate of return on the firm's stock. The inclusion of the lagged stock return as an explanatory variable was inspired by Marsh and Merton [1985], who argue that share price changes should provide information about future earnings and hence about future dividends. ΔD, D, and E were divided by the lagged stock price in order to reduce heteroskedasticity. The OLS estimates for this equation and for the equation estimated by Fama and Babiak are presented in Table 4. The signs of the coefficients are the same as in Fama and Babiak, but the magnitudes of the coefficients are different. In particular, Fama and Babiak find greater (in absolute value) average coefficients on lagged dividends, and on earnings. The especially low earnings coefficient is partly due to the inclusion of lagged returns; it increases to .03 when lagged returns are excluded.[17] To check that the data pooling was not skewing the results we also ran the exact Fama-Babiak equation both as a pooled time-series cross section with a fixed effects estimator and we also ran 287 firm-specific regressions and averaged the coefficients. We continued to get coefficients comparable to those in Table 4. We conclude that the behavior in our sample is different than that in Fama and Babiak's.[18] In order to estimate the switching regression we first estimated a probit equation explaining equity issues. This entails assigning zero to observations for which there is no equity issue, and a one to observations with an equity issue. The Probit estimation procedure is then a maximum likelihood estimate of the probability of an equity issue, conditional on the explanatory variables. As explanatory variables we used the variables in the dividend equation (lagged earnings, dividends, and stock return) and also the lagged debt-to-value ratio, and a measure of the standard deviation of the change in earnings.

The probit regression is binomial because our interest was in comparing equity issues to all other possibilities, and also because a trinomial switching model would be considerably more difficult to estimate. The appropriate treatment of swaps is ambiguous since they do not represent net external financing. Consequently, we report results both including and excluding swaps as equity issues. Since the results are similar, we will only discuss the estimates including swaps as equity issues.

The results of the first stage probit regressions are in Table 5. The probit results show that firms which issue equity have low earnings per share, low dividends (though this result is not statistically significant), a high ratio of debt to market value, and high stock returns over the previous year.

For the second-stage regressions we estimate the dividend equation (6), with allowance for the switch as in (4). The results are in Table 6. At the bottom of each column we report the chi-squared statistic from performing a Wald test for the joint significance of the switching variables. The statistic is significant (at greater than p = .005) in both cases, sharply rejecting the hypothesis that the coefficients in the dividend equation do not change when firms issue equity. This amounts to a rejection of the Lintner model. The first four rows in Table 6 report the coefficients in the non-equity issue regime. For purposes of comparison, these should be compared to the unconditional estimates of equation (6) reported in Table 4. The coefficient on the lagged dividend is zero, suggesting that dividends follow a random walk (conditional on other explanatory variables) during times when the firm is not issuing equity. It appears that when firms are not issuing equity, dividend changes are determined primarily by the lagged stock return. If the stock return reflects changes in permanent earnings, then this is consistent with our version of the hierarchy model, which predicts that when firms are unlikely to issue equity, dividend changes will reflect changes in earnings.

The interaction coefficients (those multiplied by $\hat{\Phi}$) represent the change in the estimated coefficients due to the switch in regimes. The coefficients in the equity issue regime are obtained by adding the interaction coefficient to the non-interaction coefficient. The two significant variables are lagged dividends and the lagged stock return. The dividend growth rate becomes dramatically negative when firms issue equity, meaning that conditional on being in the equity-issue regime, the greater last period's dividend, the greater the decline in this period's dividend. Although the coefficient on the lagged stock return changes significantly between the two regimes, the coefficient is insignificantly different from zero (t-statistic = 1.69) in the equity issue regime. The negative dividend growth rate is evidence against the importance of the casual empirical observation that dividends sometimes rise when shares are issued. The results suggest that at the least dividends rise by less than they would have had firms not been issuing equity. The results in this section support the hierarchy story, and call into serious question the dividend smoothing story.

5. LOGIT ESTIMATES FOR SHARE AND DIVIDEND CHANGES

The evidence in the previous section suggested that there are periods when dividends are the marginal source of finance and periods when equity issues are the marginal source of finance. In this section we develop additional indirect evidence on the financing hierarchy by estimating a logit model of the dividend change and share issue/repurchase decision. We view the analysis in this section as primarily descriptive, rather than as a test against the null hypothesis implied by a particular model.

Since equity issues and repurchases and dividend changes are discrete events it is natural to analyze them using a discrete choice model. This effectively entails grouping the observations and using the exogenous variables to explain the assignments of observations to groups. For example, in studying equity issues and repurchases, we create a dummy variable which has one value if the firm issues equity, a different value if the firm repurchases equity, and a third value if there is no issue or repurchase. The statistical procedure is then as follows: if d_{ji} is a dummy variable equal to 1 if ith observation consisted of observing event j, and if the events are independent, the likelihood function for a three-choice discrete choice model is

(7) $$\prod_{1}^{q} P_1^{d_{1i}} (1-P_1-P_3)^{d_{2i}} \; P_3^{d_{3i}}$$

The specification is completed by specifying a distribution for the probabilities, P_i , as a function of exogenous variables. The two commonly used alternatives are the normal distribution, in which case (1) specifies a multinomial probit model, and the logistic distribution, in which case (1) specifies a multinomial logit model. For the binomial case, the two give similar results (Maddala [1983]). With additional alternatives, however, the probit model quickly gains computational complexity, while the logit is tractable. Consequently, we estimate the trinomial alternatives in this section using logit. In the case of a multinomial logit model with n mutually exclusive alternatives, the probability of alternative i being chosen is:

(8) $$\Pr(d_{ij} = 1) = \frac{e^{\beta x_{ij}}}{1 + \sum_{k=1,n-1} e^{\beta x_{kj}}}$$

The vector x_{ji} is the vector of observations on independent variables, and β is the vector of coefficients. From (8), the logit coefficient, β , is the derivative of the log-odds ratio, $\ln(P_i/(1-P_i))$, with respect to the exogenous variable. Thus, the elasticity of the log-odds ratio with respect to the exogenous variable is βx. In each case the alternatives are compared to a base alternative. "No change in financial policy" is the base alternative. We use the same set of explanatory variables in the equity and dividend change equations, which can be thought of as reduced form equations. We do not impose any cross-equation restrictions.

A. Explanatory Variables

In this section we discuss the statistical model and motivate the choice of explanatory variables. As mentioned earlier, our goal in this section is not to test one specific theory of financial policy against another, since every leading theory has obvious deficiencies. Nevertheless, our general guide is the version of the financing hierarchy which says that dividends are the marginal source of finance for high cash flow firms, with debt issues following and then equity issues as a last resort. For individual explanatory variables the null hypothesis is that the variables do not have the effect predicted by this theory. We selected explanatory variables suggested by the hierarchy hypothesis, and by different theories of debt cost.

Following are the explanatory variables (variable definitions are in Table 1) used in the logit regressions:

Dividend Yield (lagged): the hierarchy model discussed in Section 2 suggests that a firm will pay high dividends if a future equity issue is unlikely, i.e. if the firm is profitable relative to future investment opportunities. In this case dividends are the marginal source of finance and will be more responsive to changes in earnings. Thus, the model predicts that the level of dividends will be positively associated with the probability of a change in dividends and negatively associated with the probability of an equity issue (since the prospect of a future equity issue will induce lower dividends today).

Stock Return (lagged): it is well known from other studies (e.g. Taggart [1977], Marsh [1982], and Asquith and Mullins [1986]) that equity issues are preceded by large positive excess stock returns, though the reason for this is not understood, and this is not predicted by any of the models we have discussed. To the extent that high stock returns reflect an increase in future expected earnings, stock returns should be positively related to dividends since higher future earnings imply a lower probability of a future equity issue. This is not an unambiguous relationship, however, since high stock returns can also reflect improved investment opportunities which, holding fixed expected earnings, could increase the chance of a future share issue. Thus, theory provides no clear prediction for this variable.

Debt/Market Value of Firm (lagged): There are two effects at work: profitable firms which expect to become unprofitable have an incentive to reduce the chance of a future equity issue and hence to reduce debt; at the same time, firms which issue equity will have exhausted other financing sources first, and thus should have greater debt. In the hierarchy model there is an ambiguous relation between debt and dividends, because a profitable firm can be highly levered, and simultaneously paying high dividends, or an unprofitable firm can be highly levered and on the verge of an equity issue. Consequently, we include an interaction term between debt and earnings, which should be positive: given a level of debt, greater earnings suggest a smaller probability of an equity issue and higher earnings suggest higher dividends.

Operating Income/Market Value (lagged): this is a measure of cash flow. Other things equal, if cash flows are positively serially correlated, firms with more cash flow should be less likely to issue equity and more likely to increase dividends.

Market Value (lagged): the log of the firm's market value. It can be argued that large firms are more widely held, more closely monitored, more mature, and better understood by potential security holders, so that external financing is less costly. As such, one might expect large firms to be more likely to issue equity in informational models such as John and Williams [1985], Miller and Rock [1985], and Myers and Majluf [1984].

Market Value of Firm/Book Value of Assets (lagged): this is included as a proxy, albeit an imperfect one, for the "growth opportunities" in Myers [1977]. Firms with higher growth opportunities will have a lower debt capacity. In the absence of a formal model it is unclear how this should affect equity issues, since the firm can adjust both dividends and debt to affect the probability of an equity issue. The effect on dividends is likewise unclear.

Standard Deviation of [(Changes in Operating Income)/Assets]: it is difficult to say how this measure of risk should affect the probability of changes in dividends and shares, largely because those are endogenous decisions, the probability of which can be affected by other decisions. For example, firms with more variable operating income may issue less debt and therefore have less resort to external equity issues. The hierarchy story suggests that firms with more variable operating income should on average have more variable dividends.

B. Results

Maximum likelihood estimates of the logit model for changes in dividends and equity are presented in Table 7a and 8a. Tables 7b and 8b report the elasticity of the log-odds ratio with respect to the exogenous variables; this is a way of interpreting the coefficients. This elasticity is evaluated at the unconditional mean of the exogenous variable. Also reported is the percentage change in the exogenous variable representing a one standard deviation move. Thus, the table reports both the elasticity and a measure of the magnitude of a plausible move in the variable. Both equations perform much as predicted.

Dividends. Many of the results in Table 7 are familiar from the work of Fama and Babiak [1968] and Marsh and Merton [1985a]. Dividends move in tandem with lagged earnings and the lagged stock risk premium, in the sense that higher earnings and stock returns increase the probability of a dividend increase and reduce the probability of a decrease. Both of these are consistent with the financing hierarchy story in this paper and with the Lintner model. The novel result in Table 7 is the positive coefficient on the lagged dividend yield for both increases and decreases in dividends. Thus, if the dividend yield is high, the dividend is least likely to remain unchanged; the higher the dividend yield, the likelier the firm is to either raise or lower dividends. This is predicted by the financing hierarchy story, since a high dividend yield is a sign that management considers dividends to be the marginal source of finance. The fact that dividends exhibit more volatility when the dividend yield is high confirms this prediction.

The financing hierarchy story predicts that firms with a high debt ratio and lower earnings should be firms which are less likely to have dividends as a marginal source of finance. Firms with high debt ratios and high earnings should be likelier to have dividends as the marginal source of finance. The coefficient lends support to this interpretation, since a high debt ratio means an increase in the probability of a decrease in dividends and a reduced probability of an increase. At the same time, firms with high debt and high earnings (the interaction term) have an increased probability of an increase in dividends. Firms with a high standard deviation of earnings are more likely to lower and less likely to raise dividends. Large firms change dividends more frequently than small firms; this may be due to dividend changes conveying less information about large (and presumably well-scrutinized) firms.

Equity. When interpreting Table 8, it is important to bear in mind that we have no theory governing repurchases, and we know of no comparable estimated repurchase equation. The equity equations display the result obtained by Taggart [1977], Marsh [1982] and Asquith and Mullins [1986] that an increase in the stock price precedes a share issue. An increase in the stock price has no effect on the probability of a repurchase. The coefficients on earnings show that lower earnings increase the probability of a share issue, and higher earnings increase the probability of a repurchase (though this coefficient is not significantly different from zero). Both results are sensible.

Finally, a high debt ratio is associated with a greater probability of an equity issue and a smaller (but statistically insignificant) probability of a repurchase. The hierarchy theory might suggest that repurchases are less likely with a high debt ratio (shareholders wish to lower the probability of a future issue), and it would also predict that issues are more likely.

6. CONCLUSION

The capital structure decisions of firms are not well understood. We argued in this paper that interactions between different facets of financial policy are important, and we demonstrated this by showing empirically that the dividend decision and share issue decisions cannot be considered in isolation from other financing decisions. In particular, we have shown that when firms are not issuing equity, dividends depend only on lagged stock returns and hence are not smoothed. When firms are issuing equity, the dividend growth rate becomes negative, and dividends are "smoothed."

We also estimated regressions explaining dividend changes and the share issue/repurchase decision. The results appear to be consistent with a version of the financing hierarchy theory, i.e. that firms which have high free cash flow use dividends as the marginal source of finance. Firms with low free cash flow undertake financial policies which minimize the chance oof a future equity issue.

Many puzzles remain. Although we presented evidence that dividends are not smoothed when firms are not issuing equity, it is still true that the typical firm changes dividends only once every 1.5 to 2 years,[19] and we have no explanation for this. The logit equations performed least well (in the sense of having few significant explanatory variables) for share repurchases. There is also no satisfactory theory explaining the repurchase vs dividend decision.

It appears that better understanding of the correlations among financial policies would permit better-posed theoretical questions. Most of the "stylized facts" in corporate finance deal with share price reactions to events; it would be useful to have stylized facts describing the behavior of financial choice variables across firms and over time. One goal of this paper was to improve our understanding of dividend and share issue and repurchase behavior in this way.

APPENDIX A: A Tax-Based Financing Hierarchy Model

In this Appendix we present an illustrative tax-based financial policy model which illustrates how avoidance of equity issues can generate interesting financial behavior. We use a simple tax model with uncertainty but without bankruptcy similar to that in Auerbach [1984]. For simplicity we will assume that the firm has a fixed debt capacity, $\hat{B}$, and that share repurchases are prohibited. In addition, we take investment policy as fixed, so the choice is purely over financial variables. Given the appropriate tax rate assumptions, the model generates equity financing as a financing source of last resort.

Assume that

i. Investors are risk-neutral.

ii. The firm maximizes the value of the equity.

iii. Firms cannot pay negative dividends and there are no share repurchases (any fixed limit will do as well).

Let

$X(t)$ = After-tax cash flow,

$B(t)$ = debt issued in period t,

$r(t)$ = coupon rate on the debt issued at t,

$N(t)$ = new issues of equity at t,

$V(t)$ = market value of the equity at t,

$D(t)$ = dividend at t,

β = one-period discount factor

u = personal tax rate on dividend income,

i = personal tax rate on interest income,

τ = corporate tax rate, and

c = tax rate on capital gains income.

We also assume that

iv. $(1-c)(1-\tau) < (1-i)$ and

v. $\beta c < u$.

$$\text{vi.} \quad (1 - \beta)\left[1 - \frac{(1-c)(1-\tau)}{1-i}\right] < u - \beta c$$

Assumption iv is the analogue to the Miller [1977) condition for there to be a tax advantage to debt. It ensures that the corporate tax deduction for interest (after personal taxes) is greater than the personal taxation of debt income (Auerbach [1979]). Firms will issue at least some debt if the condition holds. Note that the capital gains tax rate takes the place of the "equity tax rate" in the usual statement of the Miller condition: the dividend tax rate does not appear at all (Auerbach [1979]).

Assumption v says that dividends are taxed more heavily than capital gains. Assumption vi says that the tax advantage to debt, multiplied by the rate of time preference, is small relative to the tax disadvantage of dividends. Assumption vi gives the condition ensuring that if equity issues are likely in the near future, the firm will invest in debt in lieu of issuing dividends.

At time t, equity-holders choose the debt issue, B(t), the dividend, D(t), and new equity issues N(t) to maximize

$$V(t) = D(t)(1-u) - N(t) + \beta E[V(t+1) - c(V(t+1) - V(t) - N(t))]$$

or,

$$\text{(A.1)} \qquad V(t) = D(t)(1-u)/(1-\beta c) - N(t) + \beta E[V(t+1)](1-c)/(1-\beta c)]$$

subject to (with associated multipliers in parentheses):

$$D(t) \geq 0 \qquad (\lambda)$$

$$\hat{B} - B(t) \geq 0 \qquad (\mu)$$

$$N(t) \geq 0 \qquad (\nu)$$

where E_t denotes the expectation conditional on time t, and the cash flow constraint, conditional upon the firm remaining solvent, is given by

$$\text{(A.2)} \qquad D(t) = X(1-\tau) + B(t) + N(t) - B(t-1)(1+(1-\tau)r(t-1))$$

Since we have assumed that there is no bankruptcy, bondholders earn the after-tax rate of discount, grossed up by one minus their tax rate:

$$\text{(A.3)} \qquad r = (\beta^{-1} - 1)/(1-i).$$

Denote the constrained maximand as L:

$$\text{(A.4)} \qquad L(t) = V(t) + \lambda_t D(t) + \mu_t(\hat{B}(t) - B(t)) + \nu_t N(t).$$

The first order condition for new issues of shares is

$$\text{(A.5)} \qquad \frac{\partial L}{\partial N_t} = \frac{1-u}{1-\beta c} - 1 + \lambda_t + \nu_t = 0$$

Since the first two terms are negative, it is immediate that if new share issues are positive, then $\nu_t = 0$ and $\lambda t = 1 - (1-u)/(1-\beta c) > 0$, i.e. dividends will be zero. Similarly, if dividends are positive then $\lambda_t = 0$ and $\nu_t = 1 - (1-u)/(1-\beta c) > 0$, so that shares will not be issued. Thus, if $\beta c < u$, firms will never issue equity and pay dividends at the same time. To do so would result in a net current loss of $(\beta c - u)/(1 - \beta c)$ per dollar of dividends paid.

The first order condition for optimal debt finance is

$$\text{(A.6)} \frac{\partial L}{\partial B(t)} = \frac{1-u}{1-\beta c} - 1 - \mu_t + \lambda_t - \beta \frac{1-c}{1-\beta c} E_t\left(\frac{1-u}{1-\beta c} + \lambda_{t+1}\right)(1+r(1-\tau))$$

Let

$$\text{(A.7)} \qquad \delta_t = 1 \quad \text{if } \lambda_t > 0$$
$$= 0 \quad \text{if } \lambda_t = 0.$$

Using (2) and (3), and the fact that $\lambda = 1-(1-u)/(1-\beta c)$ when binding, equation (6) can be rewritten as

(A.8) $$\frac{\partial L(t)}{\partial B(t)} = \frac{1-u}{(1-\beta c)^2}(1-\beta)\left[1 - \frac{(1-c)(1-\tau)}{1-i}\right](1-E_t\delta_{t+1}(B(t)))$$

$$+ \frac{1}{1-\beta c}\left[(1-\beta)\left(1 - \frac{(1-c)(1-\tau)}{1-i}\right) - (u-\beta c)\right] E_t\delta_{t+1}(B(t)) + \delta_t - \mu_t$$

$$= 0$$

We have written δ_{t+1} as a function of B(t) to emphasize that whether or not dividends are paid next period depends in part upon the choice of debt today: for any given level of earnings at t+1 , the firm will likelier pay dividends if less debt is outstanding. Thus, increasing B(t) raises $E_t\lambda_{t+1}$ and hence raises $E_t\delta_{t+1}$.

The solution for the optimal debt issue in any period depends upon the firm's current and future expected state. If the firm is currently paying dividends and is expected to do so in the future ($\delta_t = E_t\delta_{t+1} = 0$) then since the term on the first line in square brackets is positive, the debt constraint is binding: $\mu_t > 0$. Dividends are a residual in this case and will vary perfectly with earnings. Suppose on the other hand that the firm may find the zero-dividend constraint binding in period t+1 , but the dividend constraint today is not binding if it issues $\hat{B}$ in debt. From assumption vi, the term in square brackets on the second line is positive, so the firm will issue less than maximum debt, reducing B(t) until λ_t is positive, i.e. dividends are zero. (Because current earnings and required debt repayments are given, the reduction in debt issued amounts to a reduction in current dividends.) If earnings are great enough today, and expected to be very low next period, it is possible that the firm may optimally invest in marketable debt securities in order to reduce the need to issue equity in the future.

In general, $E_t \delta_{t+1}$ depends on B(t) and (A.8) can be satisfied without being at a zero dividend corner solution. The tax advantage to debt is a weighted average of the square bracketed terms in the first and second lines of (A.8), where the weights depend on current and expected future cash flow.[20]

As a final point, suppose that the firm is currently issuing equity. Then $\lambda_t > 0$ and from (A.6) the shadow price of debt rises. Thus, if there were a gradually increasing marginal cost to debt issues (rather than an assumed debt capacity), the firm would issue additional debt before issuing equity.

This model makes several points:

1. There is a financing hierarchy generated by taxes. Profitable firms pay dividends and issue debt. The least profitable firms pay no dividends, issue debt, and issue equity. Dividends are the marginal source of finance for firms which have high cash flow both now and in the future, and equity issues are a last resort.

2. Despite the assumption that there is a tax advantage to debt, firms will not always hit the debt capacity constraint. In particular, if there is a significant chance of a future equity issue, it may be optimal to reduce debt or even hold positive amounts of debt (financial slack) in lieu of paying dividends so as to reduce the chance of a future equity issue.

3. Firms which have low cash flow today reduce dividends and (if possible) issue additional debt before issuing equity.

4. Firms which are expected to have low cash flow in the future will reduce debt and cut dividends in order to avoid future equity issues.

APPENDIX B: DETAILS OF THE TWO-STEP ESTIMATION PROCEDURE[21]

The model is given by the following three equations:

(B.1) $$I = Z\gamma - u,$$

(B.2a) $$\Delta D = X\beta_i + \varepsilon_i \qquad \text{if } Z\gamma > u$$

(B.2b) $$\Delta D = X\beta_i + \varepsilon_i \qquad \text{if } Z\gamma < u.$$

where X and Z are vectors of explanatory variables. Assume that u, ε_1, and ε_2 are joint normally distributed with covariance matrix

(B.3) $$\begin{bmatrix} \sigma_u^2 & \sigma_{1u} & \sigma_{2u} \\ & \sigma_1^2 & \sigma_{12} \\ & & \sigma_2^2 \end{bmatrix}$$

Let Φ and ϕ denote the cumulative normal density and the normal density: $\Phi(Z\gamma) = \text{prob}(u < Z\gamma) = \text{prob}(\text{regime } 1)$ and $\phi(Z\gamma) =$ the standard normal density evaluated at $Z\gamma$. As shown in the text, the equation to be estimated is

(B.4) $$\Delta D = X\beta_2 + \Phi X(\beta_1 - \beta_2) + \phi(\sigma_{2u} - \sigma_{1u}) + \eta.$$

Equation (B.4) may be estimated in the following way. First, estimate the parameters, γ, in equation (B.1) using probit, thus providing an estimate $\hat{\gamma}$. $\hat{\phi}(\hat{\gamma})$ and $\hat{\Phi}(\hat{\gamma})$ are then constructed using $\hat{\gamma}$. Let Y_i be a dummy variable which takes on the value 1 when $Z\gamma > u$ and 0 otherwise. Also let $\mathrm{diag}[x_i]$ be the n x n diagonal matrix with x_i on the ith diagonal, and let $\mathrm{col}[x_i]$ be the n x 1 column vector with x_i as the ith entry. Then

$$\text{(B.5)} \qquad \begin{aligned} \eta = {} & \mathrm{diag}[Y_i]\varepsilon_1 + \mathrm{diag}[(1-Y_i)]\varepsilon_2 + \mathrm{diag}[Y_i - \Phi_i]X(\beta_1 - \beta_2) \\ & + \mathrm{diag}[\Phi_i - \hat{\Phi}_i]X(\beta_1 - \beta_2) + \mathrm{col}[\phi_i - \hat{\phi}_i](\sigma_{2u} - \sigma_{1u}). \end{aligned}$$

The third term in the error arises because the true state is either 0 or 1, but the instrumented variable, $\hat{\Phi}$ is generally different from zero or one. The last two terms reflect estimation error in the Φ and ϕ terms. Computing the covariance matrix thus requires characterizing the estimation error resulting from the probit estimation. Using results in Maddala (1983, p. 254) due to Amemiya, the estimation error is asymptotically given by

$$\text{(B.6)} \qquad \begin{aligned} & \hat{\Phi} - \Phi \sim \phi Z(\hat{\gamma} - \gamma) \\ & \hat{\phi} - \phi \sim -\phi Z\gamma Z(\hat{\gamma} - \gamma) \end{aligned}$$

and $\hat{\gamma} - \gamma$ asymptotically has the same distribution as

$$\text{(B.7)} \qquad (Z'\Psi Z)^{-1}\, Z'\mathrm{diag}[\phi_i/(\Phi_i(1-\Phi_i))]\ \mathrm{Col}[(Y_i - \Phi_i)]$$

where $\Psi = \mathrm{diag}[\ \phi_i^2 \ / \ (\Phi_i(1 - \Phi_i))\ ]$. Also let

$A = \mathrm{diag}[\ \sigma_2^2 + (\sigma_1^2 - \sigma_2^2)\Phi_i + (\sigma_{2u}^2 - \sigma_{1u}^2)\phi_i Z_i\gamma\ ]$

$B = \mathrm{diag}[\ \Phi_i\ ]$,

$C = \mathrm{diag}[\ \phi_i\ ]$,

$F = \mathrm{diag}[\ Z_i\gamma\ ]$,

$$H = \mathrm{diag}[\ X_i(\beta_1 - \beta_2)\ ]$$

$$G = H - [\ H + (\sigma_{1u} - \sigma_{2u})F\ ]CZ(Z'\Psi Z)^{-1}Z'\Psi C^{-1}$$

Combining (B.5), (B.6), and (B.7), the error term has the same asymptotic distribution as

$$\text{(B.8)} \qquad \eta = \mathrm{diag}[Y_i]\varepsilon_1 + \mathrm{diag}[(1-Y_i)]\varepsilon_2 + [H + \{\ CH - (\sigma 2_u - \sigma 1_u)CF\ \}\ Z(Z'\Psi Z)^{-1}\Psi C^{-1}\ ]\ \mathrm{diag}[(Y_i - \Phi_i)]$$

Using (B.8) together with the fact (Maddala, p. 254) that

$$\text{(B.9)} \qquad \mathrm{Var}(\ \hat{\gamma}\ ) = E\{\ (\gamma-\hat{\gamma})\ (\gamma-\hat{\gamma})'\ \} = E\{(Z'\Psi Z)^{-1}Z'\Psi C^{-1}\ \mathrm{Col}[Y_i - \Phi_i]\ \mathrm{Col}[Y_i - \Phi_i]'\ C^{-1}\Psi Z(Z'\Psi Z)^{-1}\} = (Z'\Psi Z)^{-1}\ ,$$

it can be shown that the covariance matrix of the errors is[22]

$$\text{(B.10)} \qquad \Omega = A + HVH + M(Z'\Psi Z)^{-1}M - M(Z'\Psi Z)^{-1}ZCH - HCZ'(Z'\Psi Z)^{-1}M + HCQ + Q'CH - M(Z'\Psi Z)^{-1}ZLCQ - QCLZ(Z'\Psi Z)^{-1}M$$

where

$$L = \Psi C^{-1},$$

$$M = [\ H + (\sigma_{1u} - \sigma_{2u})F\ ]CZ,$$

$$Q = -\mathrm{diag}[\sigma_{1u}] - (\sigma_{2u} - \sigma_{1u})B.$$

Note that in constructing Ω it is necessary to obtain estimates of the elements of the covariance matrix (B.3), as well as estimates of β_i and γ. The procedure for estimating σ_{1u} and σ_{2u} is as follows. First, using data for $u < Z\gamma$, estimate equation (B.2a) by running OLS on

$$\text{(B.9a)} \qquad \Delta D = X\beta_1 - \sigma_{1u}\,\phi_i/\Phi_i + \omega_1$$

The term ϕ_i/Φ_i is included to correct for sample selection bias (since only observations for which $u < Z\gamma$ are used in the estimation) and its coefficient is an estimate of σ_{1u}. Similarly, for observations for which $u > Z\gamma$ run the regression

$$\text{(B.9b)} \qquad \Delta D = X\beta_2 + \sigma_{2u}\,\phi_i/(1-\Phi_i) + \omega_2$$

in order to obtain an estimate of σ_{2u}. Finally, given the estimates of σ_{1u}, σ_{2u}, β_1, and β_2, σ_1 and σ_2 can be estimated as in Lee and Trost (1978). Let ε_1 be the fitted residual $\Delta D - X\beta_1$ from estimating (B.9a) and ε_2 be the fitted residual $\Delta D - X\beta_2$ from estimating (B.9b). Then Lee and Trost [1978, pp. 361-2) show that

$$\hat{\sigma}_1^2 = \frac{1}{N_1} \sum_{u < Z\gamma} \varepsilon_{1i}^2 + \hat{\sigma}_{1u} Z\hat{\gamma}\, \hat{\phi}_i / \hat{\Phi}_i$$

$$\hat{\sigma}_2^2 = \frac{1}{N_2} \sum_{u \geq Z\gamma} \varepsilon_{2i}^2 - \hat{\sigma}_{2u} Z\hat{\gamma}\, \hat{\phi}_i / (1-\hat{\Phi}_i)$$

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Table 1
Industry Membership of Sample Firms
(n = 423)

2 Digit SIC Range	Industry name	Number of Firms
10-19	Metal, Oil and Construction	28
20-29	Textiles, Paper, Chemicals and Petroleum Refining	115
30-39	General Industrial, Rubber, Plastics, Glass, Cement, Steel, Machinery, Electrical and Computing	192
40-49	Transportation, Communication, Electrical and Gas Services	34
50-59	Wholesale and Retail	40
70-79	Lodging and Services	10
80-89	Health, Engineering, Architectural and Educational Services	4

Table 2

Variable Definitions

Market Value	market value of equity + current liab. + long-term debt. (from Balance Sheet)
Earnings	operating income gross of depreciation
Std. Dev. of Oper. Income	standard deviation of (change in operating income /assets) where operating income is gross of depreciation and assets is the book value of assets. Calculated with no fewer than eight and no more than 10 years of data preceding each year, depending on data availablilty. (from Balance Sheet)
Lagged Return	lagged annual stock return.
Debt	(short-term debt in current liabilities + long-term debt). (from Balance Sheet)
External Equity Financing	sales of Common and Preferred Stock less purchases of Common and Preferred. (from Statement of Changes)
External Debt Financing	Sales of long-term debt less reductions in long-term debt + change in debt in current liabilities. (from Statement of Changes and Balance Sheet)
Total External Financing	external debt financing + external equity financing.
Average Price	average price of common stock for the 14 year period 1970-1983.

Table 3

Summary Statistics for Sample Firms

Range Statistics

	Range				Overall	
Characteristic	Mean	Std Dev	Min	Max	Mean	Std Dev
1. Debt/Market Value	.259	.148	0.000	.815	.221	.175
2. Debt/Total Assets	.232	.179	.000	3.031	.249	.157
3. Lagged Dividend Yield	.055	.033	0.000	.204	.034	.027
4. Dividend/Average Price	.045	.038	.000	.045	.034	.039
5. External Equity Financing/Market Value	.067	.071	.000	.589	.002	.025
6. External Debt Financing/Market Value	.212	.164	0.000	1.191	.008	.069
7. Total External Financing/Market Value	.221	.170	.000	1.212	.010	.073

Average number of zero dividend years: 2.64 out of 14 years
Average number of dividend changes: 9.18 out of 14 years

Table 4
ESTIMATES OF SIMPLE DIVIDEND EQUATION

Dependent Variable:	Div - Div(-1)	(Div-Div(-1))/P(-1)
Independent Variable	Fixed Effects Fama-Babiak Model	Equation (16)[1]
Constant	.000000 (.00000)	.00572 (.000356)
Div(-1)	-.1597 (.0081)	-.13314 (.00805)
EPS(-1)	.01730 (.00064)	.00091 (.00019)
EPS	.02562 (.00059)	----
r(-1)	----	.00495 (.000506)

[1]All variables but r(-1) are divided by the lagged stock price.

Standard errors in parentheses.
Number of Observations: 4018 (287 firms) for fixed effects estimates, 4018 for equation (16) estimates.

Table 5

First Stage Probit Regressions

Independent Variable	Case I[1]	Case II[2]
Constant	-1.8600	-1.9254
	(0.921)	(.0959)
EPS(-1)/P(-1)	-0.2191	-0.1865
	(.0604)	(.0584)
DIV(-1)/P(-1)	-2.2804	-2.2008
	(1.237)	(1.288)
RETURN(-1)	0.2931	0.2656
	(.0655)	(.0678)
DEBT(-1)/MVAL(-1)	-1.6337	1.529
	(.1869)	(.1936)
STD DEV OPERATING INCOME	-0.5614	0.9498
	(1.057)	(1.088)
Number of Equity Issues:	261	226

Standard Errors in parentheses. Number of observations = 4018.

[1] Dependent variable is 1 if firm reported positive external equity financing, 0 otherwise. Swaps count as an equity issue.

[2] Dependent variable is 1 if firm reported positive external equity financing 0 otherwise. Swaps do not count as equity issue.

Table 6

Second-Stage OLS Regressions

Dependent Variable: (D - D(-1))/P(-1)

Independent Variable	Case I[1]	Case II[2]
Constant	0.0066	0.0067
	(0.0014)	(.0014)
EPS(-1)/P(-1)	0.00032	0.00033
	(.00032)	(.00034)
DIV(-1)/P(-1)	-0.0148	-0.0096
	(.0179)	(.0188)
RETURN(-1)	0.0085	0.0085
	(.00089)	(.00089)
$\hat{\phi}$	0.0061	0.0069
	(.0256)	(.0309)
$\hat{\Phi}$ x Constant	-0.0227	-0.0276
	(0.0401)	(.0401)
$\hat{\Phi}$ x EPS(-1)/P(-1)	-0.0009	-0.0011
	(.0031)	(.0036)
$\hat{\Phi}$ x DIV(-1)/P(-1)	-2.2269	-2.6954
	(.294)	(.2523)
$\hat{\Phi}$ x RETURN(-1)	-0.0149	-0.0170
	(.0043)	(.0048)
χ^2 Statistic (joint significance of $\hat{\Phi}$ and $\hat{\phi}$ terms, 5 d.f.):	204.00	194.05

Standard Errors in parentheses. Number of observations = 4018.

[1] $\hat{\Phi}$ and $\hat{\phi}$ are constructed using the case 1 probit regressions in the previous table. Swaps count as equity issues.

[2] $\hat{\Phi}$ and $\hat{\phi}$ are constructed using the case 2 probit regressions in the previous table. Swaps do not count as equity issues.

Table 7a

Summary of Parameter Estimates
Logit Analysis of Dividend Changes

(n = 4018)

Explanatory Variable	Coefficient[a] for dividend increases	Coefficient[b] for dividend Decreases
Lagged Dividend Yield	.1486 (.0176)	.4881 (.0273)
Lagged Returns	.0829 (.0106)	-.1110 (.0249)
Debt/Market Value	-.5887 (.0589)	.1210 (.0639)
Earnings/Market Value	.0343 (.0112)	-.0530 (.0189)
Earnings*Debt/ Market Value	.0157 (.0042)	-.0048 (.0053)
Market Value	.2271 (.0253)	.1177 (.0422)
Market Value/ Total Assets	.0017 (.0011)	.0000 (.0027)
Std. Dev. of Oper. Income	-.0849 (.0150)	.0902 (.0206)
Constant	-.5568 (.2357)	-4.097 (.3919)

Standard errors in parentheses.

[a]Positive values indicate that an <u>increase</u> in the explanatory variable would increase the probability of an <u>increase</u> in equity

[b]Positive values indicate that an <u>increase</u> in the explanatory variable would increase the probability of a <u>decrease</u> in equity

Table 7b

Elasticities of Parameter Estimates
Logit Analysis of Dividend Changes

(n = 4018)

Explanatory Variable	Elasticity for dividend increases (std error/mean)	Elasticity for dividend decreases (std error/mean)
Lagged Dividend Yield	.908 (.005)	1.364 (.008)
Lagged Returns	.092 (.016)	-.103 (.037)
Debt/Market Value	-1.369 (.028)	.530 (.031)
Earnings/Market Value	.587 (.001)	-.809 (.002)
Earnings*Debt/ Market Value	.447 (.000)	-.353 (.000)
Market Value	.891 (.004)	.380 (.007)
Market Value/ Total Assets	.040 (.000)	-.020 (.000)
Std. Dev. of Oper. Income	-.601 (.003)	.541 (.005)

Table 8a

Summary of Parameter Estimates
Logit Analysis of Equity Changes
Swaps counted as equity increases

(n = 4018)

Explanatory Variable	Coefficient[a] for equity increases (standard error)	Coefficient[b] for equity decreases (standard error)
Lagged Dividend Yield	-.0563 (.0275)	-.1329 (.0370)
Lagged Returns	.0604 (.0131)	.0285 (.0173)
Debt/Market Value	.2398 (.0686)	-.1733 (.1221)
Earnings/Market Value	-.0685 (.0217)	.0312 (.0212)
Earnings*Debt/ Market Value	.0079 (.0053)	-.0025 (.0075)
Market Value	.1557 (.0426)	.0325 (.0545)
Market Value/ Total Assets	-.0181 (.0065)	-.957 (.0221)
Std. Dev. of Oper. Income	.0327 (.0232)	-.0025 (.0332)
Constant	-3.364 (.449)	-1.369 (.6129)

[a]Positive values indicate that an increase in the explanatory variable would increase the probability of an increase in equity
[b]Positive values indicate that an increase in the explanatory variable would increase the probability of a decrease in equity

Table 8b

Elasticities of Parameter Estimates
Logit Analysis of Equity Changes
Swaps counted as equity increases
(n = 4018)

Explanatory Variable	Elasticity for equity increases (std error/mean)	Elasticity for equity decreases (std error/mean)
Lagged Dividend Yield	-.017 (.008)	-.371 (.09)
Lagged Returns	.031 (.019)	-.002 (.026)
Debt/Market Value	.648 (.033)	-.672 (.059)
Earnings/Market Value	-.952 (.002)	.585 (.002)
Earnings*Debt/ Market Value	.226 (.000)	-.170 (.000)
Market Value	.828 (.007)	-.477 (.009)
Market Value/ Total Assets	-.268 (.000)	-2.592 (.001)
Std. Dev. of Oper. Income	.147 (.005)	-.086 (.008)

FOOTNOTES

1. One possible resolution of this puzzle is simply that firms are prohibited by the IRS from regularly repurchasing significant amounts of shares. We know of no evidence either way on this question.

2. Both are single period models for which a dynamic extension is nontrivial, and neither permits debt issues as an alternative form of finance. Bhattacharya [1979] has the firm commit to a dividend which it pays after earnings are revealed. Firms with cash flow less than the announced dividend issue equity, and firms with high cash flow pay out any surplus. This payout is not a dividend, since it is not taxed, and is costless, unlike share issues. The empirical difficulty is that share issues and repurchases are rare events, and incorporating debt in the model is a non-trivial extension. In John and Williams [1985] dividends are paid by firms with temporarily low cash flow, which contradicts empirical dividend studies. Miller and Rock [1985] also develop a signalling model, but it pertains to net external cash flow rather than to dividends specifically.

3. Fama and Babiak varied the lag structure in the Lintner model, and tested the different specifications for predictive ability. Marsh and Merton included the stock price as an explanatory variable on the grounds that it should incorporate information about future earnings. While this is not exactly the Lintner model, it is very much in the same spirit.

4. Baxter and Cragg (1971), Taub (1976), and Marsh (1982) all used bivariate discrete choice estimation methods to study corporate financial policies. Uhler and Cragg (1971) used multinomial logit to study asset choice by households.

5. Marsh [1982] contains a comprehensive review of the literature on debt-equity choice. More recent work includes including Bradley, Jarrell, and Kim [1984], Jalilvand and Harris [1984], and MacKie-Mason [1986].

6. An exception is Cragg and Baxter (1970), who use probit to study the decision to issue long-term securities versus the alternative of no issue.

7. Ofer and Thakor (1986) develop a model in which managers affect their own portfolio through choice of firm financial policy and sometimes employ dividends as a signal and sometimes repurchases.

8. In a study of bank capital structure decisions, Marcus [1981] accounts for the difference between passive and active capital structure changes.

9. For an explicit empirical implementation of this idea, see Jalilvand and Harris (1984).

10. It is necessary to include debt as a choice variable in such a model to obtain interesting dynamics. In a multiperiod model the alternative to payments to shareholders is a change in investment policy. Since real investment opportunities are likely to be limited, investments in marketable financial assets are the feasible alternative. Allowing the firm to invest in financial assets in positive or negative quantities is the same as allowing a choice of debt ratio.

11. If there is a tax advantage to issuing debt, one would think that there should be a tax disadvantage to the firm's holding debt as an asset; this is one of the points made in Miller (1985). One of the interesting conclusions from the tax model, however, is that the "tax advantage to debt" is not an unvarying number, but depends upon the current and expected future profitability of the firm. It is entirely possible that debt issues are

sometimes tax advantaged and other times tax disadvantaged. See Auerbach [1984].

12. This assumes that repurchases are limited. There is no satisfactory theory of repurchases, but dividends cannot be explained in a tax model unless repurchases are limited.

13. In Bhattacharya's [1979] example with earnings distributed uniformly (pp. 263-66), the probability that earnings will be below the announced dividend is independent of expected earnings, and hence independent of the announced dividend. Thus, high dividend firms would be as likely to issue equity as would low dividend firms. This result, however, appears to depend on the particular assumed distribution (uniform) for earnings.

14. Estimation of the switching regression model was performed using RATS on an IBM 4361 mainframe. The effective limit for total observations, including all variables and constructed intermediate variables in the estimation, was about 100,000 data points. Estimation of the multinomial Logit model was performed using QUAIL on a Cyber mainframe.

15. It is well documented that the debt-equity ratio varies over time in the aggregate. See McDonald [1983] and Taggart [1985].

16. The results we use are that, if u and ε are joint normally distributed, then

$$E(\varepsilon \mid u < Z\gamma) = -\mathrm{Cov}(\varepsilon, u)\ \phi(Z\gamma)/\Phi(Z\gamma)$$

and

$E(\varepsilon \mid u > Z\gamma) = \mathrm{Cov}(\varepsilon,u)\ \phi(Z\gamma)/(1-\Phi(Z\gamma))$.

See Maddala [1983].

17. It should be noted that in the Lintner model the coefficient on earnings should be the target payout ratio, which is about .4, times the speed of adjustment coefficient. Thus, given our low estimates of the speed of adjustment, the earnings coefficient measured when returns are not in the equation is approximately correct.

18. One possible explanation for the different coefficients is that earnings were noisier in the 1970's than in the 1950's. Dividends could appear less responsive to earnings changes, even if equally responsive to "true" earnings.

19. Aharony and Swary [1980] find that 87% of firms do not change dividends in a typical quarter, which is comparable to our findings using annual data.

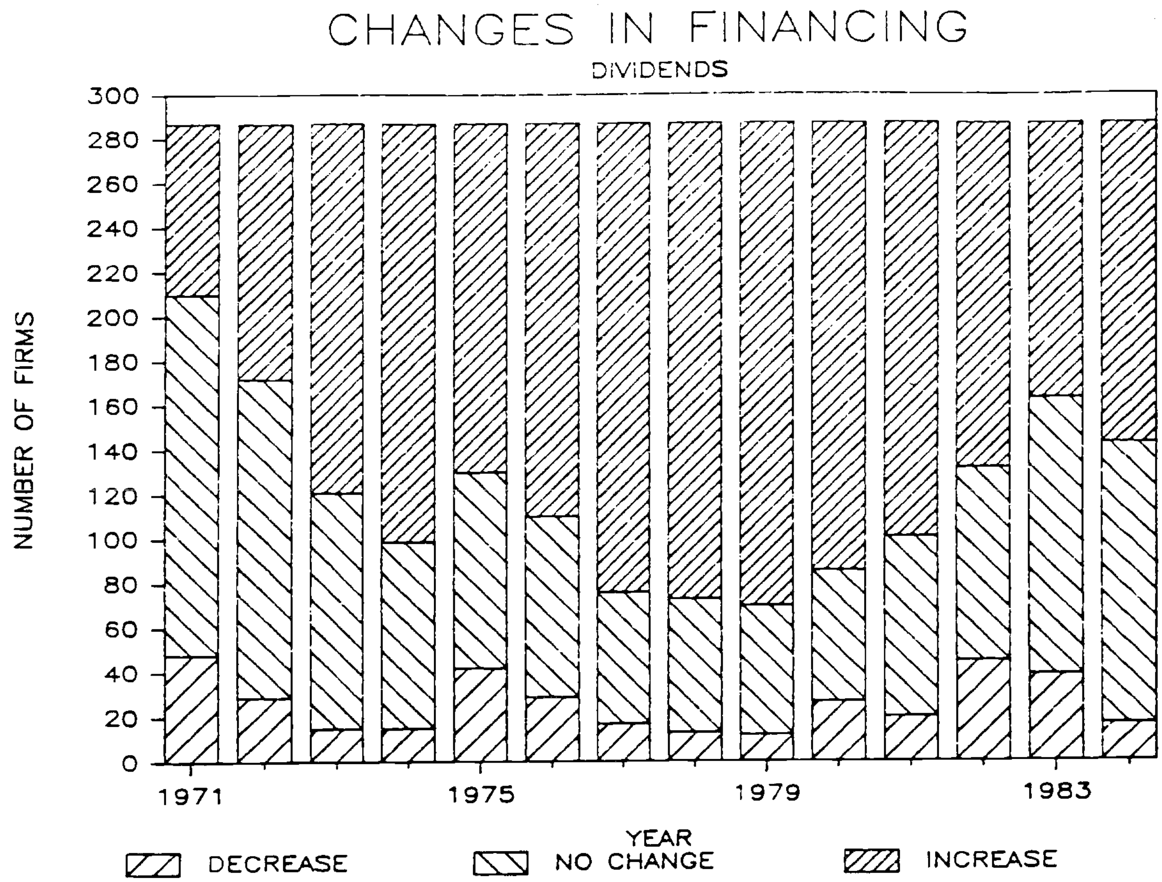
20. A similar point is made in Edwards and Keen (1984) in a comment on Auerbach (1979).

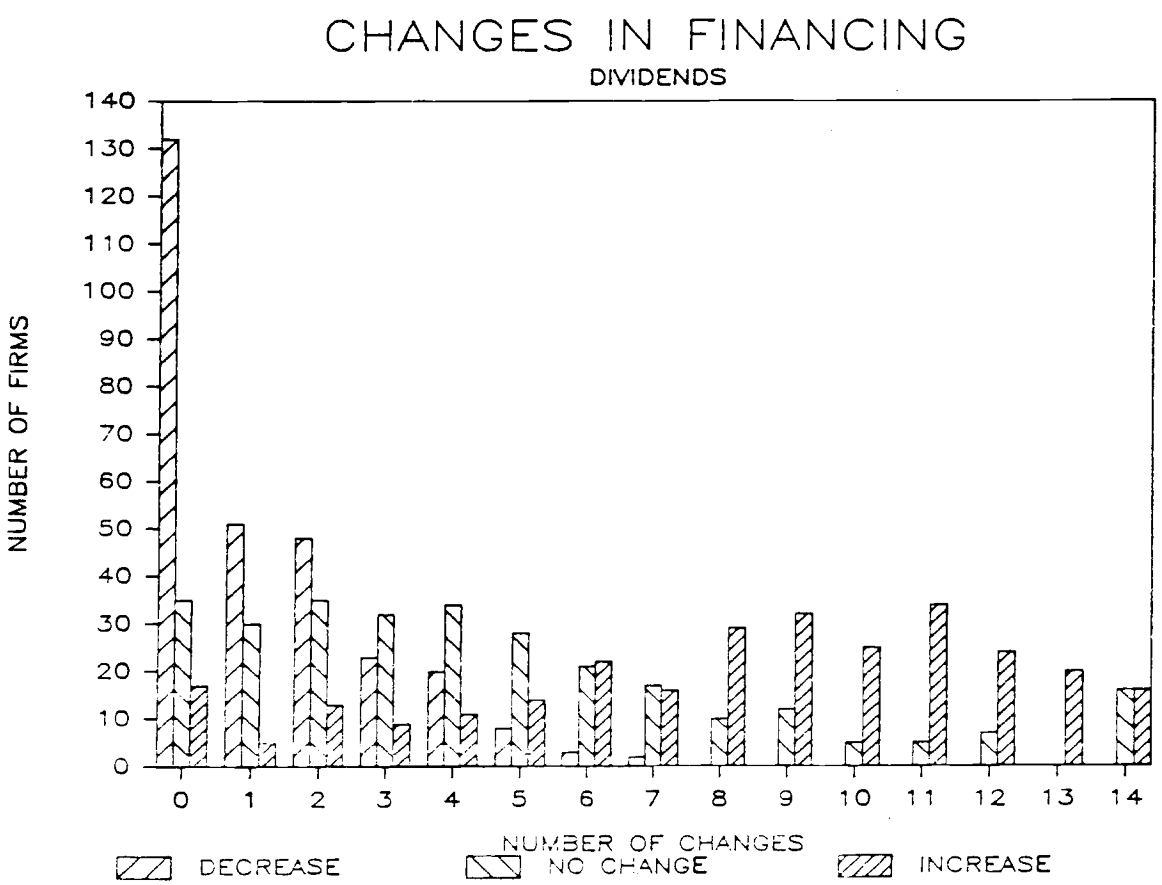
21. The derivation here closely follows that in Maddala, Lee, and Trost (1978).

22. This expression for the covariance matrix of the errors differs slightly from that in Lee, Maddala, and Trost [1978], in that it omits two terms. In their notation, the omitted terms are

$$\sigma^2_{\varepsilon 21} I_N \qquad \text{and} \qquad -(\sigma_{\varepsilon 21*} - \sigma_{\varepsilon 11*})^2 C^2.$$

Figure 1


CHANGES IN FINANCING
DIVIDENDS
NUMBER OF FIRMS
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1971
1975
1979
1983
YEAR
DECREASE
NO CHANGE
INCREASE


CHANGES IN FINANCING
DIVIDENDS
NUMBER OF FIRMS
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110
100
90
80
70
60
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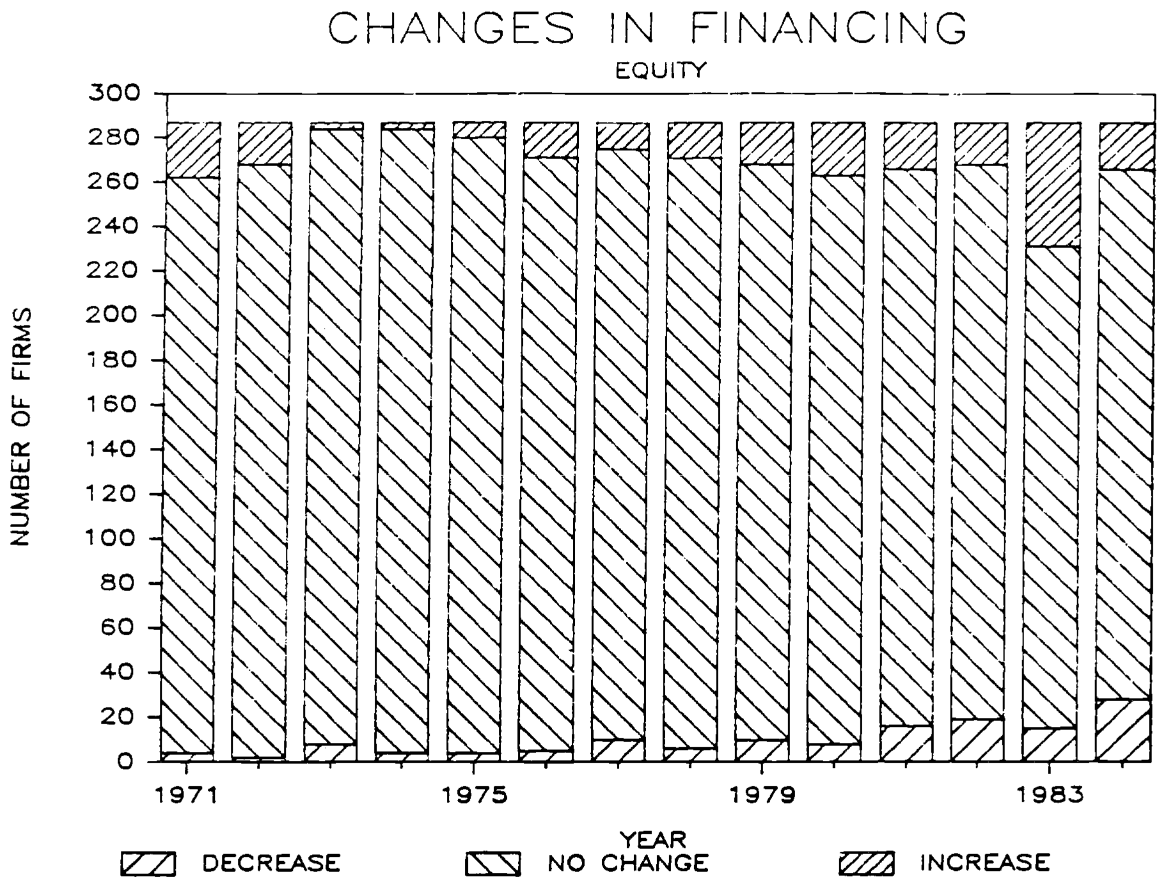
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
NUMBER OF CHANGES
DECREASE
NO CHANGE
INCREASE

Figure 2


CHANGES IN FINANCING
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NUMBER OF FIRMS
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200
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140
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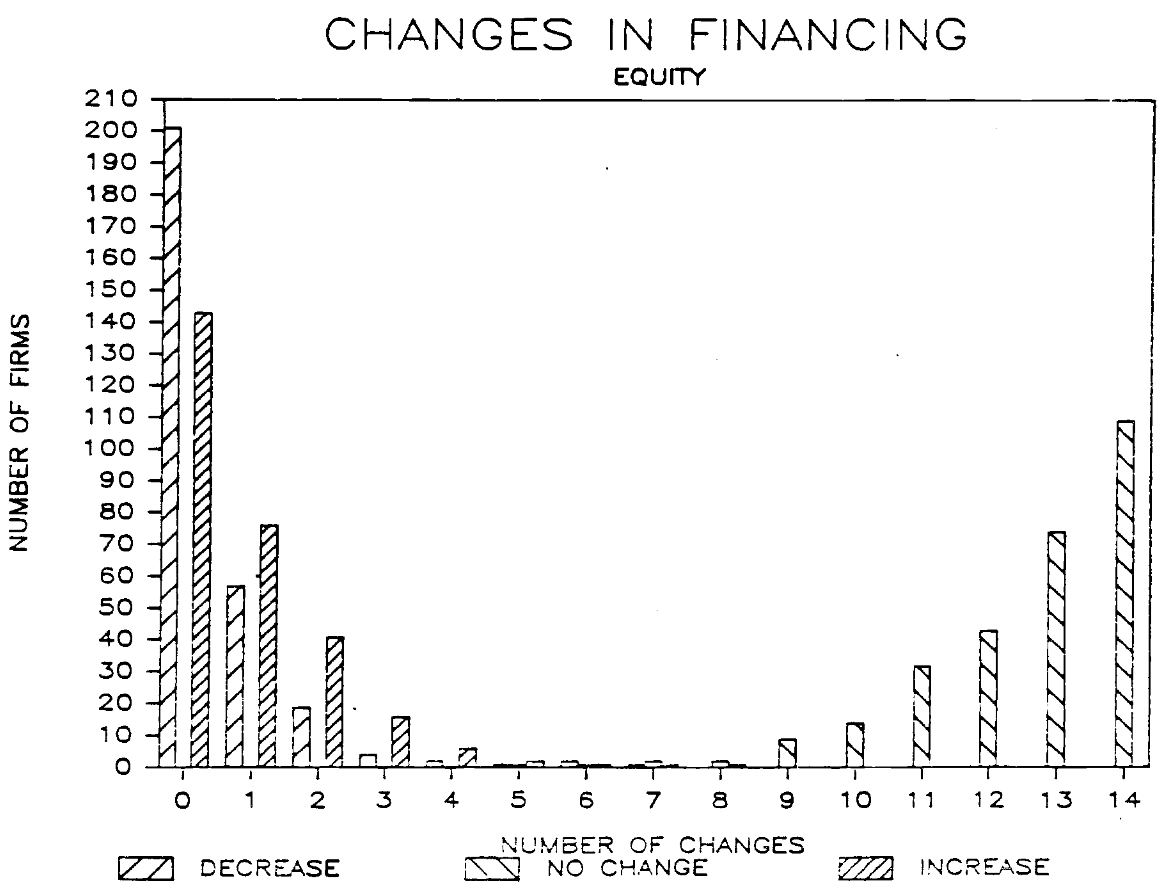
40
20
0
1971
1975
1979
1983
YEAR
DECREASE
NO CHANGE
INCREASE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EQUITY
NUMBER OF FIRMS
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170
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150
140
130
120
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60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
NUMBER OF CHANGES
DECREASE
NO CHANGE
INCREASE