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Corporate Behavior in Adjusting to Capital Structure and Dividend Targets: An Econometric Study

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ABSTRACT

This study of financing decisions by U.S. corporations examines the issuance of long term debt, issuance of short term debt, maintenance of corporate liquidity, issuance of new equity, and payment of dividends. Given costs and imperfections inherent in markets, a firm's financial behavior is characterized as partial adjustment to long run financial targets. Individual firm data are used so that speeds of adjustment are allowed to vary by company and over time. The results suggest that financial decisions are interdependent and that firm size, interest rate conditions, and stock price levels affect speeds of adjustment.

THIS STUDY OF FINANCING DECISIONS by U.S. corporations examines the issuance of long term debt, short term debt and equity, the maintenance of corporate liquidity, and the payment of dividends. The firm's financial behavior is characterized as partial adjustment to long run financial targets, and individual firm data (1966–1978) are used to estimate firm-specific, time varying speeds of adjustment. The results suggest that financial decisions are interdependent and that firm size, interest rate conditions, and stock price levels affect speeds of adjustment. Also, the estimated coefficients are more plausible than the very small (Taggart [28]) or very large (Spies [26]) values found in earlier studies.

Section I of the paper introduces the general model. In Section II, a tractable empirical model is developed. Section III presents the data to be used in the study and discusses econometric issues. In Section IV, results and conclusions are offered.

I. Background

The corporation has long served as a major form for organizing economic activity. Such "survival value" must reflect benefits from the organizational and management structure designed to harness both real and financial resources. In large part, such value is derived from costs and imperfections inherent in markets: information asymmetries, transactions costs, real economies of scale or scope, forms of taxation, etc. (see Coase [5] and Williamson [29]).

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On the other hand, there exists an extensive literature in corporate finance that assumes a perfect market environment in which to analyze a firm's behavior.[1] One logical conclusion of many such perfect market analyses is that a firm's investment, financing, and dividend decisions are independent and thus can be analyzed separately.

While such "perfect market" analysis provides useful insights into the behavior of corporations, it has the disturbing feature of denying, by assumption, many of the features ("imperfections") of financial and economic activity that give rise to corporations in the first place. This study postulates that the financial and dividend decisions of the corporation should be viewed as part of a simultaneous and interdependent process. In this sense, it follows a large body of analytical [3, 21] and empirical [14, 15, 26, 28] work which recognizes that market imperfections may cause substantial economic interactions among a firm's decisions, in addition to those imposed by the firm's basic sources and uses of funds constraints.

When perfect market assumptions are relaxed, different types of analytical issues arise. First, the existence of market imperfections implies that financing decisions may affect the value of the firm and that, as a result, firms may have long run target financial structures which are influenced by factors such as corporate and personal taxes, bankruptcy costs, and agency related costs [2, 4, 8, 11, 16, 17, 22, 23, 24]. Second, market imperfections such as adjustment costs or constraints may lead firms not to adjust completely to these long run targets in every time period but instead to follow a pattern of partial adjustment. Third, these market imperfections may lead to fundamental interdependencies among the corporation's decisions. For example, there may be important interactions between corporate financing and investment decisions [20].

In this paper, we provide an empirical framework that focuses on the second and third issues raised above (partial adjustment and interdependencies). Specifically, the firm's financing and dividend decisions are modeled as a two-phase process consisting of formation of target values and adjustment to these targets. This distinction between target values and period by period adjustment to these targets is adopted in standard empirical work using partial adjustment models [e.g., 26, 28] and provides a useful way to view corporate decisions. For example, in a recent paper, Marsh [13] finds that companies "try to maintain long term target debt levels, although they may deviate from these in the short run in response to timing considerations and capital market conditions" ([13], p. 127).

Ideally, we would estimate simultaneously both the determinants of target values and the nature of partial adjustment to these targets. In the model presented here, however, the targets are taken as given, and we focus on the determinants of period by period adjustment to financial targets and on interdependencies between different financial decisions as this adjustment takes place. To focus on interdependencies, we model the process as a system of equations (one for each financial decision) and examine empirically the interdependencies among these equations. In a "perfect market," we would expect no interdependencies to exist.

[1] Miller and Modigliani's [16, 18] seminal works formed the groundwork for this set of analysis. For useful discussions of relevant literature see Haley and Schall [9] or Copeland and Weston [6].

We investigate the process of partial adjustment by allowing speeds of adjustment to vary by firm and over time depending on the size of the firm and capital market conditions (interest rates and stock prices)—factors that might affect the costs and benefits of adjustment. In a "perfect market" world, complete adjustment would be instantaneous and factors such as firm size or capital market conditions would have no effect on such adjustment. If we find changes in speeds of adjustment induced by capital market conditions, these can be interpreted as firms' attempts to "time" their financing. Such timing would be of no benefit in perfect capital markets.

In the actual empirical description of the partial adjustment process, two major simplifying assumptions are made. First, the investment decision is taken as exogenous. In general, the financial decisions can influence the firm's cost of capital which in turn affects the firm's investment decisions. Clearly this assumption about investment is a limitation of this study. Second, targets are specified in book value terms as is done in most other empirical studies (see for example, Marsh [13] and Taggart [28]). While capital structure theory is typically couched in terms of market values, actual market values sometimes fluctuate dramatically. As a result, such market value figures may be difficult to use both in empirical research and in management's implementation of financial policy. Additionally, use of book value levels allows us to relate directly changes in balance sheet asset figures (investment) to changes in balance sheet liability figures (financing).

II. Model Development

Based on a stylized balance sheet, the firm's sources and uses identity at time t is written as:

$$\Delta A_t = \Delta LD_t + \Delta SD_t - \Delta LIQA_t + \Delta CP_t + (E_t - DIV_t) \tag{1}$$

where

Δ = the change in a variable from $t - 1$ to t,
LD = long term debt,
SD = short term debt,
$LIQA$ = liquid assets,
CP = common and preferred stock (exclusive of retained earnings),
E = net profit after taxes and preferred dividends,
DIV = cash dividends to common shareholders, and
A = the firms assets, where A is defined as total assets minus liquid assets ($LIQA$) and certain other liabilities assumed exogenous (accounts payable, accruals, deferred taxes, investment tax credits, and minority interests).

Equation (1) states that changes in A represent the total financing need of the firm which can be supplied by building up long term debt, building up short term debt, drawing down liquid assets, and/or building up equity accounts through stock issuance or earnings retention. The primary focus of this model is on the financing decisions—ΔLD_t, ΔSD_t, $\Delta LIQA_t$, ΔCP_t, and DIV_t. ΔA_t (investment) and E_t (earnings from *past* investment and financing) are taken as exogenous.

Given these variable definitions, the equations describing the adjustment model for firm i at time t can be written as

$$\Delta LD_{it} = \delta_{1it}[LD^*_{it} - LD_{it-1}] + \delta'_{1it}[RLD_{it}] \quad (2)$$

$$\Delta LIQA_{it} = \delta_{2it}[LIQA^*_{it} - LIQA_{it-1}] + \delta'_{2it}[RLQA_{it}] \quad (3)$$

$$\Delta SD_{it} = \delta_{3it}]SD^*_{it} - SD_{it-1}] + \delta'_{3it}[RSD_{it}] \quad (4)$$

$$\Delta CP_{it} = \delta_{4it}[CP^*_{it} - CP_{it-1}] + \delta'_{4it}[RCP_{it}] \quad (5)$$

$$\Delta DIV_{it} = \delta_{5it}[DIV^*_{it} - DIV_{it-1}] + \delta'_{5it}[RDIV_{it}] \quad (6)$$

where * denotes the target level of a variable, δ and δ' are adjustment coefficients, and *RLD*, *RLQA*, *RSD*, *RCP*, and *RDIV* are measures reflecting the total external financing needs of firm i at time t, as explained below.

A detailed development of the system is contained in Appendix A but examination of the long term debt Equation (2) will illustrate the financial rationale of the model. Equation (2) has two basic parts.[2] The first part states that the firm adjusts to the difference between its target level of long term debt (LD^*_{it}) and the level of debt at the beginning of the period (LD_{it-1}). If a firm completely adjusted to its target, the adjustment coefficient δ_{1it} would be equal to one. Partial adjustment ($\delta_{1it} < 1$) is expected in a world in which adjustment itself is costly.

The second part shows that the use of debt may also be affected by a measure, *RLD*, of total external financing needs. *RLD* is defined for firm i at time t as the difference between two levels of external financing requirements

$$RLD_{it} = [\Delta A_{it} - (E_{it} - DIV^*_{it})] - (LD^*_{it} - LD_{it-1}).$$

The first level, $[\Delta A_{it} - (E_{it} - DIV^*_{it})]$, is the firm's total external financing need if it adjusts completely to all financial targets. As demonstrated in Appendix A, given the firm's sources and uses identity, this first level is also equal to $\Delta LD^*_{it} + \Delta SD^*_{it} - LIQA^*_{it} + \Delta CP^*_{it}$. The second level, $(LD^*_{it} - LD_{it-1})$, represents the amount of long term debt financing required for complete adjustment to the long term debt target. *RLD* is thus a measure of the *remaining* (exclusive of long

[2] In our modeling, we have not disaggregated remaining financing needs in terms of their components. For example, one might devise a scheme to decompose remaining financing need into 1) long term financing needs if there is complete adjustment to liquidity and short run debt targets and 2) some measure of short run financing needs if the firm adjusts completely to its long run debt, equity, and dividend targets. With such a scheme one could argue for an equation similar to Equation (2) but now containing a third term and a corresponding third type of adjustment coefficient. The reasons for our specification of Equation (2) are two-fold. First, we believe the modeling in Equation (2) to be a plausible description of behavior. Second, given our specification of adjustment coefficients discussed in the text, introducing a more disaggregated version of remaining adjustment would drastically increase the number of coefficients to be estimated. Ideally, both target ratios and the coefficients of the adjustment functions would be estimated directly and simultaneously using a nonlinear estimation routine. As pointed out by previous studies [26, 28], however, use of such direct nonlinear estimation is not likely to be a feasible means of obtaining sensible estimates of the target ratios. Multicollinearity arising from the interlocking nature of the balance sheet variables appears to be a prime problem in this regard.

term debt) external financing needed for complete adjustment to financial targets. If perfect adjustment to all long term financial targets occurred, δ's = 1 in the first parts of Equations (2) through (6), δ'_{1it} would be zero. In a world with costly adjustment, however, δ'_{1it} may be nonzero. For example, when the external financing need is large, the firm may increase its use of long term debt because debt financing is more quickly adjusted than another financing source such as the issuance of stock. This would show up empirically as a positive value for δ'_{1it}.

A. Partial Adjustment Model: Adjustment Coefficients

An important feature of the model stated in Equations (2) through (6) is that the speeds of adjustment (δ's and δ''s) are allowed to be different among firms and over time. These differences reflect different perceived costs or benefits of adjusting to targets. The specific formulations used are

$$\delta_{jit} = a_{j0} + a_{j1} W_{i1t} + a_{j2} W_{i2t} + \cdots + a_{jN} W_{iNt}, \qquad j = 1, \cdots, 5 \qquad (7)$$

$$\delta'_{jit} = a'_{j0} + a'_{j1} W'_{i1t} + a'_{j2} W'_{i2t} + \cdots + a'_{jN'} W'_{iN't}, \qquad j = 1, \cdots, 5 \qquad (8)$$

where

W_{ikt} $(k = 1, \cdots, N)$ = variables affecting the firm's adjustment to its financing target, and
W'_{ikt} $(k = 1, \cdots, N')$ = variables affecting the firm's adjustment to remaining aggregate financing needs.

The coefficients of Equations (7) and (8) are assumed to be the same over firms and over time.

To provide specific financial content to the partial adjustment model, we hypothesize the firm size (S), managements' expectations about interest rates (TD), and managements' expectations about stock prices (TS) will affect the speeds of adjustment.[3] Each of these variables affect the perceived costs and/or benefits of adjustment to the target and hence should affect the magnitude of the adjustment.

Size (S): Large firms typically raise larger amounts of capital than do small firms. Given the large element of fixed costs of an issue, it is likely that percentage flotation costs will be lower the larger the size, S, of the firm's total assets. Notice that firm size may also proxy for elements of marketability and monopolistic capital market access which can lead to lower adjustment costs for the firm.

B. Timing Variables for Debt (TD) and Stock (TS)

It is often argued that managers try to time the issuance of long term debt and stock to take advantage of favorable market conditions. Whether such strategies are successful depends upon the ability of managers to make superior forecasts

[3] In an earlier version of this paper, we also developed a variable to measure managements' perceived costs of maintaining liquidity—measured as the spread between the bank prime rate and the 4–6-month prime commercial paper rate. Empirically, however, this variable tended to serve as a stock timing variable and has been dropped from all results presented here.

of future interest rates and stock prices (an ability inconsistent with the hypothesis of efficient capital markets). Nevertheless, managers may attempt such timing even if it is not rewarding *ex post.*

In this work, the variable TD is designed such that a high value of TD will coincide with debt market conditions which managers might feel were conducive to bond issuance. For example, if management expects long term interest rates to go up drastically in future periods, it might issue more long term debt in the current period. A side effect of this might be less use of short term debt and some temporary build up of liquid assets.

The timing variable for stock, TS, is designed to capture managements' attitude about stock market conditions. A high value of TS coincides with perceived favorable equity market conditions which might encourage equity issues in the current period (with possible resultant effects on other financial decisions).

The final empirical form of the model can be written as follows:

$$\Delta LD_{it} = (\textstyle\sum_{k=0}^{3} a_{1k}W_{ikt})(LD_{it}^{*} - LD_{it-1}) + (\textstyle\sum_{k=0}^{3} a'_{1k}W'_{ikt})RLD_{it} + \tilde{\mu}_{1it}, \qquad (2)'$$

$$\Delta LIQA_{it} = (\textstyle\sum_{k=0}^{3} a_{2k}W_{ikt})(LIQA_{it}^{*} - LIQA_{it-1}) + (\textstyle\sum_{k=0}^{3} a'_{2k}W'_{ikt})RLQA_{it} + \tilde{\mu}_{2it}, \qquad (3)'$$

$$\Delta SD_{it} = (\textstyle\sum_{k=0}^{3} a_{3k}W_{ikt})(SD_{it}^{*} - SD_{it-1}) + (\textstyle\sum_{k=0}^{3} a'_{3k}W'_{ikt})RSD_{it} + \tilde{\mu}_{3it}, \qquad (4)'$$

$$\Delta CP_{it} = (\textstyle\sum_{k=0}^{3} a_{4k}W_{ikt})(CP_{it}^{*} - CP_{it-1}) + (\textstyle\sum_{k=0}^{3} a'_{4k}W'_{ikt})RCP_{it} + \tilde{\mu}_{4it}, \qquad (5)'$$

and

$$\Delta DIV_{it} = (\textstyle\sum_{k=0}^{3} a_{5k}W_{ikt})(DIV_{it}^{*} - DIV_{it-1}) + (\textstyle\sum_{k=0}^{3} a'_{5K}W'_{ikt})RDIV_{it} + \tilde{\mu}_{5it} \qquad (6)'$$

where

$W_{i0t} = W'_{i0t} = 1$
$W_{i1t} = W'_{i1t} = S_{it}$,
$W_{i2t} = W'_{i2t} = TD_{it}$,
$W_{i3t} = W'_{i3t} = TS_{it}$, and
$\tilde{\mu}_{jit}\,(j=1,2,\cdots,5)$ are error terms which are normally distributed with zero mean and a constant variance over time.

Appendix A provides a more detailed development of the model and shows the form of sources and uses constraint appropriate for this model.[4]

III. Data and Estimation

A. Sample

The sample of 108 companies is selected from the manufacturing (SIC 2000–3999) companies covered by the Expanded Compustat Industrial File by imposing

[4] In Equations (2)′ through (6)′, all variables (S, TD, and TS) are allowed to affect each adjustment coefficient. We are indebted to an anonymous referee for guidance on this point. In other versions of the paper, we made *a priori* restrictions on certain coefficients.

screens (years 1963–1978) for 1) availability of required data, 2) mergers and acquisitions, and 3) refinancing activities. Screens for mergers and refinancings are imposed since such activities may produce significant changes in a firm's financial structure and associated accounting statements. Without such screens, use of reported financial data may produce a distorted view of a firm's normal financing behavior over time. The merger screen eliminates all companies except those that either 1) have not been involved in any major merger or acquisition over the period 1963–1978 (58 companies) or 2) have undertaken one or two acquisitions of relatively small magnitude during the period 1963–1978 (50 companies).[5] The external financing activities of each company have been checked through the *Capital Changes Reporter* (Commerce Clearing House) to ensure no refinancing activities for the period 1963–1978.

B. Variable Definitions—Target and Target-Related Variables

A target level for each financial variable is required for each firm (i) for each time period (t). Other studies using aggregate data [28] have modeled target values by assuming constant target ratios over time. In this work, the approach used to obtain target levels was to multiply a constant *target ratio* times an appropriate exogenous variable (A_{it} or E_{it}). For example, the target level of long term debt for firm i at time t is calculated as a constant debt ratio for firm i times firm i's cumulated funding need (A_{it}) at time t. The firm's target ratios are measured as the average of the actual ratios over the entire estimation period.

The two sources of equity (retentions and new issues) are treated as follows. The firm is assumed to maintain a target equity to asset ratio where equity can come from either retentions or new issues. Given a target dividend payment (based on the firm's dividend payout ratio and the firm's earnings), the firm's target for CP^*_{it} (common and preferred stock exclusive of retained earnings) is calculated as the residual amount necessary to attain the target level of equity. Target short term debt is calculated as the residual amount necessary to satisfy the firm's sources and uses constraint given target values for long term debt, liquid assets, and equity.

Note that book values, not market values, are used to calculate target ratios and levels. Marsh [13, p. 131] provides a discussion of the relative merits of book

[5] The screens were based on the use of COMPUSTAT footnotes on mergers and acquisitions. COMPUSTAT defines a "major merger" as one in which the acquired company's sales account for more than 25% of the combined sales of the new company. The addition of 50 companies with minor acquisitions was done to enhance the industry representation in the sample. To be in the final sample, the increase in a firm's assets (in the acquisition year) could not exceed assets that would have resulted from the *sum of the mean and one standard deviation* of the *percentage* changes in assets for the firm as calculated over the entire 1963–1978 period excluding observations relating to the acquisition year (or years). We compared our sample to all COMPUSTAT companies that passed our data availability screen. On balance, our sample contains firms that are on average larger than those excluded due to the mergers screen. Roughly stated, a larger firm (while it may have made acquisitions) was less likely to make an acquisition that substantially affected its characteristics. Our sample is spread out over the entire range of SIC classifications. On balance we feel the sample to be sufficiently representative of U.S. corporations to make useful inferences. Upon request, the authors will be glad to supply a list of the sample companies.

and market values in defining financial targets. In fact, works by both Marsh [13] and Taggart [28] suggest that results obtained with market value and book value formulations are very similar.

It is easy to criticize the use of such constant target ratios and there are not *a priori* reasons for target ratios to be constant over time. For example, changes in tax laws might well cause firms to increase their reliance on corporate debt. Possible changes in long term target ratios are of particular concern since, for empirical purposes, we assume that certain variables (S, TD, TS), affect the speed of adjustment to targets rather than being related to changes in the targets themselves. It is, however, possible that changes in some of our speed of adjustment variables may be related to changes in the target ratios. This would not cause any difficulty if targets were measured without error, but unfortunately targets are unobservable and undoubtedly measured with error. As a result, variables in the adjustment coefficient specification (W's in Equations (7) and (8)) may be related to errors in estimating targets. In this paper, we do not propose to solve this problem but follow in the path of others using constant target ratios. We must, however, interpret our results with these difficulties in mind.

While the annual cross-sectional averages of the various ratios are not perfectly constant over the time period studied, they are reasonably stable suggesting that, on average, firms' target ratios have not changed substantially over the period. As expected, the most variable ratio was the dividend payout ratio which ranged from about 0.4 to about 0.7, given annual fluctuations in earnings. The other ratios were relatively stable although there is a slight trend for an increased use of debt (SD and LD) relative to equity (CP) over time. To allow for changes in target ratios, we experimented using target ratios calculated as a moving three-year average ratio (three prior years) without producing substantial changes in the results. To provide for this check against a three-year moving average target, all estimations are reported for the period 1966–1978, although data are available beginning in 1963.

Once the target levels are measured, the remaining aggregate adjustment corresponding to any individual target is calculated as denoted in Appendix A.

C. Variable Definitions—Adjustment Coefficients (S, TD, TS)

Since (S) is measured by the natural logarithm of the firm's total assets as taken from COMPUSTAT.

The timing variable for debt (TD) is based on expectations about interest rates as reflected in the observed term structure of interest rates. Specifically, TD is the average spread (over eight quarters) between a long term interest rate (20-year U.S. government bond) and a short term rate (one-year U.S. government bond). For each year, the eighth quarter of the average corresponds to the last quarter of a company's fiscal year. Government bond rates are obtained from Salomon Brothers "An Analytical Record of Yields and Yields' Spreads." High values of TD are assumed to correspond to expected increases in the level of interest rates. Of course, whether such expectations should or do stimulate the issuance of long term debt in the current period is debatable. For example, if the expectations theory of the term structure were accurate such an expected increase in rates would exist, but a manager would not benefit by timing debt issues.

The timing variable for issuing stock, TS_{it}, is measured as a ratio of a firm's stock price in year t to the average of its stock price in the two preceding years ($t - 1$ and $t - 2$). In each year, the stock price is calculated as the average of the high and low levels of the stock price during the year. High values of TS are hypothesized to encourage stock issues.

D. Estimation

The system of equations is estimated using pooled cross-sectional time series data from each of the 108 firms over the period 1966–1978 and applying Zellner's [30] seemingly unrelated regression technique (SUR). SUR is a generalized least squares procedure for estimating several equations at once when contemporaneous disturbances across equations may be assumed to have nonzero correlations. In this respect, the technique allows for possible relations beween the various financial decisions.

To adjust for heteroscedasticity, the individual structural equations are first estimated by OLS. The resulting estimates of the coefficients (unbiased and consistent) are used to calculate the residuals for each structural equation. The firm's observations are then standardized by the standard deviation of their respective residuals. This adjustment, in general, results in asymptotically homoscedastic disturbances for the structural equations of the system.[6]

The specific form of the sources and uses constraint derived in Appendix A implies a sources and uses constraint for each firm in each time period. The problem is that there are more constraints than coefficients to be estimated; thus, not all the constraints can be simultaneously satisfied. Previous studies have, in general, failed to address the general form of the sources and uses constraint; instead, they have modeled a special form of the constraint which could be imposed. In this work, constraints are imposed "approximately" by averaging the constraints over firms at any time period. The nature of this approximation must be remembered in interpreting the results; nevertheless, some analysis of residuals suggests that the approximation works fairly well.[7]

[6] Previous studies [28] usually deal with heteroscedasticity by dividing through by a variable (e.g., size) and working with ratios. Econometrically, the ratio approach assumes that error terms are constant up to a multiplicative term and that their variable proportion is highly correlated with the predetermined factor (e.g., size) which is used as the denominator of the ratios. Although, in practice, the ratio approach and the one used in this study may be roughly equivalent in their treatment of heteroscedasticity, our approach is less restrictive (i.e., it does necessarily assume firm assets or sales as the normalizing variable) and is based on the information available for individual firms. The residuals of the structural equations are also inspected for autocorrelation. The results indicate very low degrees of autoregressiveness (the first-order autoregressive coefficients are always less than 0.08 in absolute value).

[7] If it were econometrically possible to impose the total number of the sources and uses constraints, the sum of the fitted values of the changes in the firm's financing and dividend decisions would be equal to the sum of their observed values at any period. Approximating these constraints, however, may result in some deviations from this equality for each firm at any period. According to the scatter diagram of the residuals of the system of equations, the size of these deviations were in general moderate; and, furthermore, there were no systematic patterns in their dispersion across firms.

Table I

Correlation Coefficients Across Equations[a]

	LD	LIQA	SD	CP
LD	1.00	0.3175	−0.3258	−0.0136
LIQA		1.00	0.0597	0.2456
SD			1.00	−0.0811
CP				1.00

[a] The correlations are between the residuals obtained from using OLS on individual equations of the model (after adjusting for heteroscedasticity).

In imposing the sources and uses constraint, we estimate only four of the five structural equations. If coefficients of four of the five equations are known, the coefficients of the fifth equation must take on specific values in order to satisfy the sources and uses constraint. Furthermore, the sources and uses constraint implies that the variance covariance matrix of the error terms across the equations would be singular for the system at hand. Thus, we drop one of the equations and infer its coefficients from the remaining estimates and sources and uses constraints.[8] In the results presented here, the dividend equation is eliminated from the system estimation, and its coefficients (and their standard errors) are constructed by imposing the sources and uses constraint. The dividend equation is chosen because 1) empirical measurement of "target dividends" is problematic given the annual fluctuations of earnings and 2) single equation OLS estimation of the dividend equation yielded coefficients that did not conform to expectations. The second of the above reasons is undoubtedly directly related to the first. A benefit of this procedure is that it provides an opportunity to obtain insight into dividend behavior by bringing extra information to bear on the estimation—the sources and uses constraint. Since the dividend equation has only eight coefficients to be inferred from the sources and uses constraints, eight linear constraints were formed. These constraints represent the time periods: 1978, 1977, 1976, and consecutive two-year averages for the remaining 10 years, 1975–1966.

IV. Results and Conclusions

Tables I through IV summarize the empirical results. Table I presents a correlation matrix of residuals for the OLS estimates of the first four structural equations (adjusted for heteroscedasticity) and thus provides some insight into

[8] Imposition of the sources and uses constraints restrains the sum of the error terms across equations to be equal to zero. This linear dependency causes the variance-covariance matrix to be singular. While the choice of an equation to be eliminated is somewhat arbitrary, it has econometric implications. If the error terms are autoregressive of the first degree, the sources and uses constraint restrains the autocorrelation coefficients to be equal across the equations. If this restriction is not imposed, the estimates of the parameters will be sensitive to the choice of the eliminated equation. In this study, since the autocorrelation coefficients are fairly close to zero, the above restriction is approximately satisfied and the system is reasonably invariant to the choice of the eliminated equation. For further discussion in this area, see Brendt and Savin, [1].

Table II

Ordinary Least Squares Estimates of Individual Equations (adjusted for heteroscedasticity)[a], 1966–1978 (asymptotic t values are indicated in parentheses)[b]

	Own Adjustment				Remaining Adjustment				
	a_0	S	TD	TS	a_0'	S	TD	TS	R^2
ΔLD	0.3826	0.0452	0.015	−0.0749	−0.0753	0.0334	0.0493	0.0211	0.4826
	(3.51)	(3.39)	(0.62)	(1.23)	(−1.31)	(4.60)	(3.00)	(0.48)	
$\Delta LIQA$	0.3137	0.0313	−0.027	−0.0684	0.0579	−0.0262	−0.0143	−0.0086	0.2333
	(2.38)	(2.02)	(−0.82)	(−0.88)	(1.10)	(−4.02)	(−1.25)	(−0.29)	
ΔSD	0.9761	−0.0117	−0.0552	−0.18	0.1540	−0.0057	−0.0455	−0.0099	0.4554
	(7.97)	(−0.80)	(−1.79)	(−2.32)	(3.97)	(−1.38)	(−4.99)	(−0.43)	
ΔCP	0.0332	−0.0145	−0.051	0.1494	0.0774	−0.016	−0.0397	0.0966	0.1165
	(1.03)	(−4.81)	(−6.33)	(6.94)	(2.50)	(−5.35)	(−5.20)	(5.07)	
ΔDIV	−0.2943	0.0495	0.0339	0.1286	0.0054	0.0002	−0.0063	−0.0021	0.4281
	(−7.09)	(9.44)	(3.49)	(5.41)	(0.82)	(0.33)	(−4.53)	(−0.59)	

[a] Estimates are asymptotically unbiased and consistent but not efficient.

[b] The critical value for a two tailed test (Ho: $a = 0$, Ha: $a \neq 0$) at 0.05 level of significance is 1.96.

Table III

Results of the Constrained Seemingly Unrelated Regression Estimation,[a] 1966–1978 (t values are indicated in parentheses)[b]

	Own Adjustment				Remaining Adjustment			
	a_0	S	TD	TS	a_0'	S	TD	TS
ΔLD	0.3736	0.0378	0.0134	−0.0456	−0.0818	0.0416	0.0548	0.0339
	(3.74)	(3.11)	(0.61)	(0.81)	(−1.51)	(6.11)	(3.61)	(1.01)
$\Delta LIQA$	0.1263	0.0359	−0.0171	−0.0084	0.0553	−0.0282	−0.0112	−0.0097
	(1.03)	(2.52)	(−0.57)	(−0.12)	(1.10)	(−4.52)	(−1.02)	(0.34)
ΔSD	0.8836	−0.016	−0.0582	−0.1438	0.192	−0.0063	−0.0506	−0.0219
	(7.75)	(−1.18)	(−2.03)	(−1.99)	(5.10)	(−1.56)	(−5.73)	(−0.98)
ΔCP	0.0829	−0.0190	−0.0492	0.1521	0.0742	−0.0156	−0.0371	0.0965
	(2.63)	(−6.41)	(−6.25)	(7.20)	(2.50)	(−5.33)	(−4.96)	(5.10)
ΔDIV	1.0509	−0.063	0.1865	−0.2845	0.0402	0.0112	0.0201	−0.0637
	(1.72)	(0.55)	(5.38)	(−1.30)	(0.39)	(1.74)	(1.21)	(−0.66)

Note: Weighted $R^2 = 0.4845$.

[a] Estimates are asymptotically efficient. In the actual estimation, only the first four equations are estimated using SUR. The coefficients (and standard errors) for the dividend equation are inferred from the estimates (and standard errors) of the included equations by imposing the sources and uses constraint.

[b] The critical value for a two tailed test (Ho: $a = 0$, Ha: $a \neq 0$) at 0.05 level of significance is 1.96.

Table IV

Financial and Dividend Behavior of an Average Firm[a]

	Total Own Adjustment	Total Remaining Adjustment
ΔLD	0.5612	0.2298
$\Delta LIQA$	0.3295	−0.1109
ΔSD	0.6102	0.1101
ΔCP	0.1085	0.0664
ΔDIV	0.4396	0.0490

[a] Calculations are based on multiplication of estimated coefficients (Table III) by mean (cross-section time series) of the variable in question. Thus, total is in some sense the "average" adjustment coefficient with no allowances for differences in size and/or timing. These coefficients correspond to δ_{it} and δ_{it}' in Equations (7) and (8) of the text.

the benefits of system estimation. Table II provides OLS estimates of each of the five equations while Table III reports the system estimation (SUR of the first four equations—the dividend equation inferred using the sources and uses constraint). Finally, Table IV summarizes some of the features of Table III for ease of interpretation.

Before explaining the results, some notes about format are in order. Tables II through IV are divided into two main columns (*Own Adjustment* and *Remaining Adjustment*). The "Own Adjustment" column indicates the adjustment of a particular financial variable to the difference between its own target level and its previous actual level. The "Remaining Adjustment" column indicates the response of this financial variable to the remaining aggregate adjustment necessary to fund the firm's operations. In Tables II and III these two columns are divided into their determinant variables: size and timing considerations. The entries in Tables II and III are the a and a' coefficients shown in Equations (7) and (8). Thus, the estimated coefficients of these variables represent the change in the firm's speed of adjustment (own or remaining) corresponding to changes in these variables. For example, the estimated coefficients of S in the long term debt equation indicate the effects of firm size on the firm's long term debt adjustments to target long term debt (own adjustment) and to the firm's remaining financial needs (remaining adjustment).

A. Benefits of System Estimation

Going from OLS to SUR, the standard errors of the estimates are either reduced or unchanged; hence, a benefit of simultaneous estimation appears to be additional efficiency of the estimates.[9] Table I provides further insight into the benefit of system estimation. If there were no disturbance relations among the equations, the correlation matrix in Table I would be an identity matrix and use of SUR would provide no benefits. As the table shows, however, this is not the case; there are nonzero correlations among the equations. The largest positive correlation is between long term debt and liquid assets, suggesting that long term debt issues may be used to build up liquid assets in a fashion not captured by the adjustment model. Furthermore, a negative relationship beween long and short term debt is suggestive of the substitution of one form of debt or another. Finally, a positive relationship between new stock issues and liquid assets may imply that the proceeds of new issues are temporarily used to build up liquid assets.

B. Adjustment Coefficients

The estimates in Table III show the pattern of adjustment coefficients. Each adjustment coefficient is some constant (a_0 or a_0') plus additional factors depending upon firm- or time-specific characteristics. For example, abstracting from the effects of firm size and capital market conditions, the firm would adjust 37.36% of the way to its target level of long term debt. This is the 0.3736 entry in the upper left of Table III. Table IV reports percentage adjustments given the average characteristics of the sample (i.e., representative values for δ_{jit} and δ_{jit}' in Equations (7) and (8)). In the case of the long term debt equation, there was "on average" a 56.12% adjustment to the long term debt target in a given year.

The "average" adjustment coefficients in Table IV all have the expected sign

[9] Note that there may be some disadvantages associated with system estimation when the structural equations are misspecified. The impact of specification errors on individual equation estimates is magnified when structural equations are estimated in the context of a system. However, the close similarity in size and sign of coefficients resulting from OLS and SUR estimations on the included equations (ΔLD, $\Delta LIQA$, ΔCP, and ΔSD) suggests that such misspecification problems are not large.

and are of reasonable magnitude. A firm's percentage adjustments to individual targets are, on average, reasonably large, ranging from 56.12% in the long term debt equation to 10.85% in the equity equation. The smaller percentage adjustment for equity (10.85%) suggests that adjustments to equity targets are much more gradual than is the case for the other variables. Since, in this model, equity adjustment comes from retention of earnings and issuance of new common shares, such a gradual adjustment is not surprising. Managers seldom issue new shares and would be reluctant to cut dividends to meet a target equity level over a short time horizon.

The speed of adjustment for target dividends suggests that for every dollar increase in the level of target dividends, a firm increases, on average, its dividend payments by approximately 44 cents. The average size of the speed of adjustment to target dividends (0.4396) is somewhat larger than Lintner's [12] findings (approximately 0.30) and appreciably smaller than Spies' [26] results (0.88). It does, however, fall within the range of the average speed of adjustments (0.32 to 0.47) obtained by Fama and Babiak [7] investigating many different models for explaining the firm's dividend behavior.

It should be noted that these average adjustment coefficients are considerably larger than those found by Taggart [28] and smaller than those reported by Spies [26]. Spies, for example, reports adjustment coefficients which are, in general, larger than would normally be expected in a world of costly adjustment (e.g., adjustment coefficients of 1 for target common and preferred stock).

Table IV also shows that adjustment coefficients for the individual targets (first column) are significantly larger than adjustment coefficients related to the remaining financing need (second column). Long term debt, liquid assets, and short term debt are the main sources for the firm's remaining financing need with long term debt providing the largest response.

Turning to the determinants of the adjustment coefficients found in Table III, estimates of the intercept terms (a_0 in left most column) for adjustment to targets are all positive, consistent with firm behavior of adjusting toward target levels. In the case of the dividend equation, the estimate of a_0 (approximately unity) is larger than one might expect, although it is not significant. This may in part be due to the noise caused by the approximation of the sources and uses constraints to which the estimated coefficients of the dividend equation (a_0 in this case) are directly related. Notice, however, that the imposition of the sources and uses constraint, even in its approximated form, has "improved" the estimate of a_0 relative to the single equation estimation approach in Table II (from a negative and significant estimate to a positive one).

Partial adjustment to targets implies that the firm's total external financing need is not entirely supplied by the firm's direct adjustments to targets. Thus, in any period, the firm's long term debt, liquid assets, short term debt, and common and preferred stock may be used to finance the firm's remaining funding needs. Estimates of a_0''s (in the Remaining Adjustment column) are expected, *ceteris paribus*, to capture this pattern. Estimates of a_0''s suggest that short term debt is increased, and some new stock is issued by the firm in response to its remaining financing need. The a_0' terms are insignificantly different from zero in the other three equations. It must be remembered, however, that the actual adjustment speeds depend on other explanatory variables as well as the intercept.

Size (S): To the extent that the size variable captures the effects of flotation costs or the firm's access to the capital markets, it provides sensible results in several respects. Positive coefficients on S in the long term debt equation suggest that cheaper and easier access to capital markets speeds up the adjustment of long term debt to its target and to the firm's remaining financing need. In the equity equation, the negative coefficients on size suggest that larger firms may adjust more slowly to target equity and use less common and preferred stock in responding to the remaining funding needs than do smaller firms. Perhaps this results from larger firms' superior ability to use long term debt (e.g., as a result of lower percentage flotation costs).

The coefficients on size in the liquid asset equation are somewhat puzzling. The positive significant coefficient (0.0359) in the own adjustment portion of the equation suggests that larger firms adjust more quickly to their liquid asset targets. The negative coefficient on size in the second portion of the same regression indicates that larger firms tend to make more use of liquid assets in meeting remaining financing needs. Such a pattern may result from the ability of larger firms to have lower percentage transactions costs by dealing in short term securities in large volume transactions. The coefficients of size are not significantly different from zero in the dividend and short term debt equations.

Timing Considerations (TD, TS): The coefficient for the long term debt timing variable, TD, is not significantly different from zero for the firm's long term debt adjustment to its own target. However, in the second portion of the same equation, the positive and significant coefficient of TD suggests that management's expectations of higher long term interest rates in the future may stimulate the usage of long term debt in responding to the firm's remaining funding needs. Coefficients of TD are significantly negative in both the short term debt and equity equations, showing the reduced use of short term debt and new equity financing when interest rate conditions are perceived to be conducive for the use of long term debt.

The insignificant role of TD in long term debt adjustment to its own target suggests that the marginal benefits of approaching the target long term debt swamp any marginal benefits of timing. On the other hand, timing benefits may be sufficient to affect the firm's long term debt response to remaining financing needs.

A positive and significant coefficient on TD in the own adjustment portion of the dividend equation suggests that the firm is more likely to increase its dividend payments towards target levels when there is an increased incentive to issue long term debt (caused by management's expectation of higher long term interest rates in the future).

In the own adjustment portion of the common and preferred stock equation, the positive coefficient on TS suggests that the firm's adjustment to target equity is faster when the firm's stock price enjoys an attractive premium over its immediate past level. Additionally, the positive coefficient on TS in the second portion of the same equation shows the increased use of equity to meet remaining financing needs when stock prices are viewed as favorable for issuance. The only other significant coefficient on *TS* occurs in the short term debt equation, suggesting that a firm might not adjust as much to short term debt targets when its stock price is high.

C. Conclusions

The empirical work presented here provides support for viewing financial decisions as part of a simultaneous process and suggests that firms adjust to long term financial targets. These results are consistent with the existence of market imperfections that lead to interdependencies among decisions and cause firms to adjust only partially to their long run financial targets. Furthermore, by using data for individual firms, we obtain adjustment coefficients of more plausible magnitude than those of earlier studies (Taggart [28] and Spies [26]) that used aggregate data.

Specific patterns of adjustment are present in our results. Firms seem to build up long term debt, draw down the stock of liquid assets, build up short term debt, or issue new stock in responding to their remaining funding needs. Large firms seem to adjust faster to the target level of long term debt than do small firms. Larger firms also tend to use more long term debt in responding to their remaining financing need. Furthermore, these larger firms appear to adjust more slowly to target levels of equity and use less common and preferred stock in responding to the remaining funding needs than is the case for smaller firms.

There are also indications that firms attempt to time long term debt and stock issues. Expectations of lower long term interest rates in the future seem to postpone the issuance of long term debt and increase the use of short term debt and external equity financing. The firm's adjustment to equity targets is faster the higher its stock price is relative to recent levels. Additionally, when the firm's stock price is high relative to historical standards, equity is used more for funding remaining financing needs. These apparent attempts at timing are consistent with earlier work on U.S. data (Taggart [28]) and also with Marsh's [13] findings for U.K. firms that, in choosing between debt and equity, corporations are heavily influenced by the past history of security prices and market conditions.

One shortcoming of this work is its inability to obtain a detailed explanation of firms' dividend adjustments. While the "average" adjustment coefficients for the dividend equation (Table IV) are quite plausible, few of the component coefficients (Table III) attain statistical significance.

Finally, the empirical results suggest that the firm's targets are a driving force in the firm's financial behavior. Further research is needed to explain the formation of these targets.

Appendix A

Partial Adjustment Model: The System

For compactness of notation in developing the system, redefine variables as follows:

$X_{1t} = LD_t$ = level of long term debt at t,
$X_{2t} = CP_t$ = level of common and preferred stock at t (exclusive of retained earnings),
$X_{3t} = SD_t$ = level of short term debt at t (bank loans + commercial paper + current portion of long term debt),
$X_{4t} = -LIQA_t$ = minus the level of liquid assets at t (cash + marketable securities),
$X_{5t} = -DIV_t$ = minus the dividends to common stockholders at t, and
E_t = profit after tax and preferred dividend payments at t.

$$\Delta X_{jit} = (\textstyle\sum_{k=0}^{N_j} a_{jk} W_{jikt})\Delta X^*_{jit} + (\textstyle\sum_{k=0}^{N'_j} a'_{jk} W'_{jikt}) RA_{jit} + \mu_{jit}, \qquad j = 1, 2, 3, 4, 5 \qquad i = 1, \cdots, F \quad \text{(A1)}$$

where

j = subscripts the financial decision,
i = subscripts the firm,
k = subscripts the W variables,
t = subscripts time,
$*$ = superscripts targets,

$$\Delta X^*_{jit} \equiv X^*_{jit} - X_{jit-1},$$

$$RA_{jit} \equiv [\textstyle\sum_{j=1}^{j=4} \Delta X^*_{jit}] - \Delta X^*_{jit},\ j = 1, 2, 3, 4,$$

and

$$RA_{5it} = \textstyle\sum_{j=1}^{j=4} \Delta X^*_{jit} + X^*_{5it}.$$

Note that the dividend formulation differs somewhat from the other four formulations since dividends are a flow variable and are not a source of external funds. Though somewhat cumbersome, Equation (A1) simply represents a system of five equations modeling decisions about long term debt, short term debt, liquidity, equity issues, and dividends.

Rewriting Equation (1) of the text with current notation, the sources and uses constraint can be expressed as

$$\Delta A_{it} - E_{it} = \textstyle\sum_{j=1}^{4} \Delta X_{jit} + X_{5it} \qquad \text{for all } i, t. \qquad \text{(A2)}$$

Equation (A2) reflects actual levels of financing decisions. If target levels are set in a rational, consistent fashion, the sources and uses identity should also hold for these targets (target level superscripted with *). That is, we can write Equation (A3)

$$\Delta A_{it} - E_{it} = \textstyle\sum_{j=1}^{4} \Delta X^*_{jit} + X^*_{5it} \qquad \text{for all } i, t \qquad \text{(A3)}$$

Equating Equations (A2) and (A3) and adding the known level of previous dividends (at $t - 1$) to both sides of the resultant equation, we can write

$$\textstyle\sum_{j=1}^{5} \Delta X_{jit} = \textstyle\sum_{j=1}^{5} \Delta X^*_{jit} \qquad \text{for all } i, t. \qquad \text{(A4)}$$

Summing over j in Equation (A1) and utilizing Equation (A4) for each firm, the general form of the sources and uses constraint for this model is obtained and expressed in (A5).

$$[\Delta A_{it} - E_{it}][1 - \textstyle\sum_{j=1}^{3} \sum_{k=0}^{N_j'} a_{jk}' W_{jikt}' + \sum_{j=4}^{5} \sum_{k=0}^{N_j'} a_{jk}' W_{jikt}']$$
$$= \textstyle\sum_{j=1}^{5} [(\sum_{k=0}^{N_j} a_{jk} W_{jikt}) \Delta X_{jit}^*] - \sum_{j=1}^{3} [(\sum_{k=1}^{N_j'} a_{jk}' W_{jikt}')(X_{5it}^* + \Delta X_{jit}^*)]$$
$$+ (\textstyle\sum_{k=0}^{N_4'} a_{4k}' W_{4ikt}')(X_{5it}^* + \Delta X_{4it}^*) + X_{5it-1} + \sum_{j=1}^{5} \tilde{\mu}_{jit}. \quad \text{(A5)}$$

Since all the terms in Equation (A5), except the error terms are nonstochastic, the sum of the error terms, $\sum_{j=1}^{5} \tilde{\mu}_{jit}$, must be identically equal to their expectation (i.e., zero).

Difficulties of imposing Equation (A5) are discussed in the text.

The equivalence of the definition of RLD_{it} in the text and in Equation (A1), $RA_{1it} = RLD_{it}$, can be seen by noting that from Equation (A3),

$$\textstyle\sum_{j=1}^{4} \Delta X_{jit}^* = \Delta A_{it} - E_{it} - X_{5it}^* = \Delta A_{it} - [E_{it} - DIV_{it}^*].$$

From this equivalence, we can also note that

$$RLD_{it} = \textstyle\sum_{j=1}^{4} \Delta X_{jit}^* - \Delta X_{1it}^* = \sum_{j=2}^{4} \Delta X_{jit}^* = \Delta SD_{it}^* - \Delta LIQA_{it}^* + \Delta CP_{it}^*.$$

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