Cash Flow Sensitivities With Constraints

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ABSTRACT

Empirical studies of firms' financing, investment, and payout policies typically examine those policies in isolation. For example, dividend policy is typically not considered when examining the determinants of capital expenditures. In this paper, we examine corporate policies simultaneously, subject to the constraint that sources of cash must equal uses of cash. We use this methodology to re-examine the investment/cashflow literature. Unlike single-equation studies that conclude that firms react to cashflow shocks by changing investments, we find that firms react by changing leverage. We conclude that failing to employ a constrained simultaneous-equation framework when examining corporate policies can cause omitted variable bias and result in large estimation errors.

1. Introduction

In their 1988 Brookings paper, Fazarri, Hubbard, and Petersen (hereafter FHP) document a positive relationship between internally generated cashflow and investment. They also find that this relationship is strongest for firms that are most likely to have difficulty accessing external capital markets. FHP interpret their findings as evidence of a difference between the internal and external costs of capital and conclude that capital market frictions may cause some firms to forego positive NPV projects.

Because this result, if true, has serious implications regarding the efficiency with which capital is allocated in the economy, it provoked a number of additional studies examining the relationship between cashflow and investment. Many of these studies support the original FHP findings (FHP (1996, 2000), Almeida and Campello (2002), Boyle and Guthrie (2003), Calomiris and Hubbard (1989, 1990, and 1995), Hoshi, Kashyap, and Scharfstein (1991), Oliner and Rudebusch (1992), Hubbard, Kashyap, and Whited (1992), Pawlina and Renneboog (2005), Schaller (1993), Bond and Meghir (1994), Gilchrest and Himmelberg (1995)).[1, 2] Others find completely the opposite result. For example, Kaplan and Zingales (1997 and 2000) conclude that a monotonic relation between the degree of external market constraints and cash-flow sensitivity does not exist.[3] They find that firms with the easiest access to capital markets display the largest

[1] In addition to cashflow/investment sensitivity, there is evidence that constraints in accessing external capital affect other corporate decisions. For example, Korajczyk and Levy (2002) examine the connection between firms' financial health and the timing of their financing decisions. They find that, unlike constrained firms, unconstrained firms are able to issue securities at economically favorable times.

[2] Minton and Schrand (1999) find that higher cashflow volatility increases the cost of external capital, and hence results in higher investment cashflow sensitivity. In particular they find that higher volatility is correlated with lower capital expenditures, R&D, and advertising expenses.

[3] Others such as Moyen (2004),and Alti (2003) find support for both camps. For example, Moyen, using generated data, finds that the results obtained from her unconstrained model support Kaplan and Zingales. However, she also finds that cashflow sensitivity is higher for low dividend paying firms than it is for high dividend paying firms, supporting the results of FHP.

sensitivity of investment to cash flow. Firms that are financially constrained have the next largest sensitivity, and firms that are partially constrained are least sensitive. Their findings imply that investment/cashflow sensitivities are uncorrelated with access to capital markets. Using a larger sample of firms, Cleary (1999) confirms Kaplan and Zingales' conclusion. In fact, Cleary finds that investment-cash flow sensitivities are actually inversely related to constraints--the most constrained firms have the lowest sensitivities and the least constrained firms have the highest sensitivities.

Econometric problems associated with model misspecification may be the cause of the lack of consensus in the literature. The existing literature examines the cash flow sensitivity of investment in isolation, that is, without accounting for the simultaneous effect that cash flows have on investment and financing decisions. When investment and financing decisions are condensed into a single capital expenditure equation, the estimated cashflow sensitivity coefficient is likely to suffer from omitted variable bias. Single-equation models are also likely to produce inefficient coefficient estimates because they do not exploit the information contained in the constraint that sources and uses of cash must be equal. In addition to econometric problems, single-equation models produce coefficient estimates that are difficult to interpret from an economic perspective. For example, observing that capital expenditures and cashflows are uncorrelated is consistent with the absence of financing constraints. However, it is also consistent with the existence of financing constraints if firms insulate capital expenditures by increasing asset sales to compensate for cashflow shortfalls.

In this paper, we propose a model in which firms make their investment and financing decisions jointly, subject to the constraint that sources and uses of funds are equal. The model follows James Tobin's suggestion, in his discussion of the original FHP article, that "… the firm jointly determines investment, dividend payments, and other ways of allocating its cash flow. Therefore,…the authors (should) model investment and dividends as depending on the same set of explanatory variables." Put differently, a firm's investment, financing, and distribution decisions are necessarily interrelated by the identity that sources of funds equal uses of funds.[4] A firm that experiences a one dollar increase in operating cash flow could increase capital expenditures, say, by one dollar.[5] However, it could also use the incremental cash flow to pay down debt, increase shareholder distributions, or make any combination of investment and financing decisions that result in a net response of one dollar. *Ex-post*, this constraint holds precisely. *Ex-ante*, it holds in expectation.

Specifically, our model contains nine equations describing the investment (capital expenditures, acquisitions, and asset sales), financing (short-term debt issues, long-term debt issues, and changes in cash balances), and distribution (equity issues, dividends, and share repurchases) decisions that firms make. We estimate this model using a sample that covers 1950-2003.

Our simultaneous equation model extends the literature in two primary ways. First, it provides an empirical estimate of the size of the omitted variable bias that results from estimating the capital expenditure/cashflow sensitivity in isolation. Second, rather

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[4] While there are no papers that estimate a system of cashflow sensitivity equations subject to the sources and uses of funds constraint, there are some papers that examine cashflow sensitivity of selected sources/uses variables. For example Gilchrist and Himmelberg (1998) use a structural model to find the marginal cost of funds and examine how it relates to debt, cash, and working capital. Also Fazzari and Petersen (1993), examine the cashflow sensitivity of working capital. Additionally, Almeida, Campello, and Weisbach (2002), develop a model of how cash holdings respond to cashflow changes (cashflow sensitivity of cash). Our results do not support their prediction that more of the cashflow increases will be used to build up the cash holdings in the case of the constrained firms compared with unconstrained firms.

than focusing solely on capital expenditures, it provides a description of how firms adjust leverage, distributions, and other investment decisions in response to a change in cashflow. By examining each of these responses simultaneously, we are able to make more accurate inferences regarding effects of potential capital constraints on investment. For example, we are able to determine whether firms respond to negative changes in cashflow by cutting investment and maintaining leverage (consistent with an inability to access external capital) or by maintaining investment and increasing leverage (consistent with an absence of capital constraints).

Our empirical analyses yield three primary findings. First, contrary to previously published studies, the cash flow sensitivity of investments is small, regardless of the firm's financial health. Estimating our multi-equation model using the full sample, a one dollar increase in cash flow produces a statistically insignificant \$0.001 increase in capital expenditures. In contrast, previously published single-equation studies typically find that a one dollar increase in cash flow results in an increase in capital expenditures ranging between \$0.10 and \$0.25, a result that we are able to replicate using a single-equation analysis.

Second, we find that a firm's primary response to a change in cashflow is to adjust financial leverage. Unlike investment/cashflow sensitivities, financing/cashflow sensitivities are large and highly significant, regardless of the firm's financial health. Using the full sample, a one dollar increase in cashflow results in a \$0.78 decrease in total debt and a \$0.23 increase in cash balance. Thus, our results show that net debt changes by approximately one dollar in reaction to a one dollar change in cashflow. This

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[5] In fact, the firm in question could even increase its capital expenditures even by more than a dollar, if the increase in the cashflow increases the firms' debt and/or external equity capacity by more than a dollar.

result implies the absence of a systematic underinvestment problem. If such a problem existed, we would observe firms spending a portion of the incremental cashflow to undertake new projects, rather than retiring capital. It is not possible to obtain this evidence from single-equation investment models that examine the capital expenditure/cashflow sensitivity in isolation.

Third, when we partition the sample on the basis of positive and negative cashflow changes, we observe that both the investment and financing sensitivities are symmetric.[6] For the full sample, a one dollar cashflow decrease causes firms to borrow an additional $0.80 whereas a one dollar cashflow increase causes firms to repay $0.76 of debt. What is more remarkable is that the symmetry holds even for the subsample of firms that are classified as being "financially constrained". Firms in the financially constrained subsample borrow $0.81 in response to a $1 reduction in cashflow and reduce debt by $0.75 when they experience a positive one dollar change in cashflow. The borrowing ability of firms that are perceived to have the weakest financial health, in an environment when they are experiencing negative cashflow shocks, combined with the small investment/cashflow sensitivity, provides strong evidence that impediments to accessing capital markets have little impact on firms' investment decisions.

The organization of the rest of the paper is as follows. Section 2 contrasts our system of equations model with the single-equation models employed in the literature. In Section 3, we develop the simultaneous-equations model that we use in our estimations. The data are described in Section 4. Section 5 presents and discusses empirical results and section 6 concludes.

[6]We thank the associate editor for suggesting that we estimate our model for both positive and negative cashflow changes.

2. Single Equation versus System of Equation Models

Single-equation models used to study the effect of capital constraints on investment typically estimate the following equation:

$$\frac{CAPX_t}{K_t} = \beta_1 \frac{CF_t}{K_t} + \beta_2 MB_t + \varepsilon_t \tag{1}$$

where CAPX is capital expenditures, K is fixed assets, CF is cashflow, and MB is the ratio of the market value of assets to the book value of assets. A common interpretation of the cashflow coefficient in equation (1) is that a relatively small coefficient implies that firms can immunize capital expenditures against adverse cashflow realizations. Conversely, a relatively large positive coefficient is often interpreted as evidence that firms respond to negative cashflow realizations by decreasing capital expenditures, a reaction that is consistent with costly access to external capital. To determine whether capital constraints affect investment, equation (1) is typically estimated using samples of firms with different states of financial health. The underlying hypothesis is that financially unhealthy firms are more likely to face capital constraints, and should therefore have a larger investment/casfhlow coefficient than financially healthy firms.

Prior studies that estimate equation (1) consistently find a positive relationship between capital expenditures and cashflow. As shown in Table 1, coefficient estimates between 0.10 and 0.25 are common. Using our sample of firms to estimate equation (1), and after matching the sample period and selection criterion in Cleary (1999), produces a coefficient estimate of 0.16.[7] Based on the interpretation that is common in the literature,

[7] For Table 1 only, we restrict the sample to 1987-1994 to match the period used by Cleary (1999).

this implies that a one dollar decrease in cashflow results in a $0.16 decrease in capital expenditures.

The problem with this interpretation is that it requires an implicit assumption that firms do not systematically adjust to cashflow revelations by altering other sources and uses of cash. Instead, alternate responses such as raising debt or equity, or selling assets, are subsumed in the error term. This can be problematic if the omitted variables are correlated with cash flows, in which case the cashflow coefficient may be biased. For example, the direct effect of a negative cashflow shock may be a reduction in capital expenditures. However, an indirect effect may be an increase in debt financing and a commensurate increase in capital expenditures. To determine the total effect on capital expenditures of a negative cashflow shock, both the direct and indirect effects must be considered simultaneously.

In addition to inducing a bias, failing to simultaneously account for the direct and indirect effects can lead to incorrect conclusions regarding firms' abilities to finance their projects by raising external capital. For example, consider two firms, one of which is financially unconstrained and the other financially constrained. Each firm faces a one dollar decrease to cashflow. The unconstrained firm reacts by cutting capital expenditures by $0.20 and by issuing debt worth $0.80. The constrained firm is unable to access external capital and instead responds by cutting capital expenditures by $0.20 and by selling $0.80 worth of assets. In this example, a single-equation model would show identical investment/cashflow sensitivities even though one firm is unconstrained and the other is constrained. The presence of financial constraints is evident not in the investment/cashflow sensitivity, but in the debt/cashflow sensitivity.

A second example shows that interpreting a positive investment/cashflow sensitivity relation as evidence of financial constraints can also be problematic. Consider a firm that responds to a one dollar decrease in cashflow by altering its strategy from one of organic growth to one of debt-financed acquisitions. Because organic growth is reduced, capital expenditures will decrease leading to a positive investment/cashflow sensitivity. However, in this example, the firm is not financially constrained as it was able to access the debt markets to obtain financing for acquisitions.

It is possible to construct other examples that suggest that inferences regarding access to capital markets cannot be made solely on the basis of investment/cashflow sensitivities as is typical in single-equation studies. However, it is difficult to systematically quantify the sign and magnitude of the resulting bias induced by ignoring the firm's other decision variables, especially when the full array of decision variables available to the firm are considered. Therefore, rather than attempting to quantify the bias analytically, we measure the bias empirically by estimating the simultaneous-equation model described in the following section.

3. Model

The manager's task is to select optimal values for investment and financing decision variables, given the expected values for exogenous and predetermined variables. Table 2 describes the variables that enter the optimization problem. In solving this problem, the manager faces the constraint that ex-post, sources of funds must equal uses of funds:

$$\Delta Cash_t + RP_t + DIV_t + CAPX_t + ACQUIS_t - \Delta LTD_t - \Delta STD_t - EQUISS_t - ASALES_t \equiv CF_t + OTHER_t \quad (2)$$

In equation (2), decision variables have been collected on the left-hand side of the identity for convenience. OTHER is the difference between the source and use variables used and captures miscellaneous source and use items that are not explicitly included in the model.

Our measure of cash flow (CF) is defined in equation (3):

$$CF_t = EBITDA_t - INTEXP_t - TAX_t - \Delta NWC_t \tag{3}$$

where $EBITDA_t$ is earnings before interest, taxes, and depreciation. Because $EBITDA_t$ is jointly determined by the firm's past investments and by consumers' current behavior, it is assumed to be exogenous to the firm in the current period. $INTEXP_t$ is interest expense and TAX_t is cash taxes. Both of these variables are assumed to be determined by financing and investment decisions in prior years and are therefore taken as exogenous in the current period. Similarly, ΔNWC_t which equals change in net working capital from t-1 to t, is assumed to depend on past investment decisions and current sales projections. Thus, CF_t is assumed to be exogenous and represents internally generated funds that are available for undertaking investments or for making payments to shareholders and principal payments to debtholders.

Because, as a simple matter of accounting, the sources/uses identity specified by equation (2) is always satisfied for *ex-post* quantities, it conveys little economic content. What is important from an economic standpoint is that the constraint also holds for *ex-ante* values, conditional on forecasts of end-of-period exogenous variables. This *ex-ante* budget constraint is expressed as:

$$\Delta \widetilde{Cash}_t + \widetilde{RP}_t + \widetilde{DIV}_t + \widetilde{CAPX}_t + \widetilde{ACQUIS}_t - \Delta \widetilde{LTD}_t - \Delta \widetilde{STD}_t - \widetilde{EQUISS}_t - \widetilde{ASALES}_t = \widehat{CF}_t + \widehat{OTHER}_t \tag{4}$$

where tildes represent decision variables and hats represent exogenous variables that must be forecasted. Equation (4) states that at the beginning of period t, when firms make their investment and financing decisions, the planned values of decision variables are selected such that the expected end-of-period sources/uses constraint is satisfied. This implies that a firm cannot plan to allocate funds in excess or deficit of the amount it expects to generate, either through operations or financing, during the current period.

For choice variables, ex-ante quantities are planned values, determined based on beginning-of-period known quantities. While the firm has precise control over ex-ante (planned) levels, ex-post quantities depart stochastically from their ex-ante counterparts as follows:

$$\begin{bmatrix} -CAPX_t \\ -ACQUIS_t \\ \vdots \\ \Delta LTD_t \\ -\Delta CASH_t \end{bmatrix} = \begin{bmatrix} -CA\tilde{P}X_t \\ -AC\tilde{Q}UIS_t \\ \vdots \\ \Delta L\tilde{T}D_t \\ -\Delta C\tilde{A}SH_t \end{bmatrix} + \begin{bmatrix} e_{CAPX,t} \\ e_{ACQUIS,t} \\ \vdots \\ e_{\Delta LTD,t} \\ e_{\Delta CASH,t} \end{bmatrix} \tag{5}$$

$e_{CAPX,t}$,.... $e_{CASH,t}$ are error terms associated with the nine financing and investment decision variables, and represent deviations of actual quantities from planned quantities. Similarly, ex-post exogenous source variables (CF and OTHER) equal forecasts of these variables made at the beginning of the period plus forecast errors:

$$\begin{bmatrix} CF_t \\ OTHER_t \end{bmatrix} = \begin{bmatrix} \hat{C}Ft \\ OT\hat{H}ER_t \end{bmatrix} + \begin{bmatrix} e_{CF,t} \\ e_{OTHER,t} \end{bmatrix} \tag{6}$$

Taken together, equations (4), (5), and (6) imply that the error terms are related in the following manner:

$$e_{\Delta Cash_t} + e_{RP_t} + e_{DIV_t} + e_{CAPX_t} + e_{ACQUIS_t} - e_{\Delta LTD_t} - e_{\Delta STD_t} - e_{EQUISS_t} - e_{ASALES_t} = e_{CF_t} + e_{OTHER_t} \qquad (7)$$

We assume that when making investment and financing decisions, firms attempt to achieve long-run optimal levels subject to available investment opportunities. The proxy variable used for investment opportunities is the ratio of market value of equity to book value of equity (MB). In addition, firm size is included as an exogenous variable to control for the possibility that investment opportunities and access to external capital depend on firm size. Firm size (SIZE) is measured as the natural logarithm of the book value of assets.

$$\begin{bmatrix} -CAPX_t^* \\ -ACQUIS_t^* \\ \vdots \\ \Delta LTD_t^* \\ -\Delta CASH_t^* \end{bmatrix} = M \begin{bmatrix} \hat{MB}_t \\ SI\hat{Z}E_t \end{bmatrix} + L \begin{bmatrix} \hat{CF}_t \\ OT\hat{H}ER_t \end{bmatrix} \qquad (8)$$

Our model assumes that firms attempt to minimize a penalty function that depends on deviations from optimal levels and on the speed of adjustment towards optimal levels. If the penalty function is quadratic in these two costs, then minimizing the penalty function subject to the constraint that sources of funds must equal uses of funds produces the linear equations that we estimate in the empirical section of the paper. If the true cost function has a more complicated form, the equations that we estimate should be interpreted as being reduced form.

By making investment and financing decisions to minimize the cost of being at suboptimal levels, subject to the constraint specified by equation (4), the following system of nine equations is obtained:

$$\begin{bmatrix} -\widetilde{CAPX}_t \\ -AC\widetilde{QUIS}_t \\ \vdots \\ \Delta L\widetilde{TD}_t \\ -\Delta C\widetilde{ASH}_t \end{bmatrix} = K \begin{bmatrix} -CAPX_{t-1} \\ -ACQUIS_{t-1} \\ \vdots \\ \Delta LTD_{t-1} \\ -\Delta CASH_{t-1} \end{bmatrix} + M \begin{bmatrix} \hat{MB}_t \\ SI\hat{Z}E_t \end{bmatrix} + L \begin{bmatrix} \hat{CF}_t \\ OT\hat{H}ER_t \end{bmatrix} \tag{9}$$

Where, K, M, and L are matrices of response coefficients of size 9X9, 9X2, and 9X2 respectively.

Substituting equation (9) into equation (5) gives the system of equations to be estimated:

$$\begin{bmatrix} -CAPX_t \\ -ACQUIS_t \\ \vdots \\ \Delta LTD_t \\ -\Delta CASH_t \end{bmatrix} = K \begin{bmatrix} -CAPX_{t-1} \\ -ACQUIS_{t-1} \\ \vdots \\ \Delta LTD_{t-1} \\ -\Delta CASH_{t-1} \end{bmatrix} + M \begin{bmatrix} \hat{MB}_t \\ SI\hat{Z}E_t \end{bmatrix} + L \begin{bmatrix} \hat{CF}_t \\ OT\hat{H}ER_t \end{bmatrix} + \begin{bmatrix} e_{CAPX,t} \\ e_{ACQUIS,t} \\ \vdots \\ e_{\Delta LTD,t} \\ e_{\Delta CASH,t} \end{bmatrix} \tag{10}$$

The sources and uses constraint requires that the parameter matrices satisfy:

$$i'[K]=0'; \qquad i'[M]=0'; \qquad i'[L]=-i' \tag{11}$$

Where i' is a unit vector of appropriate order. The interpretation of equation (11) is that when there is a one dollar shock in a source or use variable, the total response of the investment and financing variables is opposite in sign to the shock and adds up to one dollar. For example, if the source variable, CF, increases by one dollar, other source variables must decline by a dollar, use variables must increase by one dollar, or some combination of the response of source and use variables must add up to one dollar. If, instead of cashflow, the shock originates from a variable that represents neither a source nor a use of funds in the current period, the total response across the system of equations must sum to zero. These non-source/non-use variables are the lagged dependent variables and the exogenous variables, MB and SIZE. For example, consider the case where the estimated coefficient for the SIZE variable in the capital expenditures equation is 0.30, implying that capital expenditures go up by 30 cents when the natural log of book assets increases by one. Since capital expenditures is a use variable, and because sources of funds must equal uses of funds, either other use variables must decrease by 30 cents, net source variables must increase by 30 cents, or some combination of these responses must sum to 30 cents. As a result, the coefficients on SIZE will sum to zero. Similar constraints hold for MB and lagged dependent variables.

4. Data

The annual data we use covers Compustat firms from 1950 to 2003, excluding financial institutions and utilities. Because the model contains lagged variables, the nine equation system specified in equation (10) is estimated over the period 1952-2003.

Table 2 describes the variables used in the model in terms of their sources/uses characteristics, and also in terms of whether they act as endogenous or exogenous variables in the model. Table 3 describes how the variables used in the model are constructed from Compustat definitions.[8] Means and standard deviations for each of the variables as a percentage of total assets (except for SIZE and MB) are presented in Table 4. In addition to the full sample, summary statistics are provided for three subsamples of firm-years segmented based on Shumway (2001) bankruptcy probabilities which are used to proxy for financial constraints. Firm-years with predicted bankruptcy probabilities below the 25th percentile constitute the unconstrained subsample, firm-years with predicted bankruptcy probabilities above the 75th percentile constitute the constrained subsample, and firm-years that fall between the above two percentiles constitute the partially constrained subsample. Splitting the sample in this way results in an uneven number of firms in each subsample—the partially constrained subsample contains approximately two times the number of firm-years as do the constrained and unconstrained subsamples. The benefit of this method of segmentation over a simple trifurcation of the sample is that the identification of constrained and unconstrained firm-years is more accurate.

Table 4 shows that mean cashflow (as a percent of total assets) increases monotonically with financial health. The mean cashflow for the financially unconstrained subsample is twice as large as the mean cashflow for the partially constrained subsample. Furthermore, mean cashflow is negative for the financially constrained subsample. There is a similarly monotonic relationship between dividends and financial health. Unconstrained firms pay larger dividends (as a percent of total assets) than constrained firms. Additionally, reliance on short-term debt increases monotonically, as financial health deteriorates.

Market-to-book ratio is used in the regressions as a proxy for investment opportunities. Based on this proxy, unconstrained firms have the richest investment opportunities, while financially constrained firms have the poorest investment opportunities. Financially unconstrained firms, which have high market-to-book ratios also appear to be less acquisitive, which is consistent with these firms having healthy internal growth opportunities. Finally, like the market-to-book ratio, firm size exhibits a

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[8] To avoid dropping observations with missing Compustat variables, we replace missing data with zero. We also estimated the model after dropping observations with missing data. Results are not significantly

monotonic relationship with financial health—unconstrained firms tend to be larger whereas financially constrained firms tend to be smaller.

5. Empirical Results

The system specified in equation (10) is estimated using two methods for forecasting the endogenous variables. The first forecast model, which we refer to as the perfect foresight model, assumes that planned values of the decision variables equal end-of-period (ex-post) realizations of these variables. The second forecast model uses I/B/E/S analysts' forecasts to construct estimates of internally generated cash flow (CF).[9]

Because both approaches generate similar estimates, results only from the perfect foresight model are reported. The model is first estimated for the full sample using levels (not first differences) without firm and year fixed effects. Following this, results are presented using first differences for subsamples of data based on firms' financial health.

5.1. Model Estimation

Results from estimating equation (10) subject to the restriction specified by equation (11) are shown in Tables 5A and 5B. The estimation uses the full sample, consisting of

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affected by how missing data is treated.

[9] Forecasted cashflow is measured using the following equation:

$$\widetilde{CF} = CF + \left[(IBFIMD)(CSHO) - NI\right] - XIDO$$

where IBFIMD is the median earnings per share estimate for the current fiscal year provided by I/B/E/S, CSHO is common shares outstanding, NI is net income, and XIDO is extraordinary items and discontinued operations (all Compustat annual mnemonics.) The first term in the above equation is the realized cashflow. The second term adjusts realized cashflow to reflect differences between expected and actual net income. Finally, extraordinary items are subtracted to reflect the fact that had they been expected, they would be unlikely to be extraordinary.

244,081 firm-years. The regressions are estimated with robust standard errors that account for within-firm clustering (18,849 clusters.)

Estimated responses of each of the endogenous financing and investment variables to changes in cash flow, the residual sources/uses variable (OTHER), market-to-book ratio, and firm size are reported in Table 5A. Column 1 displays the casfhlow coefficients. As expected, a one dollar increase in casfhlow results in an increase in "use" variables and a decrease in "source" variables. In the case of use variables, the coefficients in the first column of Table 5A show that a one dollar increase in cashflow causes a $0.03 increase in capital expenditures (statistically insignificant), a $0.01 increase each in dividends and share repurchases, and a $0.24 increase in cash balances (all statistically significant).

The first column of Table 5A also shows that positive cashflow innovations cause other source variables to decline. Firms react to a $1 cashflow shock by retiring $0.15 of long-term, and $0.58 of short-term debt. Both of the estimated debt coefficients are statistically different from zero at the 1% level. Asset sales and equity issues remain unchanged while acquisitions decline (significant at the 10 percent level.) In all, 7 of the 8 coefficients in the estimated system have the expected sign, and the shareholder distribution and leverage variables are significant at the 1% level.

Because of the constraint specified in equation (11), a one dollar increase in cashflow must result in a one dollar decrease in other sources of funds, a one dollar increase in uses of funds, or some combination of a reduction in sources or increase in uses to exactly offset the one dollar cashflow increase. The coefficients reported in the first column of Table 5A show that this indeed is the case—use variables increase by $0.27, while source variables decrease by $0.73. While the sign of both total uses and total sources are as expected, the primary conclusion that emerges from these results is that financing/cashflow sensitivities dominate investment/cashflow sensitivities. Net debt (long-term debt plus short-term debt minus cash balance) decreases by \$0.97 and net investments increase by a meager \$0.02 (capital expenditures increase by \$0.03.)

The variable OTHER in Table 5A is defined to be the difference between miscellaneous source and use variables not explicitly accounted for in the model. For example, a decrease in "other assets" represents a source of funds as does an increase in "other liabilities." Neither one of these balance sheet accounts is explicitly modeled since they do not represent economically important decisions. Thus, the effects of all miscellaneous sources and uses are subsumed in OTHER. Because of the way in which OTHER is defined, it has an interpretation that is similar to the cash flow variable. A one dollar shock in OTHER must be offset by a one dollar increase in uses, a one dollar decrease in other sources, or some combination of the two. As is the case for cashflow shocks, results displayed in the second column of Table 5A show that long-term and short-term debt are the primary buffers to changes in other assets and liabilities.

The final variables in Table 5A are market-to-book ratio (MB) and firm size (SIZE). Since these variables represent neither sources nor uses of funds, the response of the system to innovations in these variables sums to zero. Results shown in the fourth column of Table 5A suggest that firms with higher market-to-book ratios are more likely to issue equity. When distributing cash to shareholders, high market-to-book ratio firms rely more on share repurchases and less on dividends. High market-to-book ratio firms are also likely to reduce both short and long-term debt compared to low market-to-book ratio firms. Overall, these results are consistent with what one would expect of firms with significant growth opportunities. Size is also related to firms' investment, financing, and distribution decisions. In general, larger firms appear to be more active participants in financial markets, having higher levels of acquisitions, equity issues, dividend payments, share repurchases, and both long and short-term debt issues.

Coefficients for the lagged endogenous variables (estimates for matrix K in equation (10)) are displayed in Table 5B. The estimated coefficients of the matrix describe how current investment and financing variables depend on lagged investment and financing variables. Diagonal elements of K can be loosely interpreted as "own" adjustment rates; the smaller in absolute value is the jth diagonal coefficient, the less inertia is displayed in the adjustment of the jth variable. Dividends, capital expenditures, and asset sales display the most inertia, with lagged coefficients of 0.92, 0.87, and 0.84, respectively. These coefficients reflect the sticky nature of dividends, and the multi-year nature of capital expenditure programs. Conversely, leverage variables (long and short-term debt issues, and change in cash balances) show very little inertia, indicating that these variables adjust quickly to shocks. In addition, debt variables respond strongly in the current period to lagged capital expenditures (both in terms of magnitude and statistical significance) reflecting the use of debt to finance capital expenditure programs.

Off-diagonal elements provide evidence that changes in cash balances and both long and short-term debt issues act as "shock absorbers" in the system. In general, the largest off–diagonal elements (in absolute value) are found in the *rows* associated with these three leverage variables, implying that current-period cash holdings and debt issues respond strongly to prior changes in other system variables. Conversely, *columns* associated with leverage variables have by far the smallest off-diagonal coefficients indicating that lagged changes in these variables do not influence the rest of the system in the current period. In sum, the relative sizes (in absolute value) of the off-diagonal rows and columns, along with small diagonal coefficients, suggest that debt absorbs, but does not transmit, shocks to the rest of the system.

5.2. Model Estimation Using First Differences

Because of the cross-sectional nature of the analysis described in the preceding section, regression coefficients reflect differences in capital expenditures across firms rather than within firms. Therefore, they provide only an indirect estimation of how individual firms alter investment and financing variables in response to cashflow shocks. To provide a more direct estimate, we first transform all variables from levels to first differences and use time dummies to account for fixed firm and year effects. The model in first differences must satisfy the constraint that changes in sources of funds equal changes in uses of funds.[10]

Results from estimating the first-difference version of the model are presented in Table 6. For brevity, only cashflow coefficients and adjusted R^2 for each of the nine equations are presented. To facilitate comparison, cashflow coefficients reported in Table 5A using levels rather than first differences are replicated in Table 6. Table 6 shows that using first differences provides even stronger evidence that firms respond to cashflow shocks by altering financing rather than investment variables. The cashflow coefficient from the capital expenditures equation is 0.001 using first differences versus

[10] Cleary (1999) does not use first differences, but instead transforms variables by subtracting firm and year means. In our analysis, transforming variables in this way makes it difficult to interpret the sources/uses constraint. Nevertheless, we also performed the analysis using this transformation. Results (unreported) are nearly identical to those obtained using first differences.

0.031 using levels. This implies that a one dollar cashflow change affects capital expenditures by less than one penny. The first difference analysis confirms that firms react to cashflow changes primarily by altering debt and cash balances. A one dollar decrease in cashflow causes long-term debt to increase by $0.14, short-term debt to increase by $0.63, and cash balances to decrease by $0.23. In addition, there is an economically small but statistically significant decrease in share repurchases. Overall, results presented in Table 6 indicate that firms do not cut capital expenditures in response to negative cashflow shocks but instead react by increasing net debt.

5.3. Effects of Capital Constraints

Prior investment/cashflow studies focus on whether constraints in accessing external capital affect firms' investment levels. Based on results presented in Tables 5 and 6, there is little evidence that financing constraints alter investment levels for the broad sample. However, the effect could be absent for the majority of firms, but might still exist for financially unhealthy firms. The approach taken in prior studies is to segment the sample based on some measure of financial health and then determine whether there is a relationship between financial health and investment/cashflow sensitivity. In their original paper, FHP (1988) segmented firms according to dividend payout ratios. Firms that paid no dividends were deemed to be financially constrained, firms that paid small dividends relative to net income were deemed to be partially financially constrained, and firms that paid moderate-to-large dividends relative to net income were deemed to be unconstrained. Subsequent papers questioned the legitimacy of simply using dividend levels as a determinant of financial health and instead used a range of financial variables to classify firms' financial health. For example, Cleary (1999) uses multiple discriminant analysis, similar to that used by Altman to generate Z scores for bankruptcy prediction. To conduct the discriminant analysis, Cleary generates three groups of firms. Firms that decrease their dividends in a given period are placed in Group 1, firms that increase their dividend are placed in Group 2, and firms that leave their dividends unchanged are placed in Group 3. Using financial variables that are likely to reflect a firms' classification into Group 1 or Group 2, Cleary calculates Z_{FC}, a pseudo Z-Score that reflects a firm's degree of financial constraint. In this paper, we follow a similar approach. However, because firms alter dividend policies for many reasons unrelated to financial constraints, we segment firms by bankruptcy probability rather than change in dividend policy.[11]

There are a number of ways to calculate bankruptcy probability. Perhaps the best approach would be to use a Merton-type model that accounts for the volatility of the firm's assets as well as the firm's capital structure (Merton 1974.) Yet because of problems in estimating asset volatility and in gathering detailed capital structure data for individual firms, this approach is cumbersome to implement over a large sample. An alternative approach is to use bankruptcy probabilities calculated using reduced-form models such as the Altman Z-Score model or the Shumway (2001) hazard model. Both of these models are easy to implement and provide reasonably accurate rankings of financial health. Shumway's hazard model in particular has been shown to produce results that are similar to those produced using the Merton asset-based model (Bharath

[11] In addition to segmenting the data using the Shumway (2001) bankruptcy probability model, we also formed subsamples by using Altman's Z-Scores, and by replicating Cleary's (1999) discriminant analysis with bootstrapped standard errors (table available upon request.) All three approaches produce similar results indicating that the analysis is robust to subsample formation and standard error estimation.

and Shumway (2004)). Shumway calculates bankruptcy probabilities using the following model:[12]

$$Pr = e^{[-13.303 - 1.982 NI/A + 3.593(L/A) - 0.467 \ln(Relative\ Size) - 1.809(Ret_{t-1}\ Ret\ Market_{t-1}) + 5.791(Sigma)]} \qquad (13)$$

where NI/A is net income divided by total assets; L/A is total liabilities divided by total assets; Relative Size is the natural log of firm market capitalization divided by the total market capitalization of the NYSE and AMEX; Ret_{t-1} – Ret $Market_{t-1}$ is the firm's equity return over the prior year minus the market return over the prior year; Sigma is the standard deviation of the residual from a regression of firm returns on market returns over the prior year.

To classify firms according to bankruptcy probability, we calculate the 25^{th} and 75^{th} percentiles of the predicted bankruptcy probability across the entire sample. Firm-years with probabilities below the 25^{th} percentile are classified as financially unconstrained (FUC), firm-years with bankruptcy probabilities above the 75^{th} percentile are classified as financially constrained (FC), and all other firm-years are classified as partially financially constrained (PFC). Because of the ordinal nature of this categorization scheme, the precise level of bankruptcy probability produced by Shumway's model is not important for our purposes.

To determine if firms' investment/cashflow sensitivities depend on whether or not they are constrained from accessing external capital, we estimate the system specified by equation (10), subject to the constraint in equation (11) for each of the three groups (FC, FUC, and PFC). Equation (10) is estimated using first differences and year dummies.

[12] Shumway (2001), Table 6B, p. 122.

Rather than presenting coefficient estimates for all variables, we focus on the sensitivities of each of the investment and financing variables to changes in cashflow. Panel A of Table 7 presents results for each of the subsamples. In addition, results for the full sample from Table 6 are repeated for ease of comparison. Results displayed in Panel A of Table 7 show that over the full sample and the three subsamples, 29 of the 36 coefficients have the expected sign (i.e. use variables increase and source variables decrease in response to positive cashflow changes) and 19 of the 29 are statistically significant. Only one of the significant coefficients has the wrong sign (the acquisitions coefficient in the partially constrained sample, which is significant at the 10% level.)

Consistent with the full sample results, firms react to a one dollar change in cashflow by altering financial leverage, regardless of financial health. For all of the subsamples, the sensitivity of leverage to changes in cashflow overwhelms the sensitivities of both investments and shareholder distributions. In fact, the capital expenditures coefficient is less than 0.01 in all of the subsamples. Thus, the approximately 0.10 to 0.25 investment/cashflow sensitivity documented in previous single-equation studies disappears when the simultaneous equation model is estimated.

While debt/cashflow sensitivities are similar across subsamples, the changes in short-term versus long-term debt differ monotonically across the subsamples. The short-term debt sensitivity for the unconstrained subsample is 0.38 suggesting that firms in this sample react to a one dollar decrease in cashflow by borrowing \$0.38 of short-term debt. Conversely, sensitivities for partially constrained and constrained firms are 0.58 and 0.70, respectively. Since change in cash balance and changes in overall leverage are similar across subsamples, the mirror image of short-term debt sensitivity holds true for long-term debt sensitivity. Long-term debt/cashflow sensitivities are 0.35, 0.17, and 0.07, for the unconstrained, partially constrained, and constrained samples, respectively. These results imply a greater reliance by financially unhealthy firms on short-term debt. Diamond (1991), using a model where borrowers have private information about their future credit rating, finds that borrowers with lower credit rating can issue only short-term debt, in spite of the fact that they prefer long-term debt. The results of Table 7 and Table 8 (which will be discussed in the next section) provide evidence in support of this hypothesis.

In determining whether capital market constraints induce underinvestment, we argue that the relative magnitudes of investment/cashflow and financing/cashflow sensitivities, rather than just the magnitude of the investment/cashflow sensitivity, should be considered. Results in Panel A of Table 7 show that financing/cashflow sensitivities dominate investment/cashflow sensitivities for firms in all categories. Thus, there is little evidence that firms are forced to forgo positive NPV projects because they are unable to access external capital. If firms were prevented from investing in valuable projects due to capital market frictions, we would expect a more dramatic change in investments and a much less dramatic change in financial leverage in response to cashflow changes.

Panel B of Table 7 examines differences between coefficients for the subsamples of data presented in Panel A. The results in Panel B show a strong similarity between firms in all subsamples. Of the 27 differences considered, only 9 are statistically different from zero. The significant pair-wise differences relate to shareholder distributions and short versus long-term debt. There is no evidence that investment/cashflow sensitivities vary across subsamples.

5.4. Positive and Negative Cashflow Shocks

A potential problem with results presented in Table 7 is that they assume symmetry: the way in which a firm reacts to a cashflow increase is assumed to be equal and opposite of the reaction to a cashflow decrease. However, the effect of capital constraints on investment is really about being able to raise external funds when faced with negative innovations in cashflow, not retiring capital in response to positive innovations. Therefore, in this section we examine the symmetry of investment/casfhlow and financing/cashflow sensitivities. Towards this end, we estimate equation (10) where the right hand side variables include an interaction variable equal to change in cashflow multiplied by a dummy variable that takes the value of one when change in cashflow is positive and zero when change in cashflow is negative.

Firms' reactions to positive and negative cashflow shocks are displayed in Table 8. For example, for the full sample (Panel A), in the short-term debt equation, the estimated coefficients for the cashflow variable and the interaction term are -0.666 and 0.059, respectively. This implies that when there is a negative one dollar change in cashflow, firms borrow an additional \$0.67 of short-term debt. Conversely, when there is a positive one dollar change in cashflow, firms pay down \$0.61 of short-term debt. The 1.53 t-statistic on the interaction term indicates that the 0.059 difference between the negative and positive short-term-debt/cashflow sensitivities is not statistically significant.

Of the nine variables studied, there is statistical evidence of asymmetry in two variables, capital expenditures and dividends. Regarding capital expenditures, the coefficients indicate that firms increase capital expenditures by \$0.008 when cashflow increases by one dollar and also increase capital expenditures by $0.007 when cashflow decreases by one dollar. Thus, while there is a statistically significant difference between investment cashflow coefficients depending on whether the cashflow change is positive or negative (t-statistic equal to 2.22), the economic implication is that capital expenditures are almost completely insulated from short-term cashflows. The significant asymmetry regarding dividends suggests that firms, on average, increase dividends but are more likely to do so following cashflow increases.

Results for subsamples of firms segmented based on financial health (panels B, C, and D of Table 8) confirm that, in general, firms respond symmetrically to negative and positive changes in cashflow. Overall, only six out of the 36 tests of symmetry indicate an asymmetric response. Regarding capital market access, there is virtually no evidence that firms react differently to positive versus negative changes in cashflow. Of the 12 coefficients that represent firms' equity issues, changes in long-term debt, and changes in short-term debt, none display asymmetry at the 5 percent level of statistical significance. If anything, the evidence presented in Table 8 suggests that firms borrow more in response to a $1 cashflow decrease than they pay back in response to a $1 cashflow increase. For example, for the financially constrained subsample (Panel D of Table 8), short-term debt increases by $0.76 in response to a $1 cashflow decrease, and decreases by $0.66 in response to a $1 cashflow increase. The $0.10 difference is significant at the 10% level. A similar effect is evident with respect to total debt. This, combined with the economically small sensitivity of capital expenditures to cashflows, provides little support for the notion that capital market constraints cause firms to forgo positive NPV projects.

6. Conclusion

Typically, corporate investment, distribution, and financing polices are evaluated in isolation using a single-equation OLS methodology. As illustrated in this paper, the single-equation approach can be problematic because it ignores interactions between corporate policies. As a result, coefficient estimates can suffer from omitted variable bias and can lead to incorrect inferences regarding determinants of corporate policies.

To demonstrate the problem that arises in single-equation studies, we examine the sensitivity of investment to cashflow. The investment/cashflow literature is well-developed and has generally produced conflicting results. While virtually all studies agree that for the typical firm, the investment/cashflow sensitivity is statistically positive, there is broad disagreement over the effects of financial constraints on investment/cashflow sensitivities. Some studies conclude that financially constrained firms exhibit larger investment/cashflow sensitivities than financially unconstrained firms, whereas other studies find the opposite result.

Investment/cashflow sensitivities from prior studies range between 0.10 and 0.25, suggesting that firms increase investment when cashflow rises and decrease investment when cashflow falls. Using the single-equation methodology followed in prior studies, we obtain similar results (investment/cashflow sensitivity equal to 0.16.) However, when we examine the investment/cashflow relationship in a larger context by simultaneously considering other corporate policies, we find that the positive relationship between investment and cashflow disappears. Regardless of the firm's degree of financial constraints, there is, on average, no relationship between investment and cashflow.

Rather, firms insulate capital expenditures from cashflow fluctuations by changing net debt. When cashflows are low, firms increase debt and reduce cash balances. When cashflows are high, firms reduce debt and increase cash balances.

Our results, while considerably different from prior studies, are intuitive. Capital expenditures typically reflect long-term investment programs and, absent severe financial market frictions, are unlikely to be affected by short-term cashflow fluctuations. Financing decisions are much less costly to change and therefore provide a superior alternative to accommodate cashflow fluctuations. The investment/cashflow and financing/cashflow sensitivities documented in this paper provide strong support for this intuition. Overall, we find no evidence that costly access to external financial markets causes firms to underinvest.

While our results have implications for the investment/cashflow literature, the more important point demonstrated in this paper is that examining corporate policies (i.e. investment, distribution, financing) in isolation can generate misleading results. Rather than modeling policies independently, they should be modeled simultaneously, subject to the constraint faced by every firm at all times—sources and uses of cash must be equal.

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Table 1
Single-Equation Cashflow Sensitivities

This table presents results from Fazzari, Hubbard, and Petersen (1988) and Cleary (1999). For comparison, a similar analysis labeled Pulvino/Tarhan which uses data described in this paper and a selection criterion similar to Cleary is presented. In each of these analyses, the following equation is estimated:

$$\frac{CAPX_t}{K_t} = \beta_1 \frac{CF_t}{K_t} + \beta_2 MB_t + \varepsilon_t$$

where CAPX is capital expenditures, K is fixed assets, CF is cashflow, and MB is the ratio of the market value of assets to the book value of assets.

	β_1	β_2	Adj. R^2	Sample Size (firm-years)	Sample Period	Data Source
FHP (1988)[a]	0.23	0.00	0.19	5,010	1970-1984	Value Line
	(23.0)	(6.7)				
Cleary (1999)	0.10	0.02	0.12	9,219	1987-1994	SEC
	(29.7)	(12.3)				Worldscope
						Disclosure
Pulvino/Tarhan[b]	0.16	0.06	0.84	10,222	1987-1994	Compustat
(2005)	(27.2)	(9.0)				

[a]FHP report results for subsamples of firms based on degree of financial constraints. They do not present results for the full sample. Therefore, entries in this table correspond to their unconstrained subsample, which represents 79% of the full sample.

[b]For this table only, we restrict the sample period to 1987-1994 to match the period used by Cleary (1999).

Table 2
Sources and Uses of Investment and Financing Variables

This table describes the variables used to estimate the system described by equation (10) subject to the constraints described by equation (11). Compustat definitions used to construct the variables are described in Table 3.

Variable Name		Description	Type of Variable
Sources	Cash Flow (CF)	Internally available cash flow for investment and financing	Exogenous/financing
	OTHER	The difference between source and use variables that captures miscellaneous sources and uses of funds not explicitly included in the model	Exogenous
	ΔLong-term Debt (ΔLTD)	Change in long -term debt	Endogenous/financing
	ΔShort-term Debt (ΔSTD)	Change in short-term debt	Endogenous/financing
	Equity Issues (EQUISS)	Dollar value of equity issues	Endogenous/financing
	Asset Sales (ASALES)	Dollar value of assets sold	Endogenous/investment
Uses	Share Repurchases (RP)	Dollar value of shares repurchased	Endogenous/financing
	Dividends (DIV)	Dollar value of dividends paid	Endogenous/financing
	Capital Expenditures (CAPX)	Dollar value of capital expenditures	Endogenous/investment
	Acquisitions (ACQUIS)	Dollar value of acquisitions	Endogenous/investment
	ΔCASH	Change in cash balance	Endogenous/financing
Other variables	Market-to Book Ratio (MB)	Ratio of market value of equity to book value of equity	Exogenous
	Size (SIZE)	Logarithm of total book assets	Exogenous

Table 3
Variable Definitions

Variable	Description	Compustat Pneumonic
CASH	Cash and equivalents	CHE
LTD	Long term debt	Long term debt (DLTT)
STD	Short term debt	Debt in current liabilities (DLC)
EQUISS	Sale of common and preferred stock	SSTK
ASALES	Sale of assets and investments	SPPE
CAPX	Net capital expenditures	Capital expenditures (CAPX)
ACQUIS	Acquisitions	ACQ
RP	Purchase of common and preferred stock	PRSTKC
DIV	Cash dividends	DV
SIZE	Log of total assets	Log of AT
MB	Market-to-book value of assets	(Market value of equity – book value of equity + book value of total assets)/book value of total assets (MKVALF – CEQ + AT)/AT
NWC	Net working capital	(Total current assets (ACT) – cash and equivalents (CHE)) – (Total current liabilities (LCT) – Debt in current liabilities (DLC))
Cash Flow	Internal cash flow net of net interest expense, cash taxes and change in net working capital	EBITDA (OIBDP) – Net interest expense (XINT –IINT) – Cash taxes (TXT – TXDC) – Change in net working capital (ΔNWC)
OTHER	Sources of funds minus uses of funds variables used in the model	(ΔSTD + ΔLTD + Cash Flow + ASALES + EQUISS +) – (CAPX + ACQUIS + RP + DIV + ΔCASH)

Table 4
Data Summary

This table presents a summary of the Compustat data used in the empirical analyses. All numbers, except for Market/Book and Firm Size, are percentages of firm assets. Firm Size is measured as the natural logarithm of book assets measured in millions of dollars. Subsamples are formed based on Shumway's (2001) hazard model, which uses market and accounting variables to calculate bankruptcy probabilities. We consider firm-years with bankruptcy probabilities below the 25th percentile to be unconstrained, and firm-years with bankruptcy probabilities above the 75th percentile to be constrained.

	Full Sample		**Unconstrained Sample**		**Partially Constrained Sample**		**Constrained Sample**	
	Number of Firm Years = 244,081		**Number of Firm Years = 60,876**		**Number of Firm Years = 121,752**		**Number of Firm Years = 61,453**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Cashflow	0.043	0.18	0.085	0.11	0.042	0.14	-0.015	0.29
OTHER	-0.004	0.25	-0.001	0.18	0.002	0.18	-0.022	0.42
ΔLTD	0.012	0.19	0.011	0.13	0.019	0.15	-0.005	0.33
ΔSTD	0.003	0.18	0.001	0.08	0.003	0.10	0.008	0.35
Equity Issues	0.041	0.14	0.031	0.11	0.041	0.14	0.055	0.19
Asset Sales	0.006	0.04	0.004	0.02	0.006	0.04	0.009	0.06
Share Repurchases	0.007	0.05	0.008	0.03	0.008	0.05	0.006	0.07
Dividends	0.010	0.04	0.018	0.05	0.008	0.04	0.004	0.04
Capital Expenditures	0.067	0.08	0.073	0.07	0.064	0.08	0.064	0.09
Acquisitions	0.014	0.06	0.012	0.05	0.015	0.06	0.016	0.07
ΔCash Balances	0.010	0.16	0.022	0.10	0.014	0.15	-0.016	0.24
Market/Book	1.537	1.28	1.844	1.55	1.465	1.17	1.284	1.02
Firm Size	5.106	1.88	5.896	1.96	5.063	1.77	4.082	1.50

TABLE 5A
Full Sample Estimates of the Impact Response Coefficients to a One Dollar Change in Cashflow

This table presents results from estimating the system of equations specified by equation (10) subject to constraints specified by equation (11). The constraints require that sources of funds are offset by uses of funds. T-statistics are in parentheses and are computed assuming clustering by firm. Number of observations is 244,081 firm-years. Number of clusters is 18,849. Annual COMPUSTAT data is used for the sample period 1952-2003.

Dependent Variable	Cash Flow	Other	Size	M/B	R^2
Capital Expenditures$_t$	0.031	-0.033	2.608	-0.714	0.83
(use)	(1.39)	(-0.82)	(1.60)	(-1.35)	
Acquisitions $_t$	-0.014	-0.012	1.858	-0.567	0.17
(use)	(-1.84)	(-1.20)	(3.63)	(-2.65)	
Asset Sales $_t$	-0.001	0.002	-0.454	0.203	0.86
(source)	(-0.50)	(0.72)	(-1.55)	(1.69)	
Equity Issues$_t$	0.005	-0.003	1.672	0.606	0.12
(source)	(1.19)	(-0.26)	(6.75)	(5.22)	
Share Repurchases$_t$	0.011	-0.008	0.249	0.183	0.44
(use)	(2.48)	(-3.00)	(2.20)	(2.55)	
Dividends $_t$	0.007	0.000	0.400	-0.185	0.83
(use)	(2.92)	(0.04)	(3.74)	(-3.94)	
Δ Long-term Debt $_t$	-0.151	0.579	2.107	-0.962	0.60
(source)	(-4.86)	(10.19)	(3.49)	(-3.43)	
Δ Short-term Debt $_t$	-0.579	0.357	2.371	-0.888	0.46
(source)	(-10.35)	(6.74)	(3.04)	(-2.62)	
Δ Cash Balances $_t$	0.239	-0.012	0.581	0.240	0.18
(use)	(5.52)	(-0.45)	(1.25)	(1.06)	

Table 5B
Coefficient Estimates for the System Dynamics Matrix

This table presents results from estimates of the system dynamics matrix, K obtained from estimating the equations specified by equation (10) subject to constraints specified by equation (11). The estimates describe the internal dynamics of the sources and uses variables by specifying how the current state of the sources/uses portfolio depends on its lagged state in the absence of external pressure. In particular, the *jth* row of K indicates how the current *jth* sources/uses item is affected by changes in the sources/uses structure last period and the *jth* column of K describes the rearrangement of the current sources/uses portfolio induced by a partial change in the *jth* item last period. The diagonal elements of K can be loosely interpreted as own adjustment rates. The smaller in absolute value the *jth* diagonal element, the less inertia is exhibited in the adjustment of the *jth* sources/uses variable in question. Since lagged dependent variables are neither sources nor uses in the current period, the constraints require that the reaction of source and use variables are equal and opposite in sign, such that the net effects of lagged dependent variables across the current dependent variables are zero. T-statistics are in parentheses and are computed assuming clustering by firm. Number of clusters is 18,849. Number of observations is 244,081. Annual COMPUSTAT data is used for the sample period 1952-2003.

Dependent Variable	**Capital Expenditure$_{t-1}$**	**Acquisitions$_{t-1}$**	**Asales$_{t-1}$**	**Equity Issues$_{t-1}$**	**Share Repurchases$_{t-1}$**	**Dividends $_{t-1}$**	**Δ Long-term Debt$_{t-1}$**	**Δ Short-term Debt$_{t-1}$**	**Δ Cash Balances$_{t-1}$**
Capital	0.873	0.049	0.157	-0.422	0.137	0.202	0.003	0.013	0.023
Expenditures	(6.22)	(1.72)	(0.54)	(-1.32)	(2.06)	(1.15)	(0.23)	(1.81)	(1.65)
Acquisitions$_t$	0.013	0.213	0.090	-0.046	0.204	0.341	-0.010	0.006	0.005
	(0.78)	(3.20)	(1.38)	(-1.38)	(4.03)	(2.50)	(-1.11)	(1.04)	(0.95)
Asset Sales$_t$	0.074	0.012	0.840	-0.055	0.045	-0.106	0.001	0.008	-0.007
	(2.49)	(0.96)	(11.88)	(-1.34)	(0.89)	(-1.90)	(0.17)	(1.42)	(-1.63)
Equity	0.019	0.049	-0.013	0.136	0.085	0.020	0.004	-0.002	0.001
Issues$_t$	(1.16)	(1.95)	(-0.46)	(3.49)	(3.19)	(0.75)	(1.20)	(-0.83)	(0.26)
Share	0.003	-0.018	0.009	0.063	0.583	0.118	-0.002	0.002	0.011
Repurchases$_t$	(0.33)	(-1.51)	(0.58)	(1.69)	(9.64)	(3.17)	(-0.64)	(0.51)	(2.26)
Dividends$_t$	0.014	0.007	-0.031	-0.003	0.030	0.915	0.004	0.004	0.011
	(2.50)	(0.78)	(-2.73)	(-0.28)	(2.32)	(26.31)	(1.63)	(1.02)	(3.46)
Δ Long-term	0.249	0.128	-0.055	-0.281	0.282	0.399	-0.033	0.051	-0.043
Debt$_t$	(5.60)	(1.23)	(-0.33)	(-2.61)	(3.99)	(2.07)	(-1.36)	(3.68)	(-1.31)
Δ Short-term	0.383	-0.001	-0.182	-0.108	0.539	1.106	0.077	-0.026	-0.004
Debt$_t$	(4.61)	(-0.02)	(-1.56)	(-0.60)	(5.18)	(7.59)	(2.35)	(-0.85)	(-0.06)
Δ Cash	-0.179	-0.062	0.364	0.100	-0.002	-0.157	0.053	0.007	-0.101
Balances$_t$	(-4.45)	(-1.20)	(5.66)	(1.05)	(-0.02)	(-1.24)	(2.06)	(0.22)	(-2.41)

Table 6
Cashflow Sensitivities: First Differences versus Levels

This table presents results from estimating the system of equations specified by equation (10) subject to constraints specified by equation (11). T-statistics are in parentheses and are computed assuming clustering by firm. The number of firm-year observations is 237,440 based on annual COMPUSTAT data over the period 1950-2003.

Dependent Variable	Cash Flow Coefficients Using First Differences	R^2	Cash Flow Coefficients Using Levels (from Table 5A)	R^2
Capital Expenditures $_t$	0.001 (0.20)	0.38	0.031 (1.39)	0.83
Acquisitions $_t$	-0.007 (-1.55)	0.25	-0.014 (-1.84)	0.17
Asset Sales $_t$	0.004 (1.93)	0.03	-0.001 (-0.50)	0.86
Equity Issues $_t$	-0.001 (-0.30)	0.37	0.005 (1.19)	0.12
Share Repurchases $_t$	0.006 (2.52)	0.15	0.011 (2.48)	0.44
Dividends $_t$	0.001 (0.62)	0.12	0.007 (2.92)	0.83
Δ Long-term Debt $_t$	-0.143 (-4.07)	0.67	-0.151 (-4.86)	0.60
Δ Short-term Debt $_t$	-0.634 (-11.08)	0.59	-0.579 (-10.35)	0.46
Δ Cash Balances $_t$	0.226 (4.90)	0.45	0.239 (5.52)	0.18

Table 7
Reactions to Cash Flow Changes and the Effects of Financial Constraints

This table presents the coefficients for the Cash Flow variable specified by equation (10), subject to the constraint specified by equation (11). Results are presented for the full sample, and for subsamples constructed on the basis of Shumway's hazard model, which uses market and accounting variables to predict bankruptcy probabilities. We consider firm years with predicted bankruptcy probabilities below the 25th percentile to be financially unconstrained (FUC), and firm years above the 75th percentile to be financially constrained (FC). Firms in between these two benchmarks are considered to be partially financially constrained (PFC). Shumway-based subsamples contain 58,709, 115,128, and 51,395 firm-years, respectively. The full sample consists of 225,232 firm years. To account for fixed effects, regressions are estimated using first differences and time dummies. Panel A presents coefficient estimates and Panel B presents differences in coefficients across subsamples. Subsample differences are computed by augmenting the system of equations such that the cashflow variable is defined as:

$$\beta_1 * CF + \beta_2 * PFC\ Dummy * CF + \beta_3 * FUC\ Dummy * CF$$

where CF is cashflow, PFC and FUC dummies take on values of 1 if the firm belongs to the appropriate constrained class, and zero otherwise. In the above equation, financially constrained firms (FC) are used as the baseline. A similar approach is followed using the partially financially constrained firms as the baseline to obtain differences between the FUC and PFC subsamples.

PANEL A

Dependent Variable	Full Sample	Financially Unconstrained	Partially Financially Constrained	Financially Constrained
Capital	0.001	-0.004	-0.005	0.003
Expenditures	(0.20)	(-0.70)	(-1.54)	(0.89)
Acquisitions	-0.007	-0.029	-0.018	-0.003
	(-1.55)	(-1.28)	(-1.90)	(-0.70)
Asset Sales	0.004	-0.001	0.001	0.006
	(1.93)	(0.73)	(0.32))	(1.79)
Net Change in Investments	-0.007	-0.032	-0.033	-0.006
Equity Issues	-0.001	-0.006	-0.009	-0.001
	(0.37)	(-1.14)	(-2.37)	(-0.50)
Share Repurchases	0.006	0.034	0.004	0.002
	(2.52)	(3.49)	(1.38)	(0.85)
Dividends	0.001	0.011	0.001	-0.000
	(0.62)	(1.90)	(0.41)	(-0.05)
Net Distribution to Shareholders	0.008	0.040	0.014	0.003
Δ Long-Term Debt	-0.143	-0.352	-0.170	-0.073
	(-4.07)	(-6.02)	(-3.57)	(-2.14)
Δ Short-Term Debt	-0.634	-0.380	-0.580	-0.703
	(-11.08)	(-9.58)	(-5.66)	(-9.60)
Δ Cash Balance	0.226	0.247	0.260	0.228
	(4.90)	(4.08)	(3.09)	(3.72)
Change in Leverage	1.00	0.979	1.00	1.00

Panel B:			
Dependent Variable	**Financially Unconstrained-Financially Constrained**	**Financially Unconstrained-Partially Constrained**	**Partially Constrained-Constrained**
Capital Expenditures	-0.002 (-0.16)	0.001 (0.12)	0.008 (1.79)
Acquisitions	-0.031 (-1.31)	-0.011 (-0.51)	0.014 (1.48)
Asset Sales	-0.006 (-2.00)	-0.002 (-0.63)	0.005 (1.07)
Equity Issues	-0.006 (-0.66)	0.002 (0.25)	0.008 (1.98)
Share Repurchases	0.034 (4.36)	0.030 (3.58)	-0.002 (-0.64)
Dividends	0.013 (2.86)	0.010 (3.62)	-.001 (-0.17)
Δ Long-Term Debt	-0.276 (-5.01)	-0.181 (-3.35)	0.098 (1.77)
Δ Short-Term Debt	0.310 (3.74)	0.199 (1.75)	-0.123 (-0.96)
Δ Cash Balance	0.007 (0.09)	-0.012 (-0.13)	-0.033 (-0.30)

Table 8
Testing for Symmetry of Positive and Negative Cash Flow Shocks

This table presents coefficients for the Cash Flow variable for each of the equations in the system specified by equation (10) subject to constraints specified by equation (11). To account for fixed firm and year effects the regressions are estimated using first differences and year dummies. The system (10) is estimated where the right-hand-side includes an interaction variable equal to change in cashflow*DUMMY, where DUMMY equals 1 when change in cashflow is positive, and zero when change in cashflow is negative. Panel A displays the results for the full sample. Panels B, C, and D display the results for the financially unconstrained, partially constrained, and the constrained subsamples.

Panel A: Full Sample
N = 225,532

Dependent Variable	Positive Cashflow $Shocks_t$	Negative Cashflow $Shocks_t$	Positive-Negative Cashflow Shocks	R^2
Capital Expenditures $_t$	0.008	-0.007	0.015	
			(2.22)	0.38
Acquisitions $_t$	-0.009	-0.005	-0.004	
			(-0.65)	0.25
Asset Sales $_t$	0.007	0.001	0.006	
			(1.93)	0.03
Equity Issues $_t$	-0.000	-0.001	0.001	
			(0.27)	0.37
Share Repurchases $_t$	0.009	0.003	0.006	
			(1.83)	0.15
Dividends $_t$	0.009	-0.007	0.016	
			(5.24)	0.11
Δ Long-term $Debt_t$	-0.152	-0.131	-0.021	
			(-1.17)	0.67
Δ Short-term Debt $_t$	-0.607	-0.666	0.059	
			(1.53)	0.59
Δ Cash $Balances_t$	0.232	0.220	0.012	
			(0.36)	0.45

Panel B: Financially Unconstrained Subsample
N = 58,709

Dependent Variable	Positive Cashflow Shocks $_t$	Negative Cashflow Shocks $_t$	Positive-Negative Cashflow Shocks	R^2
Capital Expenditures $_t$	0.010	-0.023	0.033	
			(2.93)	0.04
Acquisitions $_t$	-0.027	-0.023	-0.004	
			(-0.25)	0.26
Asset Sales $_t$	0.001	0.002	-0.001	
			(-0.16)	0.22
Equity Issues $_t$	-0.004	-0.010	0.006	
			(0.53)	0.31
Share Repurchases $_t$	0.042	0.015	0.027	
			(2.25)	0.17
Dividends $_t$	0.018	-0.003	0.021	
			(4.14)	0.11
Δ Long-term Debt$_t$	-0.324	-0.323	-0.001	
			(-0.03)	0.54
Δ Short-term Debt$_t$	-0.353	-0.360	0.007	
			(0.11)	0.49
Δ Cash Balances$_t$	0.277	0.343	-0.066	
			(-1.09)	0.44

Panel C: Partially Financially Constrained Subsample
N = 115,128

Dependent Variable	Positive Cashflow Shocks $_t$	Negative Cashflow Shocks $_t$	Positive-Negative Cashflow Shocks	R^2
Capital Expenditures$_t$	0.000	-0.007	0.007	
			(-0.00)	0.01
Acquisitions$_t$	-0.021	-0.013	-0.008	
			(-0.80)	0.30
Asset Sales$_t$	-0.001	-0.004	0.003	
			(1.07)	0.11
Equity Issues$_t$	-0.003	-0.011	0.008	
			(1.46)	0.25
Share Repurchases $_t$	0.000	0.008	-0.008	
			(-2.53)	0.19
Dividends $_t$	0.002	-0.003	0.005	
			(2.08)	0.29
Δ Long-term Debt$_t$	-0.185	-0.211	0.026	
			(0.45)	0.64
Δ Short-term Debt$_t$	-0.618	-0.592	-0.026	
			(-0.49)	0.61
Δ Cash Balances$_t$	0.220	0.197	0.023	
			(0.49)	0.46

Panel D: Financially Constrained Subsample
N = 51,382

Dependent Variable	Positive Cashflow Shocks $_t$	Negative Cashflow Shocks $_t$	Positive-Negative Cashflow Shocks	R^2
Capital Expenditures $_t$	0.006	-0.001	0.007	
			(0.85)	0.65
Acquisitions $_t$	-0.003	-0.003	-0.000	
			(-0.07)	0.19
Asset Sales $_t$	0.007	0.003	0.004	
			(1.40)	0.04
Equity Issues $_t$	-0.002	0.000	-0.002	
			(-0.67)	0.63
Share Repurchases $_t$	0.003	0.001	0.002	
			(0.45)	0.16
Dividends $_t$	0.008	-0.009	0.017	
			(3.09)	0.12
Δ Long-term Debt$_t$	-0.089	-0.053	-0.036	
			(-1.66)	0.77
Δ Short-term Debt$_t$	-0.659	-0.755	0.096	
			(1.82)	0.62
Δ Cash Balances$_t$	0.245	0.208	0.037	
			(0.79)	0.46