Where did all the dollars go? The effect of cash flows on capital and asset structure [⊥]

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This paper documents the short and long term balance sheet effect of cash flows. We show that cash savings in the short run and debt reduction in both the short and the long run account for a substantial fraction of cash flow use. Although, in the long run, investment exhibits substantial sensitivity to cash flows, investment does not absorb the entire cash flow shock. In fact, the tighter the financial constraints, the *smaller* the fraction of cash flow absorbed by investment and the more by leverage reduction. Firms stage their response to increases in cash flow, delaying investment while building up cash flow stocks and reducing leverage. These results suggest that much of the short-run economic effect of cash flow shocks to the corporate sector may be channeled into corporate debt market rather than capital goods market especially when financing constraints tighten.

Keywords: Cash Inflow, Cash Flow Sensitivity, Cash Flow Identity, Measurement Error

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Pioneered by Fazzari, Hubbard and Peterson (1988) (henceforth FHP), a large literature has developed on the usefulness of cash flow sensitivities in identifying financial constraints on investment. FHP argue that, *ceteris paribus,* a sensitivity of investment levels to cash flows indicates that the cost of internal finance is lower than that of external finance. This difference might arise because external funding imposes additional costs, arising from increased agency conflicts, underinvestment incentives, or adverse selection, on firms. FHP document cash flow sensitivity and show that this sensitivity is higher for firms which seem more constrained *a priori*. They conclude that this evidence supports the financial constraint hypothesis.

FHP's research has lead to a great deal of scholarly debate. First, the ability of their proxy, measured Tobin's Q, to maintain *ceteris paribus* has been challenged on the grounds of measurement error (e.g., Erickson and Whited, (2000), Gomes (2001), and Alti (2003)). Second, a monotone relation between the severity of financing constraints and cash flow sensitivity is not a general consequence firms being financially constrained. Thus, tests for differences in cash flow sensitivities based on a priori measures of financial constraint cannot confirm the financial constraint hypothesis (Kaplan and Zingales (1997, 2000)).

Both supporters and critics of FHP's approach are attempting to answer a rather challenging question, namely, is the pattern corporate use of cash for investments consistent with neoclassical theory? We aim to ask a much simpler but slightly broader question: to what uses, investment and noninvestment, do firms put cash flows? While important in itself, we believe that this simple question may also prove very useful in resolving the more difficult one. This belief is founded on the idea, supported by much of corporate finance theory, that many noninvestment uses of cash expand or contract investment potential and thus capture part of investment effect of cash. For this reason, the specific noninvestment use of cash the firm selects can determine whether a given pattern of cash use is consistent with financial constraints.

Consider a firm whose financing constraint is caused by adverse selection. The firm has a positive NPV project that neoclassical theory suggests should be undertaken now. The firm receives an unexpected cash inflow. It maybe possible that even with this new cash flow that allows partial internal funding, dilution costs associated with equity issuance are too high for the investment to be profitable to shareholders. However, the firm may opt to signal its intrinsic value through eschewing investment by launching a debt repurchase.

Now consider the same scenario where adverse selection costs are lower. In this case, project investment partially funded through the cash inflow sufficiently ameliorates dilution costs to make immediate investment profitable for shareholders. Responding to the same cash flow shock, this firm will undertake the investment. Both firms face some external financing costs. The firm facing the higher cost exhibits *less* investment sensitivity. In this case, taking the standard interpretation, the pattern of investment choice produces evidence against financing constraints when in fact these actions support financing constraints.

Moreover, if investment can be delayed, the highly constrained firm could well use investment delay as a signal while a less constrained firm would opt for immediate investment. Because of delay, the investment effect of cash would be latent in the short run and in a single period response model this would produce the same sort of "evidence" against capital constraints when, in fact, observed behavior would be the result of such constraints. The key observation here is that without considering the financial as well as non-financial uses of cash and without considering the long-term as well as short term responses to cash inflows, it is not possible to extract the correct inference from the data even in absence of econometric issues.

Whether a given empirical pattern of corporate cash flow use supports or undermines the financial constraint hypothesis depends both on the specific use to which the firm puts cash inflows not invested in real projects, and the time horizon over which the effects are measured. For this reason, in this paper we consider the following issues: (1) How firms allocate an additional dollar of cash in the short run (2) How they allocate a dollar of cash in the longer term and (3) whether financially constrained (or, "more-constrained") and unconstrained ("less-constrained") firms allocate differently.[1]

These questions relate to quite basic characteristics, yet unexplored, regarding corporate payout behavior. For example, firms cannot continuously dissave so they must add to their cash balances out of cash flows. If this is done mainly to alleviate future financial constraints, then we should expect to see both future capital investment and external financing to respond to today's cash flows. Do they? Cash holdings built up from inflows of cash should be gradually depleted. Does this happen? What is the transmission mechanism through which an extra dollar of cash inflow today affects future financing and investment? Are there any differences in the behavior of more constrained versus less constrained firms[2] in this regard? When cash is not invested in real capital projects, is it used to make the sort of balance sheet changes that theory suggests facilitate future investment?

To address our research question we estimate the sensitivity of investment, external financing, change in cash holdings and dividend payouts over one year as well as three years (including the current year) to an additional dollar of cash flow from operations (i.e. net of working capital accruals, as in Bushman et al.) *today*. Our main findings are as follows. Dividend-cash flow sensitivities are indeed very small – while unconstrained firms pay out more in dividends, it seldom exceeds 5 cents per additional dollar. In the short run, addition to cash holdings and reduction of external financing account for the bulk of the use of a dollar of cash inflow. Constrained firms save 41 cents, while unconstrained firms save 29 cents. Both constrained and unconstrained firms reduce external financing by about 47 cents. Consistent with the evidence that a large fraction of the contemporaneous cash inflow goes into savings

[1] Blanchard et al. (1994) examine what firms do when they have cash "windfalls" from won or settled lawsuits that supposedly do not affect the firms' investment opportunity sets or marginal Tobin's Q. For a sample of 11 firms, they find that firms increase asset acquisitions and also increase long-term debt within three years of the windfall. Most of the evidence is consistent with managerial entrenchment: managers increase targeted stock repurchases and managerial compensation increases sharply after the awards. This entrenchment interpretation is also consistent with the fact that the median 3-day cumulative excess return of the firms' stocks around the announcement of the awards is only 15% of the award. It is worth noting, however, that these 11 firms had very poor investment opportunities, with a median Q of 0.52, so it is possible that the research design identified a small set of firms with severe agency problems.

[2] Following standard practice, we use the terms "constrained" and "unconstrained"; however, "more constrained" and "less constrained" would be more appropriate, as it is hard to argue that a certain group of firms is completely unconstrained.

and to reduce external financing, we find that constrained firms spend only an average of 10 cents in the current period, while unconstrained firms spend an average of 23 cents.

Thus, there seems to be a “pecking order” in the use of funds – firms (both constrained and unconstrained) use a dollar of cash inflow to add to cash balance and reduce external financing, rather than pay out or increase investment substantially. Does this enhanced liquidity have implications for their future investment and financing behavior? This is the aspect that has been almost completely unexplored in existing literature.

We find that a dollar of cash flow affects investment of constrained firms over the next three years by 28 cents. For unconstrained firms, the corresponding number is 64 cents. Thus, unconstrained firms are spending a substantial part of a dollar of cash flow on investment over a three-year period. This is in sharp contrast to the one-period estimates in existing papers (as well as our own estimates) that suggest weak sensitivity of capital expenditure (a somewhat narrower category than investment) to cash flows.

The way in which a dollar of cash inflow today affects future investment – especially for the less-constrained firms – is interesting. Both constrained and less constrained firms draw down part of the cash that is saved out of current cash flows. However, the less constrained firms are also able to raise *additional external financing* in the subsequent periods as a result of an additional dollar of cash inflow today. One possibility is that the cash savings and reduction in external financing that is associated with additional cash flow in the current period alleviates future constraints for the less constrained firms more effectively. In other words, the “transmission mechanism” through which current cash flow affects future investment and financing is probably not limited to the “cash holding” channel – especially for unconstrained firms, reduction of external financing in the current period seems to create future financing capacity. [3]

[3] Two recent papers examine issues closely related to those studied here. Pulvino and Tarhan (2006) simultaneously estimate a system of nine equations where each of the nine dependent variables is a particular use or source of cash and add up to the firm’s cash flows. Some of the evidence in Pulvino

This result has implications both at the firm and aggregate level. Because leverage reductions are engendered by cash inflows and leverage affects investment, the implication is that the sensitivity of current investment to current cash flow underestimates the total effect of current cash flow on corporate investment. Moreover, because, in the short run, the financing channel seems to dominate the investment channel, we would expect that when an economy receives negative economic shock combined with a liquidity shock, the immediate effect will be an increase in the net demand for corporate borrowing. Given fixed supply from the non-corporate sector, this could lead to sharp increase in the borrowing costs. Thus, the immediate effect of an economic shock may be through increased borrowing costs, with corporate debt crowding government and consumer debt.

The rest of the paper is organized as follows. Section I presents a brief overview of related literature. Section II introduces our data. Variable construction and methodology are explained in Section III. In Section IV, we present our main empirical results. Section V presents evidence from simulation exercises addressing the measurement-error problem. Section VI discusses robustness checks and compares our results with those in some related papers. Finally, Section VII concludes.

I. A Brief Overview of the Relevant Literature

Following FHP's (1988), a number of papers propose alternative ways to classify firms as financially constrained or unconstrained, and find results consistent with the notion that constrained firms should exhibit higher cash flow sensitivity of investment than unconstrained firms. Hubbard (1998) provides a comprehensive overview of this literature. However, this approach has been questioned on both theoretical as well as empirical grounds.

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and Tarhan (2006) is similar to what we find for short-term cash flow sensitivity. Like us, that paper also finds that the most important immediate uses of cash flow are retirement of debt and addition to cash balances, and the response of capital expenditure to cash flow shocks is small. However, while we find a non-trivial response of investment (which includes expenditure on acquisitions as well as the conventional capital expenditure studied in the literature), they find no sensitivity. Kim and Weisbach (2008) examine how firms use proceeds from primary equity issues (both IPOs and SEOs) over the short and the long term. They find that firms spend a substantial part of the proceeds on R&D and capital expenditures over time. We further discuss these results below.

Theoretically, several authors (Kaplan and Zingales (1997, 2000) (henceforth, KZ), Dasgupta and Sengupta (2006)) show that the cash flow sensitivity of investment need not be monotonic in the degree of financial constraints faced by firms or their liquidity positions. Empirically, a variety of evidence has accumulated that raises questions about what one can learn from this methodology. For example, Kaplan and Zingales (1997) find that, based on detailed information from several sources, many of the 49 low-payout firms classified by FHP as "most constrained" appear unconstrained. When they further classify these firms into constrained and unconstrained groups, the financially unconstrained firms have significantly *higher* investment-cash flow sensitivities than their financially constrained counterparts. Cleary (1999) uses discriminant analysis to classify firm years as more or less financially constrained for a large sample of U.S. firms, and finds that in unconstrained firm years, the cash flow sensitivity of investment is higher than in the more-constrained firm years.

Several papers point out that the cash flow-sensitivity results could be driven by measurement error associated with Tobin's Q. On the empirical side, Erickson and Whited (2000) use a measurement error-consistent modified GMM procedure to re-test the neoclassical Q theory and the effect of financial constraints on corporate investment.[4] While using this method improves the fit of the neoclassical investment model and the significance of Q in the investment regression compared to OLS, for both constrained and unconstrained firms, the coefficient of cash flow is insignificantly different from zero. Gomes (2001) and Alti (2003) construct optimizing models of corporate investment and use model-simulated data to replicate regressions similar to FHP (1998).

Almeida, Campello and Weisbach (2004) argue that financially constrained firms need to save more from an additional dollar of cash flow since they anticipate being constrained in the future. Accordingly, they introduce the notion of "cash flow sensitivity of cash" – the coefficient of cash flow in a regression in which change in

[4] Different from traditional GMM, the modified GMM procedure utilizes information from higher order moments of variables to obtain consistent estimators even if the measured Q has considerable measurement error.

cash holdings is regressed on cash flow and other controls such as Q and firm size. They find that firms classified a priori as "more constrained" exhibit significant cash flow sensitivity of cash holdings, but those classified as unconstrained do not exhibit any sensitivity. In contrast, Riddick and Whited (2008) argue that measurement error issues related to Q afflict this class of models as well. Applying the modified GMM method of Erickson and Whited (2000), the authors find that the cash flow sensitivity of cash holdings is *negative* on samples from the U.S., Canada, France, Germany, Japan and the U.K. The authors argue that cash flow shocks are associated with shocks to productivity, and firms *dissave* when these shocks are positive.

A recent paper by Bushman, Smith and Zhang (2007) raises a new issue. These authors argue that the prior literature uses the "wrong" definition of cash flows. The cash flow variable in the investment-cash flow literature is earnings before depreciation (EBD), which comprises internally generated funds (cash flow from operations (CFO)), and a non-cash component (working capital accruals (WCACC)). When investment is regressed on CFO, the authors find insignificant coefficients for both constrained as well as unconstrained firms. However, investment is correlated with WCACC because capital investment and WCACC are different types of investment, and this correlation is especially strong for "growth firms", such as small or non-dividend-paying firms, which are usually classified as "financially constrained". In other words, observed investment-EBD sensitivities are driven by the correlation between capital investment and WCACC.

II. Data

Our accounting data are from the standard COMPUSTAT industry annual file, which contains comprehensive information for U.S. companies listed in the New York Stock Exchange, the American Stock Exchange, and NASDAQ. Stock price and return data are from CRSP monthly and daily file. Because our study requires the validity of the flow of funds accounting identity, data from flow of funds are especially important for our purposes. For this reason, we start our sample from 1971, the date from which flow of funds data are extensively reported in COMPUSTAT, to

2006. Following standard practice in the literature, our sample is restricted to manufacturing firms with SIC code from 2000 to 3999. Firm-years with missing values for any of the variables that appear in our regressions are eliminated from the sample. We also exclude observations with negative and zero book asset. To further reduce the impact from outliers we delete firms with cash holding greater than the market value of firm and those showing annual asset and sales growth larger than 100%. Furthermore, each regression variable is winsorized at the 1% level at each tail of our sample. All nominal values are scaled to 1971 dollars. Finally, because our empirical tests investigate both the short-term and intertemporal effects of cash flows, we require two lags of cash flows in our regression equations in addition to the contemporaneous one. Therefore each firm-year in our sample is required to have cash flow data for the past two years. The final sample includes 3845 firms and 30623 firm-years.

III. Empirical Methodology and Variable Construction

A. Empirical Methodology

To help understand our empirical design, it is useful to restate the cash flow identity:

$$\Delta Cashholding + Investment + Dividend - ExternalFinance = Ocf \qquad (1)$$

The left hand side of equation (1) consists of the four major uses of funds. Funds are primarily used in adding to cash balance, for investment activities, paying dividends and reducing external finance. *Ocf* on the right hand side of (1) denotes operating cash flow (OCF), and can be regarded as the source of funds. OCF measures the actual cash flow component, net of working capital accruals (see, for example, Bushman et al. (2007)). In our research design we use OCF as the source of funds, because one of our primary objectives is to account for the way in which a typical firm allocates an additional dollar of the actual cash flow to the four uses shown on the left hand side of (1).

Consider first the following system of equations, which show the contemporaneous allocation of cash flow into its four uses:

$$\Delta Cashholding_{i,t} = a_{1,i} + b_1 Ocf_{i,t} + c_1^{'} Controls_{i,t} + \eta_{1,i,t} \qquad (2)$$

$$Investment_{i,t} = a_{2,i} + b_2 Ocf_{i,t} + c_2^{'} Controls_{i,t} + \eta_{2,i,t} \qquad (3)$$

$$Dividend_{i,t} = a_{3,i} + b_3 Ocf_{i,t} + c_3^{'} Controls_{i,t} + \eta_{3,i,t} \qquad (4)$$

$$-ExternalFinance_{i,t} = a_{4,i} + b_4 Ocf_{i,t} + c_4^{'} Controls_{i,t} + \eta_{4,i,t} \qquad (5)$$

Each equation expresses a particular use of cash as a function of the cash flow itself and a set of *K* firm specific control variables. The coefficients of operating cash flow have the usual interpretation of capturing the sensitivity of a particular use of cash to a dollar of cash flow. Subtracting each variable from its firm-specific sample mean in (2)-(5) eliminates the firm-specific intercept. Adding equations (3)-(5) in mean-differenced form and using (1) – also in mean-difference form - we get $b_1 = 1 - (b_2 + b_3 + b_4)$, i.e., $1 = \sum_{l=1}^{4} b_l$. Notice that this, in particular, implies that the cash flow sensitivity cannot be zero for *all* the left-hand-side variables.

Suppose the vector of *K* control variables is $Z_{i,t} = (Z_1, Z_2, ..., Z_K)_{i,t}$. Then it follows from the cash flow identity that for each control variable Z_k, $k=1,\ldots,K$, the coefficients across the four equations must add up to zero, i.e., $0 = \sum_{l=1}^{4} c_{k,l}$ for $k = 1, 2, ..., K$. Hence, there is an essential interdependence in the coefficients of the right-hand side variables in equations (2)-(5). First, by virtue of the cash flow identity, the contemporaneous cash flow coefficients must add up to unity. Second, since the coefficients of the lagged cash flows and any of the control variables must add up to zero, it follows that if a variable has a non-zero coefficient in the specification for any the use of cash, it must have a non-zero coefficient in the specification for some other use of cash as well. That is, any variable that is relevant for the specification of any one of the uses of cash must also be relevant for the specification of some other use of cash.

To examine intertemporal effects of cash flow, our empirical design consists of the following regressions:

$$\Delta Cashholding_{i,t} = \alpha_{1,i} + \beta_{11}Ocf_{i,t} + \beta_{12}Ocf_{i,t-1} + \beta_{13}Ocf_{i,t-2} + \gamma_1^{'}Controls_{i,t} + \varepsilon_{1,i,t} \quad (6)$$

$$Investment_{i,t} = \alpha_{2,i} + \beta_{21}Ocf_{i,t} + \beta_{22}Ocf_{i,t-1} + \beta_{23}Ocf_{i,t-2} + \gamma_2^{'}Controls_{i,t} + \varepsilon_{2,i,t} \quad (7)$$

$$Dividend_{i,t} = \alpha_{3,i} + \beta_{31}Ocf_{i,t} + \beta_{32}Ocf_{i,t-1} + \beta_{33}Ocf_{i,t-2} + \gamma_3^{'}Controls_{i,t} + \varepsilon_{3,i,t} \quad (8)$$

$$-ExternalFinance_{i,t} = \alpha_{4,i} + \beta_{41}Ocf_{i,t} + \beta_{42}Ocf_{i,t-1} + \beta_{43}Ocf_{i,t-2} + \gamma_4^{'}Controls_{i,t} + \varepsilon_{4,i,t} \quad (9)$$

The main independent variables are the sources of cash, i.e., the operating cash flow, $Ocf_{i,t}$, $Ocf_{i,t-1}$ and $Ocf_{i,t-2}$. In the rest of this paper we use the terms cash flow and operating cash flow interchangeably to mean the true operating cash flow as in Bushman et al. (2007).[5] We scale all left-hand-side variables as well as all cash flows on the right-hand-side by the three-period-lagged book value of assets.[6] "*Controls*" is a set of *K* firm-specific variables that could potentially affect the use of cash. These will be discussed in detail below.

The coefficients of the two lagged cash flows capture the lagged cash flow sensitivities, which effectively tell us how an additional dollar of cash flow today impacts a particular use of cash flow one and two years later, ceteris paribus. For example, consider equation (7). While the lagged coefficient, β_{22} would be usually interpreted as the impact of an additional dollar of cash flow in the previous year on investment today, it can be equivalently interpreted as how much more the firm will spend on investment one year later, if they have one more dollar of cash flow this year.

[5] It could be asked why we do not include both operating cash flow and working capital accruals together in our specifications. The reason is that working capital accruals and other financing or investment decisions are jointly determined when firms make financing/investment decisions. Thus the introduction of working capital accruals as an independent variable appears unnecessary and might introduce endogeneity problems. We did, however, re-estimate all our results after adding current and two lags of working capital accruals as right-hand-side variables. Our results were qualitatively similar.
[6] We need to scale our dependent variables similarly in all the regressions because we want the cash flow-sensitivity coefficients to tell us the same thing – namely, how a dollar of cash flow shock is allocated among the different uses. Using book assets as the scaling variable is natural if one is not primarily concerned with estimating the neoclassical investment equation. For example, Almeida et al (2004) scale cash holding by total assets.

Similarly, the twice-lagged coefficient, β_{23}, could be interpreted as how much firms will spend on investment two years later, if they have one more dollar of cash flow this year. In other words, the sum of the three coefficients of the three cash flows is the amount spent on investment over three years, including the current year, in response to an additional dollar of cash flow today.

Let $\delta_l = \sum_{j=1}^{3} \beta_{lj}$, l=1,2,3,4. We can therefore interpret the δ_l's as long-term (i.e., 3-period) cash flow sensitivities. Recall that by virtue of the cash flow identity, the coefficients of all right hand side variables other than the contemporaneous cash flow must add up to zero across equations (5)-(9), whereas those of the contemporaneous cash flow must add up to unity. Therefore, it follows that we should have

$$\left.\begin{array}{l} \text{(i)} \quad \sum_{l=1}^{4} \beta_{l1} = 1, \quad \sum_{l=1}^{4} \beta_{lj} = 0,\ j = 2,3,\ \sum_{l=1}^{4} \gamma_{lk} = 0,\ k = 1,2,..K. \\ \text{and} \\ \text{(ii)} \quad \delta_1 + \delta_2 + \delta_3 + \delta_4 = 1. \end{array}\right\} \qquad (10)$$

In fact, condition (ii) is implied by the first two equalities in (i). It indicates that the cash flow sensitivities over three periods must also add up to unity, or in other words, the cash flow identity holds over three periods as well.

B. Intertemporal Channels of Transmission

It is useful to consider the possible channels through which a cash flow shock can affect investment and financing in future periods. Part of this transmission is likely to occur through current cash savings and future dissavings out of the cash balance built up. However, the savings channel is by no means the only channel through which a dollar of cash inflow affects future financing and investment activity. Suppose firms reduce external financing when they have an extra dollar of cash inflow. This could create more room for external financing in subsequent periods, and consequently allow firms to raise more external financing and also to invest more. Similarly, if firms invest today out of a dollar of cash inflow, the collateral value of its assets may increase, making it possible to borrow and invest more in the future (see Figure 1).

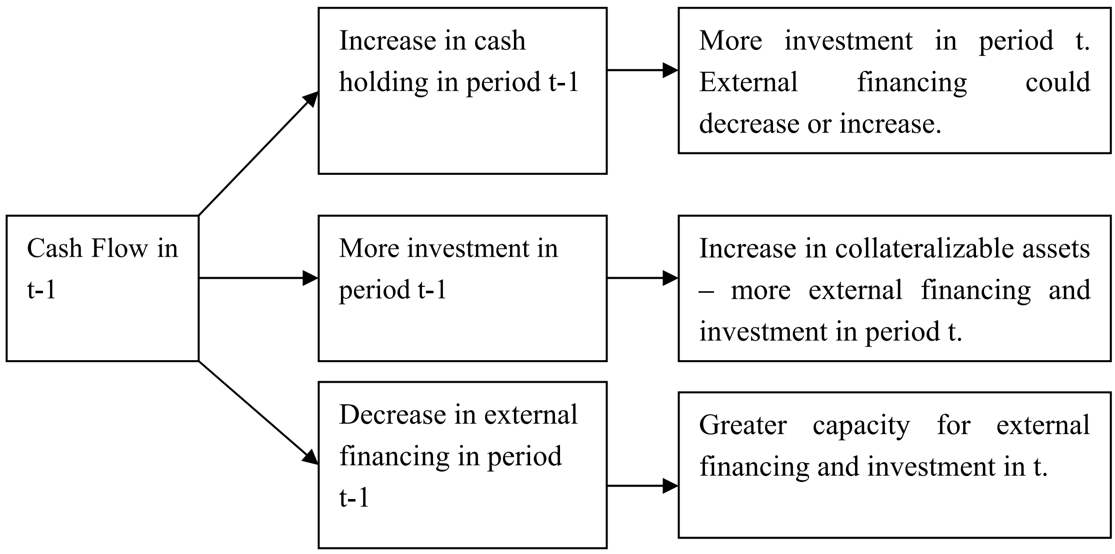

Figure 1. The Transmission Mechanism of a Cash Flow Shock in Period t-1 to Investment and Financing in Period t.

The coefficients β_{2j}, β_{3j} and β_{4j} for *j=2* (*j=3*) capture the net impact of an additional dollar of cash flow in period *t-1* (*t-2*) on investment, dividend payout, and reduction of external financing, respectively, in period *t*. Notice that these coefficients are unrestricted in sign. For example, if a dollar of cash inflow in period *t-1* leads to additional external financing due to any of the above-mentioned channels in period *t*, then $\beta_{42} < 0$.

Finally, notice that negative signs for the coefficients β_{12} and β_{13} in the cash holding equation (equation (6)) indicate dissaving behavior and are consistent with the intertemporal allocation of *cash balance*.[7] If an additional dollar of cash flow in *t-1* or *t-2* increases the combined net spending on investment, dividends and reduction of external financing in *t*, the firm must be dissaving, i.e., spending out of cash holdings in response to the additional dollar of cash flow in *t-1* or *t-2*. In other words, *if the firm is saving cash and allocating it intertemporally to different uses, the sums* $\beta_{2j} + \beta_{3j} + \beta_{4j}$ *for j=2 and j=3 will be positive, or equivalently, the coefficient* β_{12} and β_{13} *of* Ocf_{t-1} *and* Ocf_{t-2} *in the cash holding regression will be negative.*[8]

C. Control Variables in Regressions

All our regressions control for firm and year effects to capture firm-specific and common time varying effects (such as macroeconomic effects) that could affect financing, investment, cash holding and payout decisions. We also use a set of firm-specific variables to control for time-varying firm-specific factors that could affect these decisions.

Our discussion in section 3A has an important implication for the specifications of equations (6)-(9), namely, that any variable that is deemed relevant for one particular use of cash needs to be in the regression specification for any other use of cash. This follows from the restrictions in the first line of (10) which show that the coefficients of any variable other than contemporaneous cash flow must add up to zero across all the equations. Hence, if the coefficient of any such variable in any one of the equations is non-zero, it must have a non-zero coefficient in at least one other equation.

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[7] A dollar of cash inflow could have intertemporal effects on investment and financing through channels other than the cash balance channel, as discussed above.

[8] It might appear that a more direct way of testing how past financing and investment activity affect that in the future would be to incorporate lags of the dependent variables in equations (6)-(9) in the right hand sides. However, we do not take this approach for several reasons. First, our interest is to see how a dollar of cash affects future financing and investment, i.e., to estimate the long-term cash flow sensitivities. Moreover, with the lagged cash flows present as right hand side variables, adding the lagged dependent variables from (6)-(9) would cause a multicollinearity problem by virtue of the cash flow identity. Second, the presence of lagged dependent variables in a dynamic panel structure introduces well known estimation problems.

It is important to note, however, that the specification in equations (6)-(9) assumes that the control variables capture part of the variation in the dependent variables that are not explained by variations in cash flows. It is possible, of course, that the level of a control variable also affects the intertemporal allocation of cash flow as well as its allocation across the different uses. We will consider this issue in detail below.

Our control variables in (6)-(9) are a set of variables that have been used in existing literature to estimate individual equations for the use of cash. However, because of the interdependence of the decisions on the uses of cash, it is important to recognize that even a variable such as share turnover that would usually be considered as relevant for the external financing decision needs to be included in the specification for dividend payout.

We provide below a brief account of the control variables and their use in existing literature.

Leverage ratio: A firm's leverage ratio is likely to be related to the way it uses cash. For example, debt-heavy firms may prefer to reduce or pay down debt to avoid debt overhang, rather than hold cash which benefits debt holders in the event of default. Additionally leverage is also likely to affect how much cash can be distributed as dividends. Furthermore, debt and dividend are two alternative mechanisms to alleviate the agency problem (Faccio and Lang (2001)). We use the leverage ratio at year *t-3* as a control variable, since the leverage ratio at time *t* is clearly affected by the use of cash in period *t*.[9]

Indicator of financial distress: Firms in financial distress may have less discretion in their use of cash (Allayannis and Mozumdar (2004)). We use tAltman's z-score at time *t-3* as a control for the financial distress status of firms.

Firm size: The literature on the determinants of cash holdings uses firm size as a

[9] Leverage at time *t-1* or *t-2* is affected by the use of cash flow in these periods. Since use of cash in prior periods is likely to affect use of cash in the current period via the transmission mechanism discussed in section III.B above, there could be endogeneity issues if leverage lagged one or two periods in included in the specification.

proxy for the scale of the firm's operations, since it is commonly recognized that there are economies of scale in cash management. (Opler et al (1999), Alemdia, Campello and Weisbach (2004)). Firm size is also a proxy for information asymmetry, so it is likely to affect investment and issuance activity. In addition, Altinkilic and Hansen (2000) argue that issuer quality, arguably related to firm size, is an important determinant of the gross spread associated with security issuance, which is an important component of external financing costs. We define firm size as the three year average of the logarithm of book assets. In our regressions, we use the three year average of the logarithm of book assets as the proxy for firm size.

Tobin's Q: The ratio of market capitalization plus the book value of debt to total assets (Tobin's Q) has been used widely as a proxy for investment opportunities, which should affect firms' investment and external financing decisions. Tobin's Q is also considered to be a determinant of firms' cash holdings decision because firms are expected to save more in the form of cash if valuable projects are more likely in the future (Opler et al (1999)). Tobin's Q has also been widely regarded as a proxy for the firm's equity market conditions, with higher Q reflecting more favorable conditions for equity issuance. In our regressions, we use the three-year average Tobin's Q as a control variable.[10]

Credit Rating: Firms with rated debt are likely to have better access to debt markets (Faulkender and Petersen (2004)). In our regressions, we include an indicator variable which takes a value of 1 if a firm has credit rating in any of the years *t-2*, *t-1* or *t*, and zero otherwise.

Stock return volatility: Higher stock return volatility is a proxy for information asymmetry between managers and investors (Altinkilic and Hansen (2000); Lee and Masulis (2008)). We compute the standard deviation of daily stock returns for years *t-2*, *t-1* and *t*, and include the three years average as a control variable in our

[10] The use of Tobin's Q as a proxy for the marginal Q in the neoclassical investment equation has been subject to the measurement error critique (see Erickson and Whited (2000)). This issue is less critical for us since we are not testing the neoclassical investment equation (in which the dependent variable is Capital Expenditures). The determinants of "Investment", a broader concept than Capex, are theoretically less clear.

regressions.

Share turnover: If the stock of a firm is more liquid, it is easier for underwriters to place a particular issue, which lowers the cost of external finance (Chang, Dasgupta and Hilary (2006); Lee and Masulis (2008)). We define the share turnover for the years *t-2*, *t-1* and *t* as year as the median monthly share turnover divided by the mean of shares outstanding over a fiscal year. We include the three years average as a control variable in our regressions.

Stock price run-up: Chang, Dasgupta and Hilary (2006) argue that both dynamic information asymmetry theory and market timing theory predict that firms will issue equity after prior stock price run-ups. Moreover, this tendency is greater for firms that suffer more from information asymmetry. We calculate annual compounded stock return for year *t-3*, *t-2* and *t-1* and use the average of these three compounded returns as a control variable in our regressions.

C. Key Variables

Equations (6)-(9) are estimated on two sources of data.[11] In the first set, data on the regression variables are collected and constructed exactly following the common practice in the literature, except for the definition of operating cash flow which follows Bushman et al (2007). For example, *cash holding* is from Balance Sheet data item #1, as in Almeida et al (2004). *External finance* is constructed using Balance Sheet data as the sum of net debt issue, which is change in long term and short term debt, and equity issue, which follows Baker and Wurgler (2002). *Dividend* is defined as common stock (Balance Sheet #21) and preferred stock dividend (Balance Sheet #19).

Operating cash flow is defined as earnings before extraordinary income (Income Statement #14) plus depreciation and amortization (Income Statement #18) minus net working capital spending. The last component (net working capital) follows the definition of working capital accruals in Bushmen et al (2007). We implement our

[11] The Data Appendix provides details.

empirical tests on this data set so that we can readily compare our results to those in the literature. In this data set, all dependent variables are from Balance Sheet. We call our first data set Balance Sheet (BS) data for convenience.

Total investment, the dependent variable in regression (7), has received scant attention in the literature. This variable is directly available only from the Statement of Cash Flows. Thus we do not report the total investment regression for BS data. However, since all other components of the cash flow identity are available, by virtue of equation (10), one can infer the marginal effect of any independent variable on total investment from the sum of the coefficients of that variable in equations (6), (8) and (9), respectively. In contrast, by construction, the flow of funds or statement of cash flow is ideally designed for this purpose, since the relevant variables must conform to the cash flow identity. Because all data are from the same financial statement, we call this data set Statement of Cash Flow (SCF) data.

IV. Empirical Results

We estimate equations (6)-(9) separately using firm and time fixed effects.[12] Our empirical tests are first implemented on the overall sample. Our primary concern at this stage is the comparison between short-term and long-term effects of cash flows on the financing and investment activities of firms in the sample. Subsequently, we apply the same tests to financially constrained and unconstrained sub-samples split according to four widely used classification schemes.

A. Results on the Overall Sample

A.1. Constraints that follow from the Cash Flow Identity

Our regression results for the overall sample are presented in Table 1. Panel A shows the estimation results from the Balance Sheet data. The columns labeled *t*, *t-1* and *t-2* report, respectively, the coefficients of the contemporaneous and two lags of

[12] Since we have the same set of explanatory variables for each equation, there is no efficiency loss relative to joint estimation of the equations using the seemingly unrelated regressions (SUR) method.

cash flows. The former indicates how a dollar of cash inflow is used in the same year, whereas the latter, as discussed earlier, can be interpreted as the impact from an additional dollar of cash flow in the *current* year on financing and investment activities in each of the *next* two years. The last column labeled LT_CFS shows the sum of the three cash flow coefficients and indicates the aggregated influence from an additional dollar of cash flow over three periods. In other words, these are the coefficients δ_i in equation (10) and can be interpreted as long-term cash flow sensitivities.

Panel B reports results for the SCF data. This panel contains some additional information since the category "Investment" is only available from the funds-flow data. In addition, the last row in Panel B provides the sum of the cash flow sensitivities both in the short and the long run, as well as the sum of the coefficients on the control variables. The first point to note is that, consistent with (10), the contemporaneous and long-term cash flow coefficients add up to a magnitude very close to one. Since we have winsorized the data, the accounting identity does not exactly hold for about 2% of the sample, therefore, we do not expect the coefficients to exactly add up to unity. In addition, the coefficients of all the control variables add up to very close to zero, as required.

A.2. Uses of Cash in the Short and Long Term

We now discuss the intertemporal patterns in the cash flow sensitivities of specific uses of cash. We mainly discuss results from the BS data; those from the SCF are qualitatively similar.

Dividends. From the last two rows of panel A, we find that dividend-cash flow sensitivities are very small both in the short and the long term. The contemporaneous cash flow sensitivity shows that when firms have an additional dollar from operating activities, only about a cent is goes towards current period dividend. Although in the following two years firms increase their dividend payout, the magnitudes are small. Over three years, around 3 cents are spent on increasing dividends for every dollar increase in cash flow. These results corroborate the conventional wisdom that dividend policies are indeed sticky even over a longer period.

Cash Holdings. The contemporaneous cash holding-cash flow sensitivity in the cash holding regression is positive and significant, which is consistent with Almeida et al. (2004). These authors were the first to suggest that financially constrained firms should save out of their current cash flows and exhibit positive cash holding-cash flow sensitivity. However they do not directly test whether financially constrained firms deplete their saved cash in the future and how the saved cash is used. The lagged cash flow coefficients in our regression serve the latter purpose. The contemporaneous cash holding-cash flow sensitivity indicates that firms immediately save 36 cents per dollar increase in cash flow.[13] Part of the saved cash is gradually depleted in the following two years. In the next year 7 cents of the cash savings are used, and in the subsequent year another 4 cents are used. Therefore over three-year period firms still retain 25 cents out of one dollar increase in cash flow. Thus, firms save cash and allocate the cash holding intertemporally.

External Finance. The external finance regression shows that firms spend a large fraction of an extra dollar of cash flow in reducing external finance: a one dollar increase of cash flow replaces external financing by 50 cents. This result suggests that firms face constraints in accessing external financial markets. If firms face financial constraints they will replace or substitute costlier external fund when they have more cash flow. Most interestingly, one additional dollar of cash flow in the current year causes firms to *raise* 11 cents and 6 cents of external finance, respectively, in the next two years. This complementarity between liquidity and external financing is consistent with the intuition that higher liquidity due to a positive cash flow shock in the first year eases the constraints firms face in raising external financing in the future (both because firms carry more liquidity on the balance sheet, and also because by reducing external borrowing, they possibly avoid greater debt overhang in the future). Figure 1 indicates some possible ways in which a cash flow shock could lead to

[13] The numbers here are from the regressions on the balance sheet data. As the Tables show, the results from the SCF data are qualitatively very similar.

higher subsequent external financing (and investment).[14]

Investment. For the balance sheet data, how much firms spend on "investment" for every additional dollar of cash flow has to be inferred from how much is spent on other uses. By virtue of equation (10), for the contemporaneous cash flow sensitivity and the 3-period cash flow sensitivity, it is simply 1 minus the sum of the coefficients in the other three uses. For the two lagged cash flow sensitivities as well as those of all other control variables, it is negative 1 times the sum of the coefficients in the other three uses.. From the coefficient estimates in Panel A of Table 1, we find that firms immediately spend about 12.5 cents on investment – a relatively modest magnitude. However, over the next two years, they spend an additional 25.4 cents in investment and 2 cents in dividend payouts in response a one dollar increase in cash flow in the current period. Out of this, 11.1 cents is financed by depleting cash balances; another 16.3 cents is financed by raising external resources (recall that past cash flows can only indirectly affect future spending).

A.3. Short-Term versus Long-Term Effects

It is worthwhile to emphasize the importance of the difference between short-term and long-term effects. The third column of panel A in Table 1 shows that in the short term firms both save cash and reduce external finance. The total amount of cash used through these two means is a surprising 86.5 cents per dollar cash shock. Given sticky dividend policy, firms do invest very little in the first year. This short-term pattern is similar to that in Pulvino and Tarhan (2006). In their estimation of a system of nine single period regressions, they find that in response to a cash flow shock, firms primarily save cash and reduce debt. Investment is essentially insignificantly related to cash shock. Therefore they argue that the traditional Modigliani and Miller theory does indeed hold: firms respond to cash flow shocks by saving cash and reducing debt; financing policies work as buffers to temper or absorb exogenous shocks.

Given this, our results pointing to the difference between long-term and short-term

[14] A model outlining these intertemporal effects is available from the authors.

effects can not be emphasized too much. If we only look at the short-term effect from column four, we may draw the same conclusion as Pulvino and Tarhan (2006). However, the long-term effect is quite different from the short-term one. Firms save cash and reduce external finance in the short term while they use cash and raise external finance in the following years. Our long-term effects show that in the two years following a cash flow shock, firms *raise* external funds and spend it along with the saved cash on investment. Over a three year period, a dollar increase in cash flows causes investments to increase by as much as 38 cents.

The short and longer term uses of cash documented here are also consistent with results in Kim and Weisbach (2008), who examine the use of proceeds from an international sample of primary issues of equity (IPOs as well as SEOs). Treating these issuance events as exogenous, these authors find that while firms hold much of the proceeds in the form of addition to cash balance, over the subsequent four years, they draw down the cash balance and spend a substantial part of the proceeds on R&D, capital expenditures and acquisitions. In their regressions, the authors control for other sources of funds (such as cash flow from operations) over the years following the equity issue events. Firms appear to use these inflows in reducing debt.[15] This is consistent with our result that the immediate response to cash inflows is to reduce debt.

To summarize, we find that for overall sample, firms save cash, reduce external finance and invest modestly in the short term in response to a cash flow shock. Over a longer period they invest more, relying on the cash saved and new external funds raised in the subsequent years. The complementarity between higher cash flow and new external financing in later years suggests that the improved liquidity and lower weight of external finance makes firms less constrained in the subsequent years, and increases their ability to access external markets. The total investment over three periods accounts for nearly 38% of the cash shock that occurred two years ago – a sizeable number.

[15] They also use these inflows for capital expenditures and acquisitions, but finance R&D expenditure to a much lesser extent.

A.4. Control Variables

It is interesting to examine how the control variables affect various uses of cash. Tobin's Q has a positive effect on cash holdings, consistent with the notion that firms with future growth opportunities will want to hold cash balance. It also has much larger impact on external finance, and a small positive effect on dividend payout, suggesting that when Q increases, firms raise additional external finance to raise cash to add to cash balances, invest and pay out dividends. When asset size increases, firms add less to cash balance, suggesting economies in cash management. They also invest less, but increase dividend payout slightly. As a result, they end up raising less external finance. When leverage increases, firms raise less external finance, and cut down on investment, suggesting financial distress or debt overhang. They also pay out less, possibly indicating the presence of dividend-restricting covenants, and add a roughly equivalent amount to cash balance. When financial condition as measured by the z-score improves, firms expectedly add less to cash balance and raise more external financing, invest more and pay out more. Similarly, when a firm receives a credit rating, it raises more external finance and increases investment, and adds more to cash holding. It also reduces dividend payout, which is consistent with the notion that firms with less need for equity issuance will pay out less (Easterbrook, (1984)). When stock returns are more volatile, firms raise less external finance and invest less, but add more to cash balance. These results are consistent with the way more information asymmetry is expected to affect the use of funds. When share turnover is higher, firms raise more external finance, consistent with a lower cost of external finance. They add roughly an equal amount to cash balance and reduce dividends slightly, with almost no effect on investment. Finally, when the stock price run-up is higher, firms raise more external finance and invest even more, drawing down their cash balance, but there is no effect on dividend payout.

B. Constrained versus Unconstrained Firms

As discussed in section 3C, the control variables in equations (6)-(9) could affect the allocation of cash flows across the different uses, as well as over time. Since many of the control variables proxy for conditions that affect the cost of external finance, instead of interacting each coefficient with every control variable, we choose a more parsimonious approach. Using several criteria that are commonly used in the literature, we partition firm years according the degree of financial constraint faced by the firm in year *t-2*, and estimate equations (6)-(9) separately for these firm years. While our classifications follows the status of the firm as of period *t-2*, our results are virtually unchanged if we use the status as of year *t-1* or require that firms have the same status as of *t-2*, *t-1* and *t*. We discuss these issues more in the section on robustness checks.

Specifically, we follow Almeida, Campello and Weisbach (2004) and Acharya, Almeida and Campello (2007), and use payout ratio, firm size, bond rating and commercial paper rating as the basis for our classification schemes for a firm's financial constraint status in a given year, and allow the status to vary over time. We first briefly describe these classification schemes:

Firm size-based classification: In each year we rank firms according to their total book asset at beginning of the year and treat the top 30% as financially unconstrained and the bottom 30% as financially constrained.

Payout ratio-based classification: In each year we rank firms according to their payout ratio in the previous year and classify the top 30% into financially unconstrained group and the bottom 30% into financially constrained group.

Bond rating-based classification: If a firm in a given year has Standard & Poor bond rating it is deemed financially unconstrained, otherwise financially constrained.

Commercial paper rating-based classification: If a firm in a given year has Standard & Poor commercial paper rating it is deemed financially unconstrained, otherwise financially constrained.

Table 2 reports the mean and median values of the control variables corresponding to constrained and unconstrained firm years for each of the above classification schemes. Unconstrained firms are larger (higher firm size), have lower return volatility and smaller stock price run-up consistently for all classification schemes than constrained firms. The smaller run-ups for unconstrained firms is consistent with dynamic adverse selection models such as in Lucas and McDonald (1990) which imply that stock price run-ups are associated with delayed equity issuance. Financially unconstrained firms will suffer from less adverse selection and issue equity more frequently, leading to smaller run-ups. Except for the classification based on dividend payout, share turnover and leverage are also higher for unconstrained firms. The fact that unconstrained firms have higher leverage is consistent with the idea that unconstrained firms have more access to debt finance. The z-score is much higher for unconstrained firms according to the firm size-based and payout-based classifications, but lower for the bond rating-based classification and marginally lower for the commercial paper-based classification. The lower z-score for rated firms could be a reflection of their higher leverage ratios.

B.1. Results

We report a complete set of results for the firm-size-based classification of financial constraints only. Our results for the three other classification schemes are very similar and are not reported here, but are available from us on request.

As in Table 1 for the overall sample, Table 3A and Table 3B show results for the BS and the SCF data, respectively. Consistent with equation (10), the sum of the cash flow-sensitivity coefficients in the short and the long term add up to a number quite close to unity in Table 3B for both constrained and unconstrained firms. Thus, we are almost completely able to account for the possible uses of a dollar of cash flow shock, both in the current period as well as over a three-year period. Moreover, the sum of the coefficients of the control variables adds up to very close to zero for all classification schemes for both constrained and unconstrained firms, as required.

B.2.2 Cash Flow Sensitivities

Both constrained and unconstrained groups exhibit the same overall pattern of short and long-term cash flow sensitivities as were observed for the overall sample.

We discuss the results from the BS sample – results for the SCF sample are qualitatively similar.

As with the overall sample, in the current period, both groups of firms mainly save cash and reduce external finance, and increase investment only slightly. Constrained firms save 41.5 cents in the first year per dollar of incremental cash flow, while unconstrained firms save 28.6 cents. Both groups reduce external finance by about 47 cents in the first year. At the end of three years constrained firms save 33 cents and unconstrained firms save 16.7 cents. Thus, it is clear that constrained firms save more from cash flow than unconstrained firms both in the first year and at the end of three years.

Perhaps the most striking results concern the impact of cash flow shocks on total investment and external finance. Constrained firms spend an average of 10.4 cents on total investment in the short term and unconstrained firms increase total investment by 23.4 cents. Over three years constrained firms spend 28 cents on total investment, and unconstrained firms spend almost twice that much, or 64 cents. In other words, for the unconstrained firms, the bulk of a dollar of cash flow shock is transmitted to investment within three years.

The dynamic response of external financing to a dollar of cash flow shock indicates how the additional investment is financed. Both constrained and unconstrained groups reduce external finance immediately in the first year of the cash flow shock, and raise more external finance in the following two years, as was seen for the overall sample as well. However, unconstrained firms raise significantly more *additional external financing* in the next two years than the constrained firms. On average, constrained firms raise 10.4 cents in the following two years while unconstrained firms raise 31.7 cents.

These results suggest that the additional cash savings and reduction of external financing out of contemporaneous cash flows significantly enhance the ability of the unconstrained firms to raise additional funding in subsequent years and step up investment. If the so-called unconstrained firms face less binding constraints, then they are likely to benefit more from cash flow injections than the constrained firms. In the next section, we show that unconstrained firms retire and issue more long term debt subsequently than constrained firms in response to cash flow shocks. This suggests that buying back or substituting for debt financing to avoid the debt overhang problem could be a driving force behind the transmission mechanism.

B.2.3. Control Variables

The effect of control variables on the uses of cash differ markedly for the two groups of firms. As Tobin's Q increases, constrained firms raise substantially more external financing and add to cash balances and invest more, but do not increase dividend payouts. In contrast, unconstrained firms raise less external financing and significantly increase payouts, and also increase investment, but not by as much as constrained firms. These results are consistent with the idea that higher Tobin's Q may be related to better over equity market conditions.

Except for leverage, most of the other control variables do not affect the constrained firms' external financing decisions. Higher leverage causes constrained firms to raise less external financing, invest less and pay out less. Higher standard deviation of stock returns causes these firms to pay out less and save more, and reduce investment. Stock price run-ups are associated with a drawing down of cash reserves and higher investment, but not higher external financing. This is consistent with the notion that for constrained firms, positive information about future cash flows might get reflected in stock price slowly, leading to stock price run-ups while adverse selection still persists. As a result, firms have to rely more on internal cash to finance investment. The effect of these control variables on the unconstrained firms' financing, cash holding, investment and payout decisions are very similar to those for the overall sample.

B.2.4. Debt and Equity Financing

The difference between constrained and unconstrained firms in the dynamic pattern of the response of their external financing to a cash flow shock is one of our most interesting findings. It is natural to explore whether debt or equity financing plays a more important role in explaining the pattern. In particular, if mitigating the debt overhang problem (Myers, 1977) or liquidity risk (Diamond, 1991) are among the main reasons why firms first reduce external financing before allocating cash for future projects and stepping up investment, we would expect our results to be driven by debt financing (long-term and short-term debt, respectively).

To examine this issue, we further divide external finance into net debt finance and net equity finance. Table 4 shows separate regressions of debt and equity financing on cash flows for the overall sample and the size-classification sub-samples. Results for the other three classification sub-samples are similar. It is quite evident that the contemporaneous reduction and future increase of external financing in response to a cash flow shock is fundamentally driven by debt financing. Firms in the overall sample reduce debt financing by 38.4 cents in the first year of the cash flow shock, whereas in the following two years they raise 12.6 and 7.4 cents of new debt. Equity financing shows a somewhat different pattern over time. For the BS sample, most of the reduction occurs in the current period, and firms reduce equity financing by 11 cents.

There are some interesting differences between constrained and unconstrained firms with respect to the response of debt and equity financing to cash flows. Over three years, constrained firms reduce equity financing much more than unconstrained firms. This is consistent with constrained firms facing more severe adverse selection problems in the equity market. Both constrained and unconstrained firms reduce debt in the first year and raise debt in future. However, unconstrained firms raise much more debt in the second and third years – 30.2 cents as opposed to 15.1 cents for the constrained firms.

In Table 5, we further split the changes in debt financing activity into short and long-term debt financing. For the overall sample, the magnitude of reduction in the first period is similar for short and long-term debt (about 18 cents). However, while firms increase both types of debt financing in the next two years, the increase in short-term debt issuance dominates. Looking at constrained and unconstrained firms separately shows why the intertemporal pattern of immediate debt reduction and subsequent increase is more pronounced for short-term debt, and why it is more apparent for unconstrained firms. We find that while intertemporal pattern is common to both groups of firms for short-term debt, only the unconstrained firms exhibit a similar pattern with respect to long-term debt. Since long-term debt is more subject to information asymmetry, this result is consistent with our earlier observation that higher cash flow today benefits the unconstrained (or less-constrained) firms more in terms of easing financial constraints to the point where they can engage in additional issuance and investment activity.

V. Measurement Error Simulations

The control variables in our empirical specifications in equations (6)-(9) are the ones that are commonly used in the literature and are expected to affect the uses of cash. One of these is Tobin's Q, defined as the ratio of market capitalization plus the book value of debt to total assets. Tobin's Q is included because it is widely considered to be a measure of equity market conditions and firms' growth potential, which are likely to affect external financing and cash holding decisions.

The use of Tobin's Q in the neoclassical investment equation, however, has been controversial. It has been pointed out that neoclassical investment theory relates investment to Tobin's marginal q; the latter, however, is not directly observed. Hence using Tobin's (average) Q to proxy for marginal q creates an error-in-variables problem (Erickson and Whited (2000)). It is less clear, however, that this is a problem in our context. As noted above, there are good reasons to include the average Q in our specifications. Moreover, we are not aware of any theoretical model that relates the uses of cash to the marginal q on the basis of an optimizing framework similar to the one, for example, which forms the basis of the neoclassical investment equation (Tobin (1969), Hayashi (1982)).

Nonetheless, since capital expenditure (the dependent variable in the neoclassical "investment" model) is a part of investment – one of the four uses of cash in our framework – we explicitly examine whether or not measurement error in Q could affect our estimates. Specifically, we simulate random measurement error to test whether and how our estimated coefficients respond to gradually amplified measurement error. We implement two types of simulation exercise. In the first simulation exercise, we generate each dependent variable in equations (2)-(5) under the assumption that the "true" marginal q plus all other control variables in equations (2)-(5) – *but not cash flow* - are the determinants of the mean level of that variable, and add noise uncorrelated with cash flows to the mean. To implement this exercise, we pretend that the Q measured in the actual data is the true marginal q, and then we add measurement error to Q and allow different degrees of correlation between cash flow and the measurement error, and re-estimate our models. We compare the estimated cash flow coefficients with those estimated from the actual data to see if measurement error could produce cash flow coefficients comparable to those that we estimate in the actual data when cash flows are not true determinants of the left-hand-side variables in these equations. In the second simulation exercise, we do not generate any new data for the left-hand-side variables. Instead, the purpose is to examine the effect of gradually amplified measurement error (with different correlations with cash flows) on the actual coefficient estimates, especially those of the contemporaneous and lagged cash flows.

A. Measurement Error and Cash Flow Coefficients when Cash Flows are Irrelevant

We illustrate the first simulation exercise for the cash holding equation. We run the following regression on the observed real data,

$$Cashholding_{i,t} = a_i + bQ_{i,t} + c * Controls_{it} + \varepsilon_{i,t} \qquad (11)$$

where "Controls" includes all the explanatory variables in equation (2) except for operating cash flow and Q. Then we generate the simulated cash holding, Cashholding_Sim, based on the estimators, $\hat{a}_i$, $\hat{b}$, and $\hat{c}$ as well as $Q_{i,t}$ and the control variables according to the following equation,

$$Cashholding\_Sim_{i,t} = \hat{a}_i + \hat{b}Q_{i,t} + \hat{c} * Controls_{i,t} + \eta_{i,t} \qquad (12)$$

$\eta_{i,t} \sim N(0, \sigma_\eta^{\ 2})$. The variance is the estimated variance of $\varepsilon_{i,t}$ in (11). If we treat the empirically measured Q as being free of measurement error, then by construction, Cashholding_Sim satisfies the "q theory" of investment. Having the simulated cash holding at hand, we can investigate the effect of measurement error on cash flow coefficients by means of the following regression,

$$Cashholding\_Sim_{i,t} = a_i + c_1 ocf_t + c_2 ocf_{t-1} + c_3 ocf_{t-2} + bQ^{PR}{}_{i,t} + \varepsilon_{i,t} \quad (13)$$

where Q_{it}^{PR} is the proxy for the true Q in the empirical model. When we run this regression with $Q_{it}^{PR} = Q_{it}$, i.e., the proxy Q is the same as the Q constructed from the actual data, which we are pretending is the true marginal q, we find – unsurprisingly – that c_1, c_2 and c_3 are all zero. In other words, this is the measurement-error-free situation: the $Q_{i,t}$ constructed from the actual data is assumed to be the true marginal q, and Cashholding_Sim is only determined by $Q_{i,t}$ and other control variables.

Next, we add measurement error to $Q_{i,t}$ to get

$$\overline{Q}_{it} = Q_{it} + u_{it}$$

The left hand side variable is considered to be the measured Q at time t. The two right hand side variables are considered to be the true marginal Q and measurement error at t, respectively. We take the average of $\bar{Q}_{i,t}$, $\bar{Q}_{i,t-1}$, and $\bar{Q}_{i,t-2}$ as the proxy Q, i.e., $Q_{i,t}{}^{PR}$, in the estimation of (13). [16]

We now describe a procedure that allows us to create random measurement error u_t such that u_t is normally distributed with zero mean and variance σ^2, i.e., $u_t \sim N(0, \sigma^2)$, and has a given level of correlation, ρ, with the contemporaneous cash flow, Ocf_t. We refer to σ^2 in subsequent discussion as the "level" of

[16] Recall that in our tests we use the average of three consecutive Q's for the same firm, the current Q and two lagged Q's, as independent variable. In simulation we impose measurement error structure on the single-period Q's. Thus in this section, when we refer to the measured Q, we mean the single period Q. When estimating our regressions, we average the three consecutive Q's.

measurement error.

To simulate the correlation between measurement error and the already observed contemporaneous cash flow, we use the method of *Cholesky Decomposition.* To make this method work we have to first assume that the already observed contemporaneous cash flow is normally distributed.[17] Under the above assumption, we first convert the normally distributed cash flow into a new variable, $\varepsilon_1 = \sigma \dfrac{CashFlow - \bar{\mu}_{cf}}{\bar{\sigma}_{cf}}$, where $\bar{\mu}_{cf}$ and $\bar{\sigma}_{cf}$ are the sample mean and sample standard deviations of cash flow, respectively, and σ is the given level of standard deviation of measurement error. ε_1 is then normally distributed with zero mean and variance σ^2. Second, we independently simulate a random variable, $\varepsilon_2 \sim N(0,\sigma^2)$. Finally, we construct our measurement error as,

$$e = \rho\varepsilon_1 + \varepsilon_2\sqrt{1-\rho}$$

Then $e \sim N(0,\sigma^2)$ and has correlation ρ with the existing cash flow data. We fix the level of σ^2 and allow the magnitude of ρ to vary from -0.95 to 0.95. At each level of ρ we implement a 100-iterations Monte Carlo simulation by estimating equation (10), and take the average of the 100 estimated coefficients of cash flows as our coefficient estimates for that level of ρ. This procedure is repeated for three levels of σ^2, σ^2 = 5, 10, and 20.[18]

The above procedure is implemented, for each dependent variable in equations (2)-(5), starting with generating data in a manner similar to equations (11) and (12)

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[17] Although the cash flow data pass the Shapiro-Francia tests for normality, it does not pass the skewness and kurtosis tests. Therefore, while the assumption is not uncontroversial, it considerably simplifies the implementation of the simulation exercise.

[18] A measurement error variance of 5 would appear already quite large since in the actual data, the variance of the measured Q is generally between 1 and 4 for different sub-samples of constrained and unconstrained firms. For ρ greater than or equal to zero, the variance of the measured Q is an upper bound on the variance of the actual measurement error in the data.

above. The results are reported in Table 6. For a specific level of measurement error, our simulations are performed for correlations ranging from -0.95 to 0.95. In Table 6, we only report cash flow coefficients for 5 values of ρ, -0.75, -0.5, 0, 0.5 and 0.75, for each regression. Similarly, for brevity we only report results for two levels of measurement error variance, namely, σ^2 = 5 and 20[19]. Panels A and B show the results for measurement error variance levels of 5 and 20, respectively.

The overall effect of measurement error on the estimation at all levels of ρ is quite small even for a measurement error level as high as 20. The coefficient estimates of the cash flow variables are generally higher for more negative values of the correlation coefficient – still, the estimates induced by measurement error are seldom even a quarter of the actual coefficient estimates – and often much smaller than that. Moreover, the coefficient estimates of the two lagged cash flows in the cash holding regression are positive, contrary to the pattern observed in the actual data in over 60 regressions[20] that is consistent with the intertemporal allocation of cash. Therefore, overall, it appears extremely unlikely that the cash flow coefficients in *any* of our regressions in the actual data can be attributed purely to measurement error, and that cash flows are irrelevant in the "true model".[21]

B. Measurement Error and Cash Flow Coefficients when Cash Flow Matters

In our second simulation exercise,[22] we examine how measurement error affects the coefficient estimates if the true model is the one we estimate. We pretend that the measured Q is the true Q, and in a manner very similar to that described above, we

[19] The correlation simulation under measurement error level 10 shows similar pattern. For brevity we don't report this part.

[20] These include the results for the three financial constraint classifications that are not reported in a table in this paper.

[21] Notice that since we do not directly impose the cash flow identity on the simulated data, we could consider any one of the variables to be determined from this identity, given the other three and the cash flows. In other words, we can meaningfully consider any subset of three variables and the associated regressions at a time. This does not affect our conclusion that measurement error is unlikely to generate the magnitude of the coefficients we estimate in any subset of the equations.

[22] We do not tabulate the results of the second simulation exercise, but these are available on request.

create measurement error in Q correlated with the actual cash flows, and generate new Q's with measurement error. In this case, we do not create any new data for any of the other variables, but re-estimate our regressions with the newly generated Q's as the observed Q's. Again, measurement error, even at level 20, has a very small effect on the coefficient estimates. The results are presented in Table 8. Measurement error has very minor effects on the coefficient estimates both when the true cash flow coefficients are zero as well as when they are close to the actual estimates. Thus, it is unlikely that our conclusions are significantly affected by measurement error in Q.

VI. Robustness Checks

A. Endogeneity Issues

Since past investment and financing decisions affect future cash flows as well as future investment and financing (i.e., the uses of cash represented by the dependent variables in equations (6)-(9)), our estimation methodology raises a potential endogeneity concern. For example, suppose investment in period *t-1* was higher than what would be predicted on the basis on cash flows at *t-1* and earlier years, and *Q* and the control variables at *t-1*. Then this positive error in investment would be correlated – through the transmission mechanism that causes capital investment to affect future financing and investment activities – with period *t* investment and financing decisions, and therefore would be part of the error term in equations (6)-(9). However, at the same time, this positive error would affect cash flow in period *t*, thereby creating endogeneity.

To see whether the effect of such endogeneity is serious, we regress cash flow in period *t* on past investment and financing activities, and extract the residuals from these regressions. By construction, these residual cash flows are purged of the effect of past financing and investment. In Table 7, we report the results of estimating equations (6)-(9) when cash flow in period t is replaced by the residual cash flow at t. These results are reported both for the overall sample (Table 7A), as well as for firm-size-based classification of firms as financially constrained or unconstrained

(Table 7B). Our results are qualitatively very similar to the ones reported above. Endogeneity, therefore, does not appear to have a major impact on our results.

Another possible source of endogeneity that afflicts the cash flow sensitivity methodology in general – including the estimation of the conventional one-period cash flow sensitivities - is the possibility that there might be serial correlation in the errors in the investment and external financing regressions. Since past investment and external financing could affect today's cash flow, if these errors are serially correlated, today's cash flows might be correlated with contemporaneous residuals, creating an endogeneity problem. To see if there is any evidence of strong serial correlation, we re-estimated the investment and external financing regressions based on the method of Baltagi and Wu (1999) which allows for serial correlation. The estimated serial correlation is less than 0.15 in both equations, and there is only a minor effect on the coefficient estimates. Thus, the extent of serial correlation does not suggest a serious endogeneity problem. We also re-estimated all equations after dropping the contemporaneous cash flow. The endogeneity issue for this set up is likely to be even less serious since the relevant correlations are now between residuals at second and third lag. The coefficient estimates on the lagged cash flows are virtually unchanged.

B. Stricter Financial Constraint Classification

Although our findings hold across four widely accepted classifications and two sources of data sample, some robustness issues remain. In our regression specifications, cash flows in *t-2*, *t-1* and *t* are included as regressors, and the firm's financial constraint status is the status as of year *t-2*. In one robustness test we require firms to maintain the financial constraint status for all three cash flow years. This multi-period criterion guarantees that all three cash flows in the regressions are in the same financial constraint group. Imposing this requirement has no qualitative effect on our results, which remain very similar.

C. Treatment of Net Working Capital Accruals

Our definition of cash flow follows Bushman et al. (2007) and working capital accruals are removed from the definition of cash flows. Since working capital accruals could be endogenous, we do not include these accruals as regressors either. It could be argued that excluding working capital accruals biases our tests due to the omission of relevant variables. To address this concern, we redo our tests by including the contemporaneous and two lags of working capital accruals in our regressions. There is a non-trivial effect on the magnitude of the estimated cash flow coefficients, presumably because the cash flows and working capital accruals are negative correlated. However the pattern of corporate behavior in short term and long term as well as the difference between constrained and unconstrained firms remain qualitatively unchanged.

D. Comparison with Almeida and Campello (2007)

In a recent paper, Almeida and Campello (2007) (hereafter AC) also examine the relation between internal cash flow and external finance, albeit in a one-period setting. They estimate the following model separately for constrained and unconstrained firms

$$ExternalFinancing_{it} = \alpha_1 CashFlow_{it} + \alpha_2 Q_{it} + \alpha_3 Size_{it} + \sum_i firm_i + \sum_t year_t + \varepsilon_{it} \ ,$$

and find that constrained firms reduce less external finance when experiencing a positive cash flow shock than unconstrained firms. In fact, the reduction (measured by external finance-cash flow sensitivity) is insignificant for constrained firms and significant for unconstrained firms. Therefore, they argue that the negative relation between profitability and external funds is not related to higher cost of external funds. Rather, the authors argue that constrained firms might reduce less external financing than unconstrained firms for three reasons. First, constrained firms are likely to have a stock of positive NPV projects that they were unable to finance (being "constrained") and therefore they would be more likely to invest in these projects than reduce external financing. Second, they would anticipate being constrained in the future, and therefore be more inclined to save the cash. Finally, cash flows, being pledgeable, could actually help constrained firms raise additional external finance.

AC's (2007) results differ from our results on *contemporaneous* cash flow sensitivity, and moreover, we find a significant complementarity between cash flows and external finance in the second and third year after a cash flow shock for *unconstrained* firms. Therefore, it is necessary for us to compare the two findings.

Although both papers study the external finance-cash flow sensitivity, there are significant differences. The major differences are the following. First, the definitions of variables are different in the two papers. In their single period study, external finance is defined as net issue of equity and net issue of long-term debt. However, since we focus on the cash flow identity, we must include other items in Financing Activities section of Statement of Cash Flow in our definition of external finance. Thus our definition of external finance also includes "Changes in Current Debt (short-term debt)" and "Financing Activities-Other". Another important difference is the definition of cash flow. While we follow Bushman et. al (2007) and adjust for working capital accruals and other accruals items, AC (2007) calculate cash flow as earnings plus depreciation and amortization. Second, the scaling strategies are different for two papers. AC (2007) scale their regression variables by contemporaneous book asset while we do it using lagged book asset.[23]

In an effort to isolate the key differences that account for the different conclusions in the two papers, we first try to replicate AC's results and then examine the effect of introducing changes that conform to our approach in this paper. If we follow their definitions of variables and scaling strategy, the coefficient of cash flow for unconstrained firms is negative and significant, whereas that for constrained firms, though negative, is less than a fifth of the value for unconstrained firms and insignificant. These results are very similar to those in AC's (2007) Table 3.

However, our results start to diverge when we incorporate the other differences in

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[23] Since we have two lags of cash flows, we scale cash flow and the dependent variables by *t-3* book assets. Also, our Q is the three-year average Q. Our *single-period* cash flow-sensitivity patterns are not affected when we use *t-2* or *t-1* book assets as the scaling variable, or only include the contemporaneous cash flow and Q in our regressions. One innocuous difference is that AC (2007) define size as the nature logarithm of sales. We use logarithm of book asset as proxy of firm size in our robustness checks.

the approaches mentioned above. The definition of cash flow and the choice of the scaling variable are the primary factors behind the difference in the estimated pattern of the cash flow coefficients between AC's (2007) study and ours. In unreported results, we find that the intertemporal pattern of the response of external financing to cash flow shocks for constrained and unconstrained firms is weaker when "Changes in Current Debt (short-term debt)" and "Financing Activities-Other" are omitted. Thus, the differences are substantive in that they are related to the different choices the two studies make regarding the definition of relevant variables rather than differences in sample construction.

VII. Conclusion

In this paper we study short-term and long-term cash flow sensitivities of all uses of cash, and how these are related to the degree of financial constraints faced by firms. We find that firms behave as though there is a pecking order in the *use of funds*- first de-levering and saving cash, and then raising more external financing and investing.

In the short term, the non-investment uses of cash dominate. Firms mainly reduce external financing and add to their cash balances. However, subsequently, firms step up investment. The so-called unconstrained firms step up investment more, by raising additional external funds and drawing down on their cash balance. The constrained firms also step up investment, but not as much. These firms do increase short-term debt financing in subsequent years, but do not increase long term debt. They actually reduce equity financing. We argue that these results are consistent with the notion that the so-called unconstrained firms face less binding financial constraints than the so-called constrained firms.

Our results show that it is important to consider cash flow sensitivities in both the short and the long run. Several studies find that the contemporaneous sensitivity of capital expenditure to cash flow is close to zero. We find a substantial difference in the sensitivity of short-term and long-term sensitivity of investment (a broader category than capital expenditure) to cash flows, especially for unconstrained firms. In the short term, firms mainly reduce external financing and add to cash balances when their cash flows increase. However, these actions expand the investment potential, and lead to additional external financing and investment in the next two years. Although our purpose is not to test the neoclassical investment model, this exercise suggests that the longer term implications of cash flow shocks need to be considered before we can reject alternatives to the neoclassical model.

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Data Appendix

Variable Construction

A. Balance Sheet Sample

For this sample we construct the variables as follows. *Cash Holding* is defined following Almeida, Campello, and Weisbach (2004). We calculate *External Finance* following Baker and Wurgler (2002). The definition of *Capital Expenditure* is the same as in the investment-cash flow sensitivity literature. *Cash Flow* is defined according to Bushman, Smith and Zhang (2007). *Tobin's Q* is defined as in Almeida, Campello and Weisbach (2004). Because most of these variables are defined using data items from Balance Sheet, we call this sample Balance Sheet Sample. The specific definitions are as follows.

Change in Cash Holding: change in cash and cash equivalents (data1)
Net issuances of Equity: change in book equity – change in retained earnings (data36), where book equity is measured as total assets (data6) – total liabilities (data181) – preferred stock (data10) + deferred taxes (data35) + convertible debt (data79). When preferred stock is missing, redemption value of preferred stock (data56) is used instead
Net issuances of Debt: change in long term debt (data9) + change in short term debt (data34)
External Finance: net issue of equity + net issue of debt
Net issuances of long term debt: change in long term debt (data9) + last year's debt due in second year (data91)
Net issuances of short term debt: change in short term debt (data34) – last year's debt due in second year
Dividends: common stock dividends (data21) + preferred stock dividends (data19)
Capital Expenditure: capital expenditure (data128)
Working Capital Accruals: (change in current assets (data4) – change in cash and cash equivalents (data1)) – (change in current liabilities (data5) – change in short-term debt (data34) – change in tax payable (data71))[24]
Cash Flow: income before extraordinary items (data18) + depreciation and amortization (data14) – working capital accruals

All flow variables used in the regressions are divided by the *t-3* total assets (data6) (recall that our specification involves two lags of cash flows) to account for heteroscadasticity.

B. Statement of Cash Flow Sample

To conduct our tests under the condition that the uses of funds equal the sources of funds, we rely on the Statement of Cash Flow sample. According to the COMPUSTAT manual, with the adoption of Statement of Financial Accounting Standard (SFAS) 95, U.S. firms are required to issue Statement of Cash Flow

[24] This definition follows Bushman et al (2007), Table 1.

(COMPUSTAT format code 7) with effect from 15th July, 1988. Prior to that, three different types of formats (CAMPUSTAT format code 1, 2 and 3) were available to firms to report their cash flows. Our Statement of Cash Flow sample makes use of not only the Statement of Cash Flow but all the other three types of formats available from 1971 to 1988, as in Frank and Goyal (2003).

Before we explain the details of variable construction for this sample, it is useful to consider the structure of a typical Statement of Cash Flow, which can also be found in the fourth chapter of the COMPUSTAT manual. This structure helps us to check whether flow of funds identity holds.

Statement of Cash Flow from COMPUSTAT (Format Code 7)

Annual Variable	Item #
Indirect Operating Activities	
Income Before Extraordinary Items	123
Depreciation and Amortization	125
Extraordinary Items and Discontinued Operations	124
Deferred Taxes	126
Equity in Net Loss (Earnings)	106
Sale of Property, Plant, and Equipment and Sale of Investments – Loss (Gain)	213
Funds from Operations – Other	217
Accounts Receivables – Decrease (Increase)	302
Inventory – Decrease (Increase)	303
Accounts Payable and Accrued Liabilities – Increase (Decrease)	304
Income Taxes – Accrued – Increases (Decrease)	305
Assets and Liabilities – Other (Net Change)	307
Operating Activities – Net Cash Flow	308
Investing Activities	
Increase in Investments	113
Sale of Investments	109
Short – Term Investments – Change	309
Capital Expenditures	128
Sale of Property, Plant, and Equipment	107
Acquisitions	129
Investing Activities – Other	310
Investing Activities – Net Cash Flow	311
Financing Activities	
Sale of Common and Preferred Stock	108
Purchase of Common and Preferred Stock	115
Cash Dividends	127

Long – Term Debt – Issuance	111
Long – Term Debt – Reduction	114
Changes in Current Debt	301
Financing Activities – Other	312
Financing Activities – Net Cash Flow	313
Exchange Rate Effect	314
Cash and Cash Equivalents – Increase (decrease)	274

The definition of variables for Statement of Cash Flow sample is as follows:

Change in Cash Holding: data274.

Debt Finance: data111 – data114 – data301 for firms with format code 1; data111 – data114 + data301 for firms with format codes 2, 3 and 7.

Equity Finance: data108 – data115 form firms with format codes 1, 2 and 3; data108 – data115 + 312 for firms with format code 7.

External Finance: debt finance + equity finance.

Long Term Debt Finance: data111 – data114.

Short Term Debt Finance: - data301 for firms with format code 1, data301 for firms with format code 2, 3, and 7.

Capital Expenditure: data128.

Dividends: data127.

Total Investment: data128 + data113 + data129 +data219 – data107 – data109 for firms with format codes 1, 2 and 3; data128 + data113 + data129 – data107 – data109 – data309 – data310 for firms with format code 7.

Working Capital Accruals: data236 for firms with format code 1; – data236 for firms with format codes 2 and 3; – data302 – data303 – data304 – data305 – data307 for firms with format code 7.

Cash Flow: data123 + data124 + data125 + data126 + data106 + data213 + data217 + data218 – working capital accruals for firms with format codes 1, 2 and 3; data123 + data124 + data125 + data126 + data106 + data213 + data217 + data314 – working capital accruals for firms with format code 7.

Tobin's Q is defined as in Balance Sheet sample. All the flow variables used in the regressions are divided by total assets (data6) at time *t-3*.

Additional Notes on Variable Construction for the SFC Sample: Our variable construction method for SCF sample mainly follows Frank and Goyal (2003). We also recode missing values for any variables to zero to keep as many observations as possible. However to satisfy the requirements of our research design we make some important changes. Frank and Goyal (2003) design their definitions to suit tests of capital structure theories, so some modifications are needed for our purposes and compatibility with the literature on cash flow sensitivity. Major adjustments are the following. (i) We regard *Change in Current Debt* (data301) as a component of debt financing and *Financing Activities-Other* (data312) as a part of equity financing. We make this change because these two items are originally classified by the COMPUSTAT manual in the Financing Activities section of the Statement of Cash Flow. Moreover, some researchers (Frank and Goyal (2003), Almeida and Campello (2007)) consider only long-term debt as a source of external debt finance but ignore the short-term debt. For our purposes, inclusion of short-term debt is appropriate. Recall also that we treat C*ash and cash equivalents* (data274) separately as a dependent variable of one of our regressions. (ii) Due to the above changes, unlike Frank and Goyal (2003), our definition of working capital accruals does not include the three items (data274, data301 and data312). (iii) We subtract working capital accruals from the conventional definition of cash flow, exactly as we did for the BS sample.

C. Common Control Variables

Leverage: (long-Term Debt (data9) + debt in Current Liabilities (data34)) / total assets (data6)

Zscore: 1.2*(current assets (data4) – current liabilities (data5)) / total assets (data6) + 1.4*retained earnings (data36) / total assets (data6) + 3.3*(pretex income (data170) + interest expense (data15)) / total assets (data6) + 0.999*sales (data12) / total assets (data6)

Size: ln (total asset (data6))

Tobin's Q: (total assets (data6) + market capitalization (data24*data25) – common equity (data60)) / total assets (data6)

Credit rating: S&P long-term issuer credit rating (data280)

Stock returns volatility: standard deviation of daily stock returns in a fiscal year

Share turnover: median monthly volume over a fiscal year / mean shares outstanding over a fiscal year

Stock price run-ups: compounded monthly stock returns over a fiscal year

For *leverage*, *zscore* and *cash holding*, we use year t-3 level as control variables. For *size*, *Tobin's Q*, *stock returns volatility* and *share turnover,* we take average of annual levels over t-2, t-1 and t as control variables. For stock return run-up, we use average of annual levels over t-3, t-2 and t-1 as control variable. We define *credit rating* over three years, t-2, t-1 and t as a dummy variable. It equals one if a firm has credit rating in any year of t-2, t-1 or t and zero otherwise.

Table 1: Regressions on the Overall Sample

This table reports regression results on the overall sample for both the Balance Sheet (Panel A) and the Statement of Cash Flow (Panel B) data. The dependent variables are change in cash holding, external finance, dividends and total investment in period t. ΔCashholding stands for the change in cash holdings, which corresponds to data item 1 for BS data and data item 274 for SCF data. External Finance is defined as changes in long term (data9) and short term (data34) debt plus book equity defined in Baker and Wurgler (2002) for the BS sample and the sum of net equity issuances, net debt (long-term and short-term) issuances and financing activities-other for the SCF sample. Dividend is defined as common dividend (data 21) plus preferred stock dividend (data 19) for BS data and cash dividend (data 127) for SCF data. In our regressions, this dependent variable is multiplied by negative 1 to convert it to a use of cash (reduction of external finance). Total investment is defined using investing activities (data 311) for SCF data. Operating cash flows is defined as earnings plus depreciation and amortization minus working capital accrual following Bushman, Smith and Zhang (2007). All the above variables are scaled by the beginning of period book assets at t-3. Q is the average of market to book ratios over three periods. Size is the average of the log of book assets over three periods. Crating is a dummy variable defined as one if a firm has credit rating in period t-2, t-1 or t and zero otherwise. Ret_std is the average of one year daily stock return volatility over period t-2, t-1 and t. Shrturn is the average of one year median share turnover over shares outstanding over period t-2, t-1 and t. Lrunup is the average of yearly compounding return over t-3, t-2 and t-1. Leverage is the book leverage at t-3. Zscore is defined following Altman 1968 to indicate the financial healthiness of a firm. LT_CFS is the long-term cash flow sensitivity, i.e., the sum of coefficients of cash flows over three periods. SUM means the sums of the period t and the long-term cash flow-sensitivity coefficients from the cash holding, total investments, dividend and -1 times the coefficient from the external finance regressions. The model we estimate is as the following:

$$\Delta Cashholding_{i,t} = \alpha_{2,i} + \beta_{21}Ocf_{i,t} + \beta_{22}Ocf_{i,t} + \beta_{23}Ocf_{i,t} + \gamma_{22}\hat{Q}_{i,t} + \gamma_{23}Size_{i,t} + \gamma_{24}Leverage_{i,t} + \gamma_{25}Zscore_{i,t} + \gamma_{26}Crating_{i,t} + \gamma_{27}\mathrm{Ret}\_std_{i,t} + \gamma_{28}Shrturn_{i,t} + \gamma_{29}Lrunup_{i,t} + \varepsilon_{2,i,t} \quad (6)$$

$$Investment_{i,t} = \alpha_{3,i} + \beta_{31}Ocf_{i,t} + \beta_{32}Ocf_{i,t} + \beta_{33}Ocf_{i,t} + \gamma_{32}\hat{Q}_{i,t} + \gamma_{33}Size_{i,t} + \gamma_{34}Leverage_{i,t} + \gamma_{35}Zscore_{i,t} + \gamma_{36}Crating_{i,t} + \gamma_{37}\mathrm{Ret}\_std_{i,t} + \gamma_{38}Shrturn_{i,t} + \gamma_{39}Lrunup_{i,t} + \varepsilon_{3,i,t} \quad (7)$$

$$Dividend_{i,t} = \alpha_{4,i} + \beta_{41}Ocf_{i,t} + \beta_{42}Ocf_{i,t} + \beta_{43}Ocf_{i,t} + \gamma_{42}\hat{Q}_{i,t} + \gamma_{43}Size_{i,t} + \gamma_{44}Leverage_{i,t} + \gamma_{45}Zscore_{i,t} + \gamma_{46}Crating_{i,t} + \gamma_{47}\mathrm{Ret}\_std_{i,t} + \gamma_{48}Shrturn_{i,t} + \gamma_{49}Lrunup_{i,t} + \varepsilon_{4,i,t} \quad (8)$$

$$-ExternalFinance_{i,t} = \alpha_{5,i} + \beta_{51}Ocf_{i,t} + \beta_{52}Ocf_{i,t} + \beta_{53}Ocf_{i,t} + \gamma_{52}\hat{Q}_{i,t} + \gamma_{53}Size_{i,t} + \gamma_{54}Leverage_{i,t} + \gamma_{55}Zscore_{i,t} + \gamma_{56}Crating_{i,t} + \gamma_{57}\mathrm{Ret}\_std_{i,t} + \gamma_{58}Shrturn_{i,t} + \gamma_{59}Lrunup_{i,t} + \varepsilon_{5,i,t} \quad (9)$$

For the Balance Sheet data we estimate equation (2), (4), (5) and (6). If the cash flow identity holds exactly, the coefficients of equation (3) can be inferred from those of the other three. The row “Implied Investment” reports these inferred coefficients. For the Statement of Cash Flow data we estimate all four equations. All regressions control for firm and time fixed effects. The t statistics are adjusted using Huber-White estimator allowing within firm clusters to avoid potential heteroscedasticity and serial correlation. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Overall	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
	t-2	t-1	t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	t-3
Data Sample	Panel A: Balance Sheet Data											
Cash holding	-0.043	-0.068	0.358	0.009	-0.011	0.018	-0.001	0.006	0.245	0.001	-0.007	0.247
t-ratio	-4.89***	-7.80***	32.96***	4.78***	-6.12***	2.67***	-1.76*	2.31**	3.82***	3.50***	-2.77***	
-External Finance	-0.059	-0.105	0.508	-0.036	0.015	0.173	-0.004	-0.018	0.419	-0.001	-0.043	0.344
t-ratio	-4.30***	-7.32***	30.24***	-11.95***	4.67***	12.97***	-2.07**	-3.27***	3.05***	-3.28***	-8.80***	
Dividend	0.010	0.011	0.009	0.004	0.002	-0.017	0.000	-0.001	-0.007	-0.000	0.000	0.030
t-ratio	8.56***	9.35***	8.73***	7.94***	3.76***	-11.62***	1.76*	-1.82*	-0.68	-2.58***	0.74	
Implied Investment	0.092	0.162	0.125	0.023	-0.006	-0.174	0.005	0.013	-0.657	0	0.05	0.379
Data Sample	Panel B: Statement of Cash Flow Data											
Cash holding	-0.040	-0.100	0.317	0.005	-0.008	0.021	-0.000	0.004	0.132	0.000	-0.006	0.177
t-ratio	-4.42***	-11.43***	29.18***	3.41***	-5.35***	3.51***	-0.60	1.69*	2.36**	2.07**	-2.28**	
-External Finance	-0.025	-0.057	0.357	-0.020	0.015	0.115	-0.001	-0.014	0.355	-0.000	-0.033	0.275
t-ratio	-2.19**	-5.20***	25.42***	-8.85***	5.11***	11.49***	-1.09	-3.49***	3.55***	-2.05**	-9.22***	
Dividend	0.011	0.012	0.008	0.003	0.001	-0.016	0.000	-0.001	-0.009	-0.000	0.000	0.031
t-ratio	11.09***	11.36***	7.98***	7.95***	3.29***	-11.15***	1.80*	-1.96**	-0.83	-2.64***	0.74	
Total Investment	0.058	0.152	0.263	0.015	-0.010	-0.129	0.000	0.011	-0.516	0.000	0.043	0.473
t-ratio	5.28***	14.66***	21.50***	7.05***	-3.54***	-13.69***	0.35	2.54**	-5.40***	1.36	12.60***	
SUM	0.004	0.007	0.944	0.004	-0.002	-0.010	-0.001	-0.001	-0.037	0.000	0.005	0.955

Table 2: Firm Characteristics Based on Four Financial Constraint Classifications

This table reports means and medians of firm characteristics based on firm size classification. The overall sample is split into "constrained" and "unconstrained" sub-groups based on firm size, payout ratio, bond rating and commercial paper rating. Q is the average of market to book ratios over three periods. Size is the average of the log of book assets over three periods. Ret_std is the average of one year daily stock return volatility over period t-2, t-1 and t. Shrturn is the average of one year median share turnover over shares outstanding over period t-2, t-1 and t. Lrunup is the average of yearly compounding return over t-3, t-2 and t-1. Leverage is the book leverage at t-3. Zscore is defined following Altman 1968 to indicate the financial healthiness of a firm.

Firm Characteristics	Constrained Firms		Unconstrained Firms	
	Mean	Median	Mean	Median
	Panel A: Firm Size Classification			
Q over 3 years	1.8704	1.3507	1.6960	1.3851
Size over 3 years	1.3879	1.4876	6.2683	6.0713
Return volatility over 3 years	0.0503	0.0460	0.0225	0.0201
Share turnover over 3 years	5.4311	3.5147	8.7663	5.7832
Return run-up over 3 years	0.2215	0.1142	0.1645	0.1409
Leverage at t-3	0.1812	0.1386	0.2425	0.2334
Zscore at t-3	1.6061	2.1396	2.2414	2.2402
	Panel B: Payout Ratio Classification			
Q over 3 years	1.6568	1.3001	1.6426	1.3529
Size over 3 years	2.9663	2.7359	5.0734	5.0459
Return volatility over 3 years	0.0441	0.0393	0.0240	0.0206
Share turnover over 3 years	8.0668	5.0854	5.9972	4.2471
Return run-up over 3 years	0.1836	0.1031	0.1626	0.1345
Leverage at t-3	0.2390	0.2233	0.2025	0.1995
Zscore at t-3	1.5604	1.8756	2.5858	2.5561
	Panel C: Bond Rating Classification			
Q over 3 years	1.6438	1.2995	1.7712	1.4591
Size over 3 years	3.4751	3.3425	6.4811	6.4091
Return volatility over 3 years	0.0356	0.0301	0.0237	0.0206
Share turnover over 3 years	6.7096	4.1005	9.4773	6.8341
Return run-up over 3 years	0.1883	0.1315	0.1625	0.1341
Leverage at t-3	0.1979	0.1791	0.2956	0.2773
Zscore at t-3	2.2026	2.4256	1.9671	1.9884
	Panel D: Commercial Paper Rating Classification			
Q over 3 years	1.6319	1.2982	2.0084	1.6602
Size over 3 years	3.7103	3.6016	7.1891	7.0996
Return volatility over 3 years	0.0349	0.0295	0.0188	0.0178
Share turnover over 3 years	7.1936	4.3895	7.5961	6.1757
Return run-up over 3 years	0.1867	0.1310	0.1522	0.1378
Leverage at t-3	0.2133	0.1973	0.2447	0.2392
Zscore at t-3	2.1533	2.3456	2.2041	2.2054

Table 3A: Regression Results Based on Firm Size Classification (Balance Sheet Data)

The overall sample for both the Balance Sheet data (Table 3A) and the Statement of Cash Flow data (Table 3B) are split into "constrained" and "unconstrained" sub-groups based on firm size, which is defined as log of book assets. In each year firms are sorted into ten deciles based on firm size. The top three deciles are classified as unconstrained firms. The bottom three deciles are classified as constrained firms. Variable definitions follow Table 1. The model we estimate is as shown Table 1. All regressions control for firm and time fixed effects. The t statistics are adjusted using Huber-White estimator allowing within firm clusters to avoid potential heteroscedasticity and serial correlation. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Firm Size	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
	t-2	t-1	t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	3-yr
Data Sample	Panel A: Constrained Firms (Balance Sheet Sample)											
Cash holding	-0.038	-0.047	0.415	0.014	-0.016	-0.009	-0.002	0.046	0.296	0.001	-0.016	0.330
t-ratio	-2.29**	-2.82***	19.69***	3.38***	-2.44**	-0.53	-1.07	0.62	2.37**	1.99**	-3.28***	
-External Finance	-0.030	-0.074	0.474	-0.041	-0.015	0.136	0.001	-0.043	0.070	-0.001	-0.012	0.370
t-ratio	-1.29	-3.09***	16.05***	-6.43***	-1.56	4.30***	0.18	-0.47	0.27	-0.98	-1.46	
Dividend	0.005	0.008	0.007	0.000	0.000	-0.008	-0.000	-0.002	-0.030	0.000	0.001	0.020
t-ratio	2.56**	3.57***	3.38***	0.42	0.01	-2.98***	-0.58	-0.25	-1.81*	0.45	1.74*	
Implied Investment	0.063	0.113	0.104	0.027	0.031	-0.119	0.001	-0.001	-0.336	0	0.027	0.28
Data Sample	Panel B: Unconstrained Firms (Balance Sheet Sample)											
Cash holding	-0.046	-0.073	0.286	0.003	-0.008	0.031	-0.001	0.006	0.319	0.000	-0.006	0.167
t-ratio	-2.66***	-4.56***	14.68***	1.40	-3.28***	2.92***	-0.25	2.02**	2.00**	2.50**	-1.35	
-External Finance	-0.099	-0.218	0.464	-0.020	0.015	0.115	-0.017	-0.020	1.057	-0.001	-0.049	0.147
t-ratio	-3.65***	-7.27***	13.58***	-4.01***	2.81***	5.27***	-3.75***	-2.97***	2.53**	-3.11***	-4.72***	
Dividend	0.013	0.018	0.016	0.005	0.002	-0.019	0.002	-0.001	-0.143	-0.000	-0.001	0.047
t-ratio	6.24***	7.17***	6.97***	8.52***	2.45**	-7.48***	5.54***	-1.70*	-2.94***	-1.73*	-1.93*	
Implied Investment	0.132	0.273	0.234	0.012	-0.009	-0.127	0.016	0.015	-1.233	0.001	0.056	0.639

Table 3B: Regression Results Based on Firm Size Classification (Statement of Cash Flow Data)

Firm Size	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
	t-2	t-1	t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	3-yr
Data Sample	Panel A: Constrained Firms (Statement of Cash Flow Sample)											
Cash holding	-0.036	-0.074	0.361	0.011	-0.016	0.003	0.001	0.045	0.201	0.000	-0.013	0.251
t-ratio	-2.06**	-4.51***	17.33***	3.22***	-2.54**	0.20	0.28	0.66	1.84*	1.08	-3.03***	
-External Finance	-0.013	-0.044	0.380	-0.025	-0.004	0.107	0.004	0.003	0.066	-0.000	-0.014	0.324
t-ratio	-0.58	-2.18**	14.58***	-4.89***	-0.44	4.13***	1.31	0.05	0.37	-0.09	-2.19**	
Divided	0.008	0.009	0.006	0.001	0.000	-0.007	0.000	-0.002	-0.016	0.000	0.001	0.023
t-ratio	4.80***	4.90***	3.41***	0.66	0.18	-2.91***	0.90	-0.26	-1.13	0.12	1.86*	
Total Investment	0.050	0.115	0.187	0.017	0.025	-0.118	-0.007	0.033	-0.300	-0.000	0.024	0.352
t-ratio	2.62***	6.30***	8.89***	4.17***	3.32***	-5.34***	-2.32**	0.60	-1.84*	-0.08	4.18***	
SUM	0.009	0.006	0.935	0.004	0.005	-0.015	-0.002	0.079	-0.049	0.000	-0.002	0.950
Data Sample	Panel B: Unconstrained Firms (Statement of Cash Flow Sample)											
Cash holding	-0.051	-0.114	0.261	0.001	-0.003	0.023	0.001	0.000	0.115	0.000	0.000	0.096
t-ratio	-3.30***	-7.51***	14.44***	0.74	-1.82*	2.84***	0.42	0.01	1.05	1.55	0.00	
-External Finance	-0.031	-0.091	0.267	-0.006	0.011	0.072	-0.008	-0.011	0.885	-0.000	-0.036	0.145
t-ratio	-1.57	-4.01***	11.52***	-1.66*	2.79***	4.52***	-2.44**	-2.43**	3.29***	-2.05**	-5.92***	
Divided	0.014	0.016	0.013	0.005	0.001	-0.017	0.002	-0.001	-0.165	-0.000	-0.002	0.043
t-ratio	5.68***	7.44***	5.16***	8.47***	1.78*	-7.02***	5.47***	-1.76*	-3.32***	-1.72*	-2.24**	
Total Investment	0.070	0.192	0.421	-0.001	-0.013	-0.092	0.004	0.013	-0.767	0.000	0.049	0.683
t-ratio	3.56***	8.62***	16.28***	-0.43	-3.46***	-5.24***	1.15	2.60***	-2.85***	1.52	7.76***	
SUM	0.002	0.003	0.961	-0.001	-0.004	-0.015	-0.001	0.000	0.068	0.000	0.012	0.966

Table 4: Cash flow Sensitivities of Debt and Equity Financing Based on Overall Sample

We divide external finance into debt finance and equity finance and re-estimate equation (9). The models estimated are

$$-Equity\_Finance_{i,t} = \alpha_{6,i} + \beta_{61}Ocf_{i,t} + \beta_{62}Ocf_{i,t} + \beta_{63}Ocf_{i,t} + \gamma_{62}\hat{Q}_{i,t} + \gamma_{63}Size_{i,t} + \gamma_{64}Leverage_{i,t} + \gamma_{65}Zscore_{i,t} + \gamma_{66}Crating_{i,t} + \gamma_{67}\mathrm{Ret}\_std_{i,t} + \gamma_{68}Shrturn_{i,t} + \gamma_{69}Lrunup_{i,t} + \varepsilon_{6,i,t} \quad (9')$$

$$-Debt\_Finance_{i,t} = \alpha_{7,i} + \beta_{71}Ocf_{i,t} + \beta_{72}Ocf_{i,t} + \beta_{73}Ocf_{i,t} + \gamma_{72}\hat{Q}_{i,t} + \gamma_{73}Size_{i,t} + \gamma_{74}Leverage_{i,t} + \gamma_{75}Zscore_{i,t} + \gamma_{76}Crating_{i,t} + \gamma_{77}\mathrm{Ret}\_std_{i,t} + \gamma_{78}Shrturn_{i,t} + \gamma_{79}Lrunup_{i,t} + \varepsilon_{7,i,t} \quad (9'')$$

Debt Financing is defined as change in long term debt and change in short term debt. Equity Financing is defined as change in book equity minus change in retained earnings as in Baker and Wurgler (2002). The models are estimated based on overall BS sample and separately for constrained and unconstrained firms under firm size classification following table 3. All regressions control for firm and time fixed effects. The t statistics are adjusted using Huber-White estimator allowing within firm clusters to avoid potential heteroscedasticity and serial correlation. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Equity vs. Debt	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
	t-2	t-1	t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	3-yr
Data Sample	Panel A: Overall Sample (Balance Sheet Data)											
-Equity Finance	0.012	0.021	0.111	-0.025	0.011	-0.016	-0.004	-0.005	-0.038	-0.001	-0.014	0.144
t-ratio	1.31	2.03**	10.43***	-10.18***	4.49***	-1.52	-1.74*	-1.55	-0.46	-3.29***	-4.06***	
-Debt Finance	-0.074	-0.126	0.384	-0.010	0.004	0.190	-0.000	-0.012	0.508	-0.000	-0.027	0.183
t-ratio	-8.13***	-13.45***	31.89***	-6.40***	2.04**	20.68***	-0.07	-3.50***	6.55***	-0.16	-9.38***	
Data Sample	Panel B: Constrained Firms (Balance Sheet Data)											
-Equity Finance	0.023	0.032	0.126	-0.035	-0.014	-0.043	-0.002	-0.006	-0.251	-0.001	0.003	0.182
t-ratio	1.41	1.75*	6.40***	-6.59***	-1.83*	-1.80*	-0.91	-0.11	-1.65*	-1.19	0.53	
-Debt Finance	-0.051	-0.100	0.330	-0.002	-0.004	0.171	0.003	-0.091	0.437	0.000	-0.014	0.180
t-ratio	-3.01***	-6.36***	15.86***	-0.51	-0.64	7.32***	1.39	-0.84	3.45***	0.43	-2.93***	
Data Sample	Panel C: Unconstrained Firms (Balance Sheet Data)											
-Equity Finance	-0.001	-0.029	0.077	-0.009	0.010	-0.056	-0.013	-0.010	-0.121	-0.000	-0.016	0.047
t-ratio	-0.08	-1.71*	3.76***	-2.53**	2.56**	-3.79***	-4.37***	-2.57***	-0.47	-2.53**	-1.67*	
-Debt Finance	-0.105	-0.193	0.391	-0.012	0.006	0.175	-0.003	-0.008	1.186	-0.000	-0.033	0.092
t-ratio	-5.86***	-9.26***	16.48***	-4.36***	1.97**	12.15***	-0.98	-1.89*	4.75***	-1.83*	-6.52***	

Table 5: Cash flow Sensitivities of Long Term and Short Term Debt Financing Based on Overall Sample

We divide debt finance into long term and short term debt and re-estimate equation (9''). The models estimated are

$$-Long\_Debt_{i,t} = \alpha_{6,i} + \beta_{61}Ocf_{i,t} + \beta_{62}Ocf_{i,t} + \beta_{63}Ocf_{i,t} + \gamma_{62}\hat{Q}_{i,t} + \gamma_{63}Size_{i,t} + \gamma_{64}Leverage_{i,t} + \gamma_{65}Zscore_{i,t} + \gamma_{66}Crating_{i,t} + \gamma_{67}\mathrm{Ret}\_std_{i,t} + \gamma_{68}Shrturn_{i,t} + \gamma_{69}Lrunup_{i,t} + \varepsilon_{6,i,t}$$

$$-Short\_Debt_{i,t} = \alpha_{6,i} + \beta_{61}Ocf_{i,t} + \beta_{62}Ocf_{i,t} + \beta_{63}Ocf_{i,t} + \gamma_{62}\hat{Q}_{i,t} + \gamma_{63}Size_{i,t} + \gamma_{64}Leverage_{i,t} + \gamma_{65}Zscore_{i,t} + \gamma_{66}Crating_{i,t} + \gamma_{67}\mathrm{Ret}\_std_{i,t} + \gamma_{68}Shrturn_{i,t} + \gamma_{69}Lrunup_{i,t} + \varepsilon_{6,i,t}$$

Long Term Debt Financing is defined as the change in long term debt plus last year's debt maturing in second year. Short Term Debt Financing is defined as the difference between change in current year's short term debt and last year's debt maturing in second year. The models are estimated based on overall BS sample and separately for constrained and unconstrained firms under firm size classification following table 3. All regressions control for firm and time fixed effects. The t statistics are adjusted using Huber-White estimator allowing within firm clusters to avoid potential heteroscedasticity and serial correlation. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Long vs. Short	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
Term Debt	t-2	t-1	t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	3-yr
Data Sample	Panel A: Overall Sample (Balance Sheet Data)											
-Long Term Debt	-0.011	-0.028	0.184	-0.007	-0.002	0.115	-0.000	-0.007	0.164	0.000	-0.019	0.145
t-ratio	-1.23	-2.85***	16.66***	-4.41***	-1.01	11.81***	-0.17	-1.90*	2.01**	1.19	-7.09***	
-Short Term Debt	-0.058	-0.091	0.191	-0.002	0.004	0.076	-0.000	-0.003	0.311	-0.000	-0.007	0.041
t-ratio	-8.61***	-12.88***	23.19***	-2.25**	2.88***	11.88***	-0.23	-1.53	5.12***	-3.19***	-3.61***	
Data Sample	Panel B: Constrained Firms (Balance Sheet Data)											
-Long Term Debt	0.003	-0.004	0.114	-0.002	-0.018	0.079	0.003	-0.042	0.156	0.000	-0.008	0.112
t-ratio	0.19	-0.26	6.21***	-0.81	-2.91***	3.71***	1.84*	-0.43	1.30	1.57	-2.11**	
-Short Term Debt	-0.053	-0.093	0.206	0.002	0.015	0.090	-0.001	-0.043	0.259	-0.000	-0.004	0.060
t-ratio	-4.13***	-6.98***	13.39***	0.87	2.69***	4.65***	-0.78	-0.48	2.38**	-1.70*	-1.16	
Data Sample	Panel C: Unconstrained Firms (Balance Sheet Data)											
-Long Term Debt	-0.049	-0.105	0.234	-0.007	-0.001	0.117	-0.006	-0.008	0.801	-0.000	-0.027	0.081
t-ratio	-2.63***	-5.01***	10.40***	-2.34**	-0.22	7.08***	-1.85*	-1.73*	2.65***	-0.70	-4.56***	
-Short Term Debt	-0.046	-0.085	0.164	-0.006	0.006	0.065	0.003	-0.001	0.320	-0.000	-0.012	0.033
t-ratio	-3.74***	-6.76***	11.04***	-3.98***	3.08***	6.87***	1.76*	-0.31	1.66*	-2.52**	-3.53***	

Table 6. Two Step Regression Results Based on Overall Sample

In the regressions reported in this table, we replicate the regressions in Table 1 and Table 3A after replacing cash flow in period t with *Resid_t*, defined below. All other variables are defined as in Table 1. The results in this table are based on Balance Sheet sample.

Resid_t is the regression residual of the following regression:

$$CashFlow_{i,t} = \alpha + \beta_1 ExternalFinance_{i,t-1} + \beta_2 ExternalFinance_{i,t-2} + \beta_3 Capex_{i,t-1} + \beta_4 Capex_{i,t-2} + \varepsilon_{i,t}$$

The above regressions incorporate firm and time fixed effects.

Overall	Cash Flows			Q	Size	Leverage	Zscore	Crating	Ret_std	Shrturn	Lrunup	LT_CFS
	t-2	t-1	Resid_t	3-yr	3-yr	t-3	t-3	3-yr	3-yr	3-yr	3-yr	t-3
Data Sample	Panel A: Overall Sample (Balance Sheet Sample)											
Cash holding	-0.046	-0.070	0.359	0.010	-0.010	0.013	-0.001	0.006	0.223	0.001	-0.007	0.243
t-ratio	-5.01***	-7.91***	32.57***	5.28***	-5.47***	1.60	-1.03	2.22**	3.32***	3.55***	-2.55**	
-External Finance	-0.053	-0.102	0.512	-0.036	0.018	0.161	-0.008	-0.019	0.350	-0.001	-0.041	0.357
t-ratio	-3.79***	-6.99***	30.13***	-11.97***	5.30***	11.73***	-3.86***	-3.52***	2.52**	-3.06***	-8.37***	
Dividend	0.009	0.010	0.009	0.004	0.002	-0.018	0.001	-0.001	-0.005	-0.000	0.000	0.029
t-ratio	8.40***	8.87***	8.44***	8.02***	3.77***	-12.57***	3.85***	-1.48	-0.48	-2.52**	0.91	
Data Sample	Panel B: Constrained Firms (Balance Sheet Sample)											
Cash holding	-0.039	-0.047	0.407	0.015	-0.016	-0.005	-0.003	0.045	0.302	0.001	-0.015	0.321
t-ratio	-2.32**	-2.83***	19.08***	3.60***	-2.43**	-0.23	-1.11	0.61	2.39**	1.65*	-2.92***	
-External Finance	-0.025	-0.062	0.484	-0.044	-0.012	0.161	-0.002	-0.047	-0.009	-0.001	-0.013	0.397
t-ratio	-1.01	-2.55**	16.32***	-6.87***	-1.25	4.94***	-0.56	-0.53	-0.04	-0.85	-1.55	
Dividend	0.005	0.008	0.006	0.000	0.000	-0.009	-0.000	-0.002	-0.030	0.000	0.001	0.019
t-ratio	2.41**	3.41***	3.09***	0.49	0.05	-2.97***	-0.30	-0.24	-1.68*	0.44	1.74*	
Data Sample	Panel C: Unconstrained Firms (Balance Sheet Sample)											
Cash holding	-0.050	-0.077	0.294	0.003	-0.006	0.021	0.001	0.006	0.393	0.001	-0.005	0.167
t-ratio	-2.82***	-4.70***	14.81***	1.27	-2.31**	1.92*	0.55	2.21**	2.21**	2.62***	-1.09	
-External Finance	-0.089	-0.217	0.458	-0.020	0.017	0.093	-0.016	-0.019	1.314	-0.001	-0.045	0.153
t-ratio	-3.17***	-7.16***	13.10***	-4.03***	3.05***	4.01***	-3.56***	-2.97***	3.22***	-3.08***	-4.46***	
Dividend	0.013	0.018	0.015	0.005	0.002	-0.021	0.002	-0.001	-0.169	-0.000	-0.001	0.046
t-ratio	6.01***	7.06***	6.40***	8.68***	2.50**	-7.76***	5.44***	-1.50	-3.43***	-1.62	-1.67*	

Table 7: Analysis of Measurement Error and Correlation I (Overall Sample)

For each dependent variable in equations (2)-(5) – denoted by *Y* – we generate new data, denoted by *Y_Sim* as follows:

$$Y\_Sim_{i,t} = \hat{a}_i + \hat{b}Q_{i,t} + \hat{c}X_{i,t} + v_{i,t} \qquad \text{(A)}$$

$\hat{a}_i$ $\hat{b}_i$ and $\hat{c}_i$ are estimated from regressing observed *Y* on measured Q, defined as (total assets (data6) + market capitalization (data24*data25) – common equity (60)) / total assets (data6) and other control variables (X), excluding cash flows. In equation (A), $v \sim N(0,\delta^2)$ and δ^2 is the estimated variance of the residual in the regression of observed *Y* on Q. For our simulations, we treat the measured Q in the current year in the actual data as the measurement-error free Q, and add measurement error, denoted by u_t, to get a Q measured with error:

$$\overline{Q}_{it} = Q_{it} + u_{it}$$

Then we average the $\overline{Q}_{it}$ over the past two years and the current year to get the three year average Q. The measurement error u_{it} is constructed in such a way that it is normally distributed with mean zero and variance σ^2 and has a correlation coefficient of ρ with cash flow. For the data thus generated, and given values of σ^2 and ρ, we repeat regressions (2)-(5) 100 times. Panel A reports our regression results for $\sigma^2 = 5$ while panel B for $\sigma^2 = 20$. For a given value of σ^2, the correlation ρ is increased in step of 0.05, from -0.95 to 0.95. For each of these 39 levels of correlation, we average the coefficient estimates from the 100 regressions. In the Table below, these averaged coefficients are reported under five levels of ρ, -0.75, -0.5, 0, 0.5 and 0.75, for brevity.

Correlation	Panel A: Measurement Error Level 5				Panel A: Measurement Error Level 20			
	CF_{t-2}	CF_{t-1}	CF_t	Q	CF_{t-2}	CF_{t-1}	CF_t	Q
ΔCash Holding_Sim								
-0.75	0.0144	0.0153	0.0137	0.0010	0.0130	0.0142	0.0129	0.0003
-0.5	0.0139	0.0147	0.0130	0.0013	0.0128	0.0140	0.0127	0.0004
0	0.0108	0.0119	0.0104	0.0015	0.0111	0.0124	0.0112	0.0004
0.5	0.0063	0.0077	0.0065	0.0019	0.0085	0.0100	0.0090	0.0006
0.75	0.0012	0.0029	0.0020	0.0027	0.0053	0.0070	0.0062	0.0008
-External Finance_Sim								
-0.75	-0.0065	-0.0073	-0.0125	-0.0013	-0.0050	-0.0061	-0.0117	-0.0004
-0.5	-0.0055	-0.0063	-0.0115	-0.0015	-0.0043	-0.0055	-0.0111	-0.0004
0	-0.0018	-0.0029	-0.0084	-0.0019	-0.0022	-0.0036	-0.0094	-0.0005
0.5	0.0035	0.0020	-0.0038	-0.0023	0.0008	-0.0008	-0.0069	-0.0006
0.75	0.0104	0.0086	0.0025	-0.0034	0.0052	0.0033	-0.0030	-0.0011
Dividend_Sim								
-0.75	0.0030	0.0051	0.0040	0.0005	0.0024	0.0047	0.0037	0.0001
-0.5	0.0027	0.0048	0.0037	0.0006	0.0023	0.0045	0.0036	0.0002
0	0.0014	0.0036	0.0026	0.0007	0.0015	0.0038	0.0030	0.0002
0.5	-0.0005	0.0018	0.0010	0.0008	0.0004	0.0028	0.0020	0.0002
0.75	-0.0028	-0.0003	-0.001	0.0012	-0.0010	0.0015	0.0008	0.0004
Total Investment_Sim								
-0.75	0.0157	0.0105	0.0309	0.0026	0.0122	0.0078	0.0291	0.0007
-0.5	0.0139	0.0088	0.0292	0.0032	0.0114	0.0070	0.0283	0.0009
0	0.0062	0.0016	0.0225	0.0039	0.0070	0.0030	0.0246	0.0011
0.5	-0.0056	-0.0093	0.0123	0.0050	-0.0001	-0.0035	0.0186	0.0015
0.75	-0.0194	-0.0225	-0.0002	0.0072	-0.00933	-0.0122	0.0105	0.0023

Table 8: Analysis of Measurement Error and Correlation II (Overall Sample)

For our simulations, we treat the measured Q in the current year in the actual data as the measurement-error free Q, and add measurement error, denoted by u_t , to get a Q measured with error:

$$\overline{Q}_{it} = Q_{it} + u_{it}$$

We average the $\overline{Q}_{it}$ over the past two years and the current year to get the three year average Q. The measurement error u_{it} is constructed in such a way that it is normally distributed with mean zero and variance σ^2 and has a correlation coefficient of ρ with cash flow. For the data thus generated, and given values of σ^2 and ρ, we repeat regressions (2)-(5) 100 times. Panel A reports our regression results for $\sigma^2 = 5$ while panel B for $\sigma^2 = 20$. For a given value of σ^2, the correlation ρ is increased in step of 0.05, from -0.95 to 0.95. For each of these 39 levels of correlation, we average the coefficient estimates from the 100 regressions. In the Table below, these averaged coefficients are reported under five levels of ρ, -0.75, -0.5, 0, 0.5 and 0.75, for brevity. The regressions include the control variables, but except for Q, the coefficients of these control variables are not reported.

Correlation	Panel A: Measurement Error Level 5				Panel A: Measurement Error Level 20			
	CF_{t-2}	CF_{t-1}	CF_t	Q	CF_{t-2}	CF_{t-1}	CF_t	Q
ΔCash Holding								
Actual data	-0.040	-0.100	0.317	0.005				
-0.75	-0.0369	-0.0965	0.3216	0.0004	-0.0377	-0.0972	0.3212	0.0001
-0.5	-0.0372	-0.0969	0.3213	0.0005	-0.0378	-0.0973	0.3210	0.0001
0	-0.0385	-0.0980	0.3202	0.0008	-0.0383	-0.0977	0.3206	0.0003
0.5	-0.0417	-0.1011	0.3172	0.0014	-0.0407	-0.1000	0.3185	0.0005
0.75	-0.0466	-0.1058	0.3127	0.0023	-0.0451	-0.1042	0.3146	0.0010
-External Finance								
Actual data	-0.025	-0.057	0.357	-0.020				
-0.75	-0.0388	-0.0733	0.3362	-0.0023	-0.0361	-0.0714	0.3375	-0.0007
-0.5	-0.0370	-0.0717	0.3379	-0.0028	-0.0351	-0.0704	0.3384	-0.0008
0	-0.0305	-0.0657	0.3434	-0.0031	-0.0311	-0.0668	0.3417	-0.0009
0.5	-0.0223	-0.0582	0.3503	-0.0035	-0.0268	-0.0628	0.3453	-0.0010
0.75	-0.0127	-0.0491	0.3589	-0.0050	-0.0209	-0.0574	0.3504	-0.0015
Dividend								
Actual data	0.011	0.012	0.008	0.003				
-0.75	0.0131	0.0142	0.0113	0.0004	0.0126	0.0139	0.0111	0.0001
-0.5	0.0128	0.0140	0.0111	0.0004	0.0125	0.0138	0.0110	0.0001
0	0.0118	0.0130	0.0102	0.0005	0.0119	0.0132	0.0105	0.0001
0.5	0.0104	0.0117	0.0090	0.0006	0.0111	0.0125	0.0099	0.0002
0.75	0.0087	0.0102	0.0075	0.0009	0.0102	0.0116	0.0090	0.0002
Total Investment								
Actual data	0.058	0.152	0.263	0.015				
-0.75	0.0689	0.1654	0.2787	0.0020	0.0668	0.1639	0.2777	0.0006
-0.5	0.0675	0.1640	0.2773	0.0024	0.0660	0.1631	0.2770	0.0008
0	0.0619	0.1590	0.2728	0.0023	0.0624	0.1598	0.2740	0.0007
0.5	0.0568	0.1544	0.2686	0.0022	0.0602	0.1579	0.2723	0.0005
0.75	0.0520	0.1498	0.2644	0.0029	0.0590	0.1568	0.2713	0.0005