Corporate Propensity to Dissave

Alexander Vadilyev and Vikram Nanda§

Abstract

We study the effect of disinvestment inertia, in the sense of the rational reluctance towards liquidation of unproductive assets (projects), on firms' propensity to save/dissave out of cash flow. Contrary to previous evidence, we find that firms do not disinvest and do not save the proceeds from disinvestment in response to negative cash flow (productivity) shocks. In contrast, firms tolerate both large and small negative shocks and dissave from their cash reserves. This behavior reflects firms' rational choices to absorb negative shocks and retain the flexibility to continue with temporarily unproductive assets. This behavior is generally evident for both financially constrained and unconstrained firms, cash-rich and cash-poor firms, and for firms with both high and low cash flow uncertainty. Our empirical evidence is obtained from the integrated regression framework, in which the cash flow identity holds implicitly, and using q measurement-error consistent estimators. In conclusion, the propensity to dissave strongly dominates in a negative cash flow environment.

Keywords: corporate propensity to save/dissave, disinvestment inertia, cash flow environment, q measurement error.

JEL classification: D25, G31, G32.

§ Alexander Vadilyev (email: alexander.vadilyev@anu.edu.au) is from the Research School of Finance, Actuarial Studies and Statistics, Australian National University. Vikram Nanda (email: vikram.nanda@utdallas.edu) is from the Naveen Jindal School of Business, University of Texas at Dallas. We have benefited from discussions with Eduardo Schwartz, Ron Giammarino, Kai Li, and Will Gornall; seminar participants at the University of British Columbia, Simon Fraser University, and Queensland University of Technology; and conference participants at the 2019 Financial Markets and Corporate Governance Conference and 2019 International Conference of the Financial Engineering and Banking Society. All errors are ours.

1 Introduction

Cash flow environment in which a firm operates is of great importance to our understanding of the dynamics of corporate liquidity. Still, the relation between saving behavior and cash flow is a debatable topic in the literature. Almeida et al. (2004) model a firm's demand for internal liquidity (dubbed "*the cash flow sensitivity of cash*") to gauge the cost of external finance. Riddick and Whited (2009) challenge this approach to measure external finance constraints and show that saving and cash flow are often negatively related (dubbed "*the negative propensity to save*").[1] This negative propensity to save occurs because a positive productivity shock causes both cash flow and the marginal product of capital to increase. A substitution effect then induces the firm to use some of its savings to acquire more productive assets for future growth, that is, to dissave and invest.[2] Conversely, in times when capital productivity is low (cash flow is negative), the substitution effect induces the firm to liquidate its unproductive assets (projects) and return the proceeds from liquidation to its "savings account", that is, to disinvest and save.[3]

Motivated by real options reasoning, we argue that the negative propensity to save does not hold when cash flow is negative. When the firm faces a negative cash flow (productivity) shock, it tolerates the shock and dissaves from its cash reserves. By doing so, the firm retains the flexibility to continue with temporarily unproductive assets. This rational reluctance towards instantaneous disinvestment (*disinvestment inertia*) manifests itself in the marginal propensity to dissave, not to save, in a negative cash flow

[1] The flip in the sign of the cash flow coefficient is due to the correction for measurement error in Tobin's q. In the saving regression, the OLS estimator yields a positive cash flow coefficient (Almeida et al., 2004), while the measurement-error consistent esimator - a negative cash flow coefficient (Riddick and Whited, 2009).

[2] This mechanism implies that the optimal allocation of cash flow to savings decreases and becomes negative in the return differential between the firm's productive and liquid assets.

[3] Following this reasoning, we assume that saving (dissaving) is equivalent to disinvestment (investment). We further define disinvestment as the decision to terminate a project or liquidate non-cash asset.

environment. This result is the major extension of the argument by Riddick and Whited (2009).

Disinvestment inertia is central to our understanding of firms' termination choices. The real options approach provides a microeconomic explanation for this kind of inertia (Dixit, 1992, Dixit and Pindyck, 1994). It asserts that the firm may increase its profit by deferring an irreversible disinvestment even if the expected present value of the asset's (project's) cash flow falls below the liquidation value. The underlying reason is that in case of at least partially irreversible decision, waiting has a value because new information about the expected cash flow arrives in subsequent periods. As long as the disinvestment has not been realised, the firm has the flexibility to continue with an existing asset (ongoing project) that could prove to be valuable in case the cash flow increases in the future. Termination of the asset exercises this option and reduces the firm's flexibility and potential profit. This loss of flexibility therefore must be compensated by the liquidation value before a termination choice becomes optimal. This mechanism results in a kind of inertia that has been called a 'tyranny of the status quo'. It is a tyranny based on rational considerations, however.

It is often desirable to delay a disinvestment decision because uncertainty associated with the assets that yield negative cash flows is high. There is ample evidence that, in many industries, firms stay in business for lengthy periods of time while absorbing large operating losses. They quite rationally preserve their option to retain a foothold in the market, thereby keeping alive their option to operate profitably in the future. Going out of operations means a loss of much productive capital. If the market conditions are to become more favorable and operation can be resumed profitably, the capital has to be reassembled at substantial cost. Continuing operations preserve the capital almost intact, and therefore the firm retains it, even at the cost of suffering temporary losses. Similarly, goodwill impairment can be a significant hurdle to divestiture. Shutting down operations means an irreversible loss of much intangible capital - the specialized skills that the workers have developed would disappear, brand recognition and customer loyalty could fade. As such, it can be rational to delay a disinvestment decision, withstand the negative cash flow shock, and wait for more information about market conditions. In the meantime, the dissaving of cash reserves, not the liquidation of assets and the retention of cash proceeds, should be a plausible immediate response to negative cash flow.

Furthermore, the firm often cannot promptly terminate most of its unproductive assets. This inability to leave a losing activity occurs for several reasons. First, unproductive assets are illiquid, and thus cannot be quickly terminated and converted into cash. Second, unproductive assets are hard to value. If an industry is reasonably competitive, the depressed values of the troubled assets are known and about the same for other firms in the industry, so there is little gain from selling them. Third, the costs associated with the liquidation of unproductive assets are often prohibitively high and prevent the firm from immediate diverstiture. Last, the firm incurring cash flow losses may have limited access to external finance and thus may need to tap its "savings account" to continue operations, that is, to dissave. Its cash flow deficit can be borrowed, but borrowing is problematic for the majority of loss-making firms. Dissaving is therefore a natural way to counteract part of the effects of negative cash flow.[4]

In this paper, we present the disinvestment choice as a dynamic optimal stopping problem with a stylised decision to abandon an unprofitable project (asset) in exchange for a certain liquidation value. The model predicts that it is often optimal to stay in the project and tolerate its low or negative cash flows. The model prediction is robust to the degree of uncertainty in project returns and to the level of risk aversion. We therefore

[4]Credit lines are not the best all-around substitute for cash reserves. Sufi (2009) provides evidence that access to credit lines is restricted following covenant violations, and that such violations typically follow declines in firm profitability. The cost of credit line revocation is therefore higher for firms with a higher risk of facing profitability shocks. In these circumstances, firms that are exposed to greater cash flow risk are more likely to use cash reserves for their liquidity needs.

hypothesize that the firm should use its savings to absorb current cash flow losses; that is, the firm should demonstrate a strong propensity to dissave in a negative cash flow environment.

The identification strategy is as follows. Using a large panel of U.S. firms from 1984 to 2016, we estimate the model by errors-in-variables regression with identification from higher-order cumulant estimators. The use of these measurement error-consistent estimators is required because measurement error in Tobin's q, which is a control variable in the saving model, can cause the cash flow coefficient bias. In our case, because the information about growth prospects contained in cash flow leads to a positive correlation between cash flow and q, the measurement error is likely to bias the cash flow coefficient. We therefore follow the suggestion by Erickson et al. (2014) who developed the q measurement-error remedy that is asymptotically equivalent to the moment estimators in Erickson and Whited (2000, 2002) and run our regressions using both OLS and cumulant estimators.[5]

The proposed empirical model further stands out from those used in the literature. Existing models lack a number of important uses of cash flow and thus provide an incomplete view of the firm's saving behavior. To accurately measure the propensity to save/disburse funds out of cash flow, we simultaneously track all cash flow uses, which are interrelated by the accounting *identity* that the sum of all uses of cash flow must equal cash flow itself (Gatchev et al., 2010, Chang et al., 2014).[6] We define cash flow and its uses using the flow-of-funds statement of Compustat, so that the cash flow identity holds well in our data. Further, we separately estimate six equations that describe firms' major uses of cash flow, namely, the change in cash holdings (the main variable of interest), investment, the change in working capital, dividends, net equity repurchases, and net debt

[5]The moment estimators have been under debate (Almeida et al., 2010, Erikson and Whited, 2012).

[6]The *cash flow identity* implies that the cash flow sensitivities of various uses of cash flow must add up to unity. Because all cash flow uses must absorb a cash flow shock completely, if cash flow increases by one dollar, the incremental allocations to all cash flow uses must sum to one dollar.

reductions. The OLS estimates of cash flow should always satisfy the cash flow identity, whereas the measurement-error consistent estimates often violate the identity. The upshot here is that while the OLS estimators offer economically meaningful estimates of the cash flow allocation across various uses, the cumulant estimators offer error-corrected estimates of the cash flow allocation. Both estimation methods are therefore valid for use in our study.

Although the cash flow identity holds in the OLS regression, a common critique of interpreting cash flow coefficients in the OLS regression is that cash flow may contain information about a firm's growth prospects if growth prospects are not properly controlled for. As discussed, we address this problem by using measurement-error consistent estimators in all our regressions. To provide additional robustness to our findings, we employ an approach due to Butterworth (1930) and Pollock (2000) to decompose cash flow into a trend (permanent) component and a cycle (transitory) component. The trend component contains information about future cash flow and thus is likely to correlate with the error terms when growth prospects are not adequately controlled for. This is less likely for the cycle component that contains little information about the future beyond short-term fluctuations. Therefore, the coefficient for the cycle component can be reliably interpreted as estimates of the use of cash flow.

The study contributes to the economics of corporate liquidity. Controlling for all major uses of cash flow and q measurement error, we document that the propensity to dissave typically holds in both positive and negative cash flow environments. Firms find it optimal (i) to dissave out of positive cash flow in order to acquire more productive assets and (ii) to dissave in response to negative cash flow in order to finance unproductive assets that could prove to be valuable in the fututre. Economically, on average, firms dissave up to 35 cents out of a dollar of marginal cash inflow, and further dissave up to 45 cents in response to a dollar of negative cash flow. The results hold strongly in both OLS and error-corrected regressions, and are robust to cash flow decomposition. Our results extend the Riddick and Whited (2009)'s argument that firms counteract movements in cash flow with opposite movements in saving. We show that their argument generally holds when the firm yields positive cash flow but it does not necessarily hold when the firm yields negative cash flow.

We conduct additional analysis to ensure that our results are robust to augmented model specification. The results remain largely the same when we include the lagged value of the net PPE-to-assets ratio to measure the tangibility of firm assets, the lagged value of the total debt-to-assets ratio to control for leverage, the lagged value of the cash-to-assets ratio and the lagged value of the change in cash holdings to account for the dynamic nature of the saving process. Further, we compare the dissaving patterns in the subsamples of firms with large and small negative cash flows, and find that, although firms from both subsamples dissave in response to negative cash flows, the firms with large negative cash flows dissave significantly less. Facing deep negative productivity shocks, they are more likely to liquidate some of their unproductive assets and thus spend less from savings to support them.

Next, we test the possibility that, when facing negative cash flows, firms with costly external finance dissave differently from those with more established access to external finance. Our results conclude that the propensity to dissave in response to negative cash flow holds for both financially constrained and unconstrained firms. However, unconstrained firms are more likely to support their existing projects and continue to exploit their growth opportunities. They are more prone to dissave from their cash reserves (in order to invest) because they find it easier to obtain external finance. In contrast, constrained firms cannot readily support their projects and must give up good investment opportunities. They are more likely to spend less from their cash reserves (in order to preserve liquidity).

We further test the possibility that firms with more uncertain cash flows dissave differently from those with more stable (predictable) cash flows. Our results show that the propensity to dissave in a negative cash flow environment holds for firms with both high and low cash flow uncertainty, though it holds significantly stronger for the latter firms. Firms that do not face a great deal of uncertainty dissave more in response to negative productivity shocks. They find it easier to absorb negative shocks. Otherwise identical firms facing a great deal of uncertainty cannot make large changes in their savings in response to negative shocks.

We proceed to explore the possibility that cash-rich firms dissave differently from cash-poor firms. Our results indicate that cash-poor firms facing negative cash flow (productivity) shocks do not dissave or dissave significantly less than cash-rich firms. Cash-poor firms cannot completely absorb negative shocks because they are liquidity constrained. The results thus confirm the important role of cash liquidity for firm's propensities to save/disburse funds out of cash flow.

Finally, we address the question of whether firms ever save in response to negative cash flows, and find a relatively small subsample of unprofitable firms (12% of the total number of firm-years with negative cash flows) that tend to save in response to negative shocks. This propensity to save, however, holds under specific and rare condition: the level of a firm's cash flow loss must be lower than the rate of its disinvestment. In contrast, when the rate of disinvestment falls below the level of cash flow loss, which is by far the most common scenario (nearly 88% of the total number of firm-years), the propensity to dissave continues to hold.

The rest of the paper is organised as follows. In Section 2, we present the disinvestment model and derive the testable hypothesis. The subsequent section describes the data and empirical strategy. In Section 4, we present the outcome of the hypothesis tests. The last section concludes.

2 Disinvestment model and hypothesis derivation

2.1 Model setup

A value of waiting is present in various corporate decision problems that are characterized by irreversibility, uncertainty and flexibility. In this paper, we describe the value of waiting in the context of a simple disinvestment (or optimal stopping) problem.[7] We employ dynamic programming to derive our hypothesis. In contrast to standard stochastic real options models, we prefer a discrete time framework, although qualitatively similar results can be derived for an infinite time horizon.

Consider an existing asset (project) with a finite lifetime of three periods that earns an annual cash flow X_0 in period 0. The cash flow follows a binomial tree, i.e., in period 1 the cash flow will either increase by a value $z > 0$ with probability p or decrease by z with probability $1-p$. In period 2, the cash flow realizations are as follows: X_0+2z with probability p^2; X_0-2z with probability $(1-p)^2$; and X_0 with probability $2p(1-p)$.[8] A risk-neutral firm must decide whether to keep or abandon the asset. Liquidation of the asset yields a salvage value S in addition to the cash flow of the current period. The liquidation decision is irreversible so that the asset cannot be restored once it has been liquidated. Classical investment theory asserts that the asset should be terminated if the salvage value $S+X_0$ exceeds the continuation (holding) value $\hat{C}$, which is the expected value of the discounted cash flows. Consequently, the value of the asset, $\hat{V}_0$, is as follows:

$$\hat{V}_0 = \max(\hat{C}, S + X_0) \quad (1)$$

where

[7] Real option models are popular in agricultural, environmental and energy economics as well as in economic policy studies (Arrow and Fisher, 1974, Titman, 1985, Paddock et al., 1988, Quigg, 1993, Richards and Patterson, 2004, Sandri et al., 2010, among many others).

[8] $p(1-p)+(1-p)p = 2p(1-p)$ and $p^2+2p(1-p)+(1-p)^2 = 1$

$$\hat{C} = X_0 + \underbrace{(p(X_0+z) + (1-p)(X_0-z))q^{-1}}_{Period_1} +$$
$$\underbrace{(p^2(X_0+2z) + 2p(1-p)X_0 + (1-p)^2(X_0-2z) + S)q^{-2}}_{Period_2} \quad (2)$$

Here $q^{-1} = 1/(1+r)$ and $q^{-2} = 1/(1+r)^2$ are discount factors and r is an interest rate. The expectation of cash flows is build only on the information available in period 0. The decision here is simply a comparison between the two alternatives "holding of the asset" and "liquidation of the asset" in period 0. By equating the continuation (holding) value $\hat{C}$ defined in Eq.(2) and the salvage value $S + X_0$, we obtain the disinvestment trigger $\hat{X}_0$:

$$\hat{X}_0 = Sr - z(2p-1)(1 + \tfrac{1}{1+q}) \quad (3)$$

A disinvestment trigger marks the threshold level of the cash flow where it becomes optimal to disinvest. In each period the firm compares this normative threshold with the realization of the random cash flow. As long as the actual cash flow is larger than the disinvestment trigger, the asset should be held for use. According to the traditional NPV, the asset should be liquidated if the current cash flow falls below $\hat{X}_0$.

The situation is different if the decision on the asset liquidation can be deferred to period 1. The firm now has an abandonment option in period 0 that it can either exercise or keep alive until maturity (period 1 in our case). Deferring the decision has the potential advantage that it allows the firm to take into account new information that may emerge in period 1. Of particular interest is the situation where $X_0 - z < Sr < X_0 + z$, which implies that holding (liquidation) of asset is the optimal decision if the cash flow in period 1 increases (decreases). According to the options-based reasoning, the asset value $\tilde{V}_0$, which is also called the *strategic net present value* (Trigeorgis, 1996), is given by

$$\tilde{V}_0 = \max(\tilde{C}, S + X_0) \quad (4)$$

with a continuation value

$$\tilde{C} = X_0 + \underbrace{(p(X_0 + z) + (1-p)(X_0 - z + S))q^{-1}}_{Period_1} + \underbrace{(p^2(X_0 + 2z + S) + p(1-p)(X_0 + S))q^{-2}}_{Period_2} \quad (5)$$

The optimal disinvestment trigger referring to the options-based approach is

$$\tilde{X}_0 = Sr - z(2p - \tfrac{q}{p+q}) \quad (6)$$

Note that in contrast to the standard NPV, the second term of Eq.(5) addresses the holding and the termination of the asset, respectively, depending on whether an upward or downward movement of the cash flow occurs in period 1. The NPV decision rule generally differs from the optimal (options-based) decision rule. This difference occurs for two main reasons. First, the classical NPV of the asset, $\hat{V}_0$, is less than or at most equal to $\tilde{V}_0$ ($\hat{V}_0 \leq \tilde{V}_0$). Second, disinvestment triggers built on these strategies may deviate ($\hat{X}_0 \neq \tilde{X}_0$). The difference between the two disinvestment triggers amounts to

$$\hat{X}_0 - \tilde{X}_0 = \tfrac{z(1-p)(2p+q)}{(1+q)(p+q)} > 0 \quad (7)$$

Apparently, $\tilde{X}_0$ is smaller than $\hat{X}_0$ as long as $p > 0$.

Two simple numerical examples illustrate the difference between the two decision rules. First, assume that an initial positive cash flow X_0 = 10, an upward movement z = 5 with probability p = 0.3, a salvage value S = 80 and an interest rate r = 10%. The disinvestment trigger according to the NPV rule (in Eq.(3)) is $\hat{X}_0 = 11$. The initial cash flow falls below this trigger; thus, the asset should be immediately liquidated and the proceeds from liquidation should be returned to the "savings account". In contrast, the real options approach (in Eq.(6)) suggests a disinvestment trigger $\tilde{X}_0 = 8.9$, and thus keeping the asset alive is optimal.

Second, assume that an initial negative cash flow X_0 = -5, an upward movement z = 40 with probability p = 0.5, a salvage value S = 50 and an interest rate r = 10%.

The disinvestment trigger according to the NPV is $\hat{X}_0 = 5$. Thus, the asset should be immediately liquidated and the proceeds from liquidation saved. In contrast, the options-based approach indicates a disinvestment trigger $\tilde{X}_0 =$ -7.5. Thus, it is optimal to tolerate negative cash flow and keep the asset for use.

Overall, the rational firm considers the asset value $\tilde{V}_0$ and the disinvestment trigger $\tilde{X}_0$. By obeying these options-based decision rules, the rational firm tolerates lower positive/larger negative cash flows before terminating an asset compared with a naive firm that follows the traditional NPV disinvestment rules and thus ignores the value of waiting. It is therefore natural to suggest that firms often find it optimal to absorb negative cash flows and keep funding existing asses (ongoing projects) from available cash reserves.[9] This prediction can be expressed as the following hypothesis in the alternate form.

$\mathbf{H}_1$: *Facing negative cash flow (productivity) shocks, firms may prefer to tolerate the shocks and dissave from their cash reserves.*

Our hypothesis predicts that the propensity to dissave should dominate in a negative cash flow environment. This prediction extends the Riddick and Whited (2009)'s argument that firms counteract movements in cash flow with opposite movements in saving. Their argument should generally hold when the firm yields positive cash flow. Our argument should be valid when the firm yields negative cash flow.

2.2 Model extenstions

Our model further suggests that the firm tolerates lower cash flows if the degree of uncertainty in asset returns increases. Increasing uncertainty can be considered via a mean-preserving spread of the cash flow. The spread can be implemented by increasing the additive cash flow shock z, so that $z' > z$. The optimal disinvestment trigger $\tilde{X}_0$ in

[9]As discussed, the firm incurring cash flow losses may have no or limited access to external financing to borrow its cash flow deficit.

Eq.(6) can be modified by replacing z by z'. The modified trigger $\tilde{X}_0'$ is smaller than $\tilde{X}_0$ if $p = 0.5$. In the second numerical example discussed above, if we increase the additive cash flow shock z from 40 to 50 (that is, we add more uncertainty) and remain all other parameters unchanged, the NPV disinvestment trigger $\hat{X}_0$ will stay at 5 while the optimal disinvestment trigger $\tilde{X}_0'$ will decline from -7.5 to -10.6. In other words, the firm prefers to tolerate larger negative cash flows when the uncertainty associated with the asset is higher. Given that uncertainty is usually high for unproductive assets, this model extension further contributes to the development of our H_1.[10]

Thus far, we derive the disinvestment triggers assuming a risk-neutral firm. Real options are typically based on a risk neutral valuation framework that ignores subjective risk preferences. However, the standard assumption of financial option pricing, which requires the existence of a riskless hedging portfolio, is rarely fulfilled in the context of real options. It is therefore problematic to ascertain whether disinvestment inertia is caused by option effects or simply by risk aversion. Dixit and Pindyck (1994) posit that risk preferences are relevant for the valuation of real options if it is impossible to set up a replicating portfolio of traded assets, which duplicates the stochastic outcome of the (dis)investment project under consideration. Such a duplication is problematic in most real-life decisions on real options. To mitigate this problem, the valuation of a risky project can be conducted in an expected utility framework either by replacing uncertain outcomes with their certainty equivalent or by using risk-adjusted discount factors. If we denote the risk-adjusted interest rate $r^* > r$ and discount factor $q^* = 1 + r^*$, we can then modify the disinvestment triggers in Eq.(3) and (6). Apparently, risk aversion increases the disinvestment triggers of both standard and options-based decision rules. Although risk-averse firms disinvest earlier in this case, they still value the option to

[10] We acknowledge that a higher degree of uncertainty reduces the optimal disinvestment trigger, but at the same time the probability of passing a certain trigger level also increases. Thus, the effect of the uncertainty on the first passage time of the stochastic process can be ambiguous.

wait longer for new information, and thus choose to tolerate lower cash flows and forgo termination decisions. In conclusion, the changes in the risk preferences of the firm should not question the validity of our H_1.

3 Empirical methodology, data and variables

3.1 Regression model and cash flow identity

Following Gatchev et al. (2010) and Chang et al. (2014), we use the following cash flow accounting *identity* defined using flow-of-funds data:

$$CF_t = \Delta Cash_t + Inv_t + \Delta WC_t + Div_t - \Delta D_t - \Delta E_t, \quad (8)$$

where the change in cash holdings ($\Delta Cash$), investment (Inv), the change in working capital (ΔWC), and cash dividends (Div) are the uses of funds. The sources of funds include cash flow (CF), the net debt issuance (ΔD), and the net equity issuance (ΔE). For investment, working capital, payout, issuance and repurchase activities, we consider those that are associated with actual cash inflows or outflows. The activities generating no cash flow to the firm are excluded from our analysis. **Table 1** describes how the regression variables are constructed from Compustat definitions. All flow-of-funds variables are scaled by total assets.

Some studies define cash flow as operating cash flow, net of the change in working capital (Dasgupta et al., 2011). They remove the effect of the change in working capital to mitigate the concern that investment and working capital accruals, which are non-cash component of earnings, are correlated. They argue that the sensitivity of investment to cash flow is mainly due to the naturally positive correlation between fixed capital investments and working capital accruals. However, this problem is unlikely to bias our inferences as we focus on the relation between saving (not fixed investment) and cash flow. No significant correlation exists between the change in cash holdings and non-cash working capital accruals. Hence we retain the change in working capital as a standalone use of funds in our regressions.

In our baseline empirical model, we regress the change in cash holdings (saving) on cash flow (CF), the market-to-book ratio (q) as a proxy for investment opportunities, and firm size ($Size$). This saving model resembles that by Riddick and Whited (2009). We then create the indicator variable NEG, which is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. This variable reveals negative income and its cross-product terms with cash flow, $CF * NEG$ and $CF * (1 - NEG)$, determine how firms' propensities to save/disburse funds vary with the sign of cash flow. This augmented saving model allows us to test whether firms' saving/dissaving behavior changes in different cash flow environments. We further include firm (f) and year (y) fixed effects to control for unobserved heterogeneity and time effects, respectively. The main regression equation of interest is therefore written as follows:

$$\Delta Cash_{it} = \alpha^{\Delta Cash}(CF_{it} * NEG_{it}) + \beta^{\Delta Cash} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{\Delta Cash} q_{it} + \delta^{\Delta Cash} Size_{it} + f_i + f_t + \epsilon_{it}^{\Delta Cash} \quad (9)$$

The system of regression equations that provides a complete view of cash flow allocations is as follows:

$$Inv_{it} = \alpha^{Inv}(CF_{it} * NEG_{it}) + \beta^{Inv} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{Inv} q_{it} + \delta^{Inv} Size_{it} + f_i + f_t + \epsilon_{it}^{Inv} \quad (10)$$

$$\Delta WC_{it} = \alpha^{\Delta WC}(CF_{it} * NEG_{it}) + \beta^{\Delta WC} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{\Delta WC} q_{it} + \delta^{\Delta WC} Size_{it} + f_i + f_t + \epsilon_{it}^{\Delta WC} \quad (11)$$

$$Div_{it} = \alpha^{Div}(CF_{it} * NEG_{it}) + \beta^{Div} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{Div} q_{it} + \delta^{Div} Size_{it} + f_i + f_t + \epsilon_{it}^{Div} \quad (12)$$

$$\Delta D_{it} = \alpha^{\Delta D}(CF_{it} * NEG_{it}) + \beta^{\Delta D} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{\Delta D} q_{it} + \delta^{\Delta D} Size_{it} + f_i + f_t + \epsilon_{it}^{\Delta D} \quad (13)$$

$$\Delta E_{it} = \alpha^{\Delta E}(CF_{it} * NEG_{it}) + \beta^{\Delta E} CF_{it} * (1 - NEG_{it}) +$$
$$\gamma^{\Delta E} q_{it} + \delta^{\Delta E} Size_{it} + f_i + f_t + \epsilon_{it}^{\Delta E} \quad (14)$$

The accounting identity implies that (i) sources of cash funds must equal uses of cash funds, and (ii) cash flow must equal uses of cash flow. Because all cash flow uses must absorb a cash flow shock completely, if cash flow increases by one dollar, the incremental allocations to all cash flow uses must sum to one dollar. It means that a one-dollar increase in cash flow needs to be used to increase investment, increase cash holdings, pay dividends, reduce debt, or buy back shares. This integrated regression framework accounts for the interdependence among cash flow allocations and thus produces consistent CF coefficient estimates.

The coefficient estimates in Eq.(9) to (14) must satisfy the following conditions:

$$\alpha^{\Delta Cash} + \alpha^{Inv} + \alpha^{\Delta WC} + \alpha^{Div} - \alpha^{\Delta D} - \alpha^{\Delta E} = 1 \quad (15)$$

$$\beta^{\Delta Cash} + \beta^{Inv} + \beta^{\Delta WC} + \beta^{Div} - \beta^{\Delta D} - \beta^{\Delta E} = 1 \quad (16)$$

$$\gamma^{\Delta Cash} + \gamma^{Inv} + \gamma^{\Delta WC} + \gamma^{Div} - \gamma^{\Delta D} - \gamma^{\Delta E} = 0 \quad (17)$$

$$\delta^{\Delta Cash} + \delta^{Inv} + \delta^{\Delta WC} + \delta^{Div} - \delta^{\Delta D} - \delta^{\Delta E} = 0 \quad (18)$$

Constraints in Eq.(15) and (16) are consistent with the cash flow accounting identity. Constraints in Eq.(17) and (18) stipulate that the total response across different sources and uses of cash funds must sum to zero if the shock stems from an exogenous or predetermined variable that represents neither a source nor a use of funds. If the variables in Eq.(8) are consistently defined so that the cash flow identity holds in the data, the constraints should hold automatically. **Appendix 1** confirms that the adding-up constraints hold in our data.

Last, given that the same set of explanatory variables is included in each regression equation, we can use OLS to estimate Eq.(9) to (14). In this case, our unconstrained equation-by-equation OLS estimates are identical to the constrained seemingly unrelated regressions' estimates. Thus, there is no need to use the SUR estimation and impose constraints in Eq.(15) to (18) explicitly.

3.2 *Q* measurement-error consistent methodology

In addition to OLS, we estimate our saving model in Eq.(9) by linear errors-in-variables regression with identification from higher order cumulants. In this, we follow Erickson et al. (2014) who developed the q measurement-error remedy that is asymptotically equivalent to the moment estimators in Erickson and Whited (2000, 2002). The method obtains consistent estimates of slope coefficients in the presence of measurement error. Specifically, we consider estimation of a linear model with multiple mismeasured and perfectly measured regressors:

$$Y_i = X_i\beta + Z_i\alpha + \mu_i, \quad (19)$$

$$x_i = X_i + \epsilon_i, \quad (20)$$

in which Y_i is the dependent variable (saving), X_i is a vector of unobservable regressors, Z_i is a vector of perfectly measured regressors, and μ_i is the disturbance. x_i is the proxy for X_i, and ϵ_i is the measurement error. In our case, X_i is the unobservable marginal q, and x_i is the average or empirical Tobin's q. By substituting Eq.(20) into (19), we have $Y_i = x_i\beta + Z_i\alpha + \nu_i$, in which $\nu_i = \mu_i - \beta\epsilon_i$. The correlation between x_i and ν_i causes the estimate of β to be biased *downward.* If there is a positive correlation between the mismeasured q and the perfectly measured regressor α (cash flow), the attenuation bias causes the coefficient of the cash flow regressor to be biased *upward.*

To control for the q measurement error, the errors-in-variables regression can implement either the cumulant estimators or moment estimators. The moment and cumulant estimators are asymptotically equivalent, but the cumulant estimators are an advance beyond the moment estimators. Overidentified moment estimators require a numerical minimization and starting values for this minimization, but cumulant estimators are linear and have a closed-form solution.[11] This feature of cumulants eliminates starting-value selection for the parameters, which is important, given the sensitivity of moments to starting values documented in Erickson and Whited (2012). The number of order is an empirical choice. Generally, the more data one has, the higher the order one can use. We use orders of three to five in all our regressions.

The R^2 of the regression (Rho) and the R^2 of measurement equation (Tau), which is an index of measurement quality, are reported. The Tau index ranges between zero and one, with zero indicating a worthless proxy and one indicating a perfect proxy. Low proxy quality (well below 0.5) is expected in the saving regression model, where measurement error typically stems from large conceptual gap between the q empirical proxy and the underlying true variable (unobservable investment opportunities set).

3.3 Cash flow decomposition

To provide additional robustness to our evidence, we decompose cash flow into trend (permanent) and cycle (transitory) components. Specifically, we apply a method described in Pollock (2000), which is a variation of the Butterworth filter (Butterworth, 1930; henceforth BW) tailored toward economic applications. The BW filter separates a time-series y_t into trend τ_t and cyclical c_t components:

$$y_t = \tau_t + c_t,$$

[11] The underlying estimating equations are linear in the third and higher-order cumulants of the joint distribution of the observable variables. Because these estimators do not require any information beyond that contained in the observable regressors, they are practical to implement. However, because third and higher-order cumulants equal zero for normal distributions, these estimators require non-normality of the mismeasured regressor (Tobin's q).

in which $t = 1, ..., T-1$ and $c_t \sim N(0, \sigma^2)$. τ_t may be nonstationary. It may contain a deterministic or stochastic trend. BW filter initially estimates c_t, a stationary cyclical component that is driven by stochastic cycles within a specified range of periods. The trend component τ_t is simply the difference $\tau_t = y_t - c_t$.

The BW filter blocks lower-frequency stochastic cycles while passing through stochastic cycles that are at or above a specific frequency. The gain function of the filter is as close as possible to being a flat line at 0 for the unwanted periods and a flat line at 1 for the desired periods. According to Pollock (2000), the gain function of the BW filter is given by

$$\psi(\omega) = [\{1 + \tfrac{tan(\omega_c/2)}{tan(\omega/2)}\}^{2m}]^{-1},$$

in which m is the order of the filter, $\omega_c = 2\pi/p_h$ is the cut-off frequency, and p_h is the maximum period of stochastic cycles filtered out. Following common practice, we set p_h to 8 years in our annual data. We set the order of the filter to 2.

One could write the series to be filtered, y_t, in terms of zero mean, covariance stationary, and i.i.d. shocks ν_t and ϵ_t:

$$y_t = \tfrac{(1+L)^m}{(1-L)^m}\nu_t + \epsilon_t,$$

in which L is the lag operator which moves forward and backward over y_t. From this equation, Pollock (2000) shows that the optimal estimate for the cyclical component is given by

$$\mathbf{c} = \lambda \mathbf{Q}(\Omega_L + \lambda\Omega_H)^{-1}\mathbf{Q}'\mathbf{y},$$

in which $\lambda = \{tan(\pi/p_h)\}^{-2m}$, $\Omega_L = \text{Var}\{\mathbf{Q}'(\mathbf{y} - \mathbf{c})\}/\sigma^2_\nu$, and $\Omega_H = \text{Var}\{\mathbf{Q}'\mathbf{c}\}/\sigma^2_\epsilon$. The parameter λ is thus a function of p_h and the order of the filter m. Here Ω_L and Ω_H are symmetric Toeplitz matrices. The matrix $\mathbf{Q}'$ is a function of the coefficients in the polynomial $(1-L)^d = 1 + \delta_1 L + ... + \delta_d L^d$.

After obtaining the trend and cycle components of cash flow, we scale both components by the book value of assets to get CF_trend and CF_cycle.

3.4 Data

The sample includes U.S. non-financial firms from the Compustat Industrial Annual files. The data constitute an unbalanced panel that covers 1984 to 2016. We use the flow-of-funds data to define variables in the cash flow identity. We set the starting point of our sample at 1984, since this is the year that Compustat starts to report flow-of-funds data extensively. Dollar values are converted into 2005 constant dollars.

Following common practice, we exclude firms with SIC codes ranging from 4900 to 4999 (regulated firms), 6000 to 6999 (financial firms), and greater than 9000 (miscellaneous). We deal with outliers in three ways. First, we require firms to provide valid information on the regression variables used in Eq.(9) to (14). Second, we drop firm-years for which the market (book) value of assets is below \$1 million and those with annual sales revenue below \$1 million. Third, we trim the top and bottom 0.5% of the regression variables.

To ensure that the cash flow identity holds in our data, we exclude observations for which the absolute value of the difference between the left-hand and right-hand sides of Eq.(8) is greater than 1% of total assets. To ensure that the BW decomposition of cash flow can be performed with a reasonably long time series, we restrict the sample to firms with at least 15 non-consecutive years of cash flow data. The final sample includes 53,463 firm-years.

3.5 Summary statistics

Table 2 reports summary statistics for the main regression variables. The average ratio of cash flow to assets is 7.0%. Negative cash flow observations constitute 16.7% of the sample, whereas positive cash flow observations - 83.3%. The average ratio of negative cash flow to assets is -2.6%, whereas the average ratio of positive cash flow to assets is 9.6%. On average, the sample firms every year increase cash holdings by 0.7% and working capital by 1.3%, invest 7.4%, pay out as dividends 0.9%, raise in equity financing 2.4%, and borrow 0.8% of total assets. The mean (median) Tobin's q is 1.78 (1.38). The mean is much larger than the median. Because the conditions require non-normality of the mismeasured regressor, this skewness is essential for identifying the slope coefficient in the measurement-error consistent estimations. The average number of observations per year is 1,620. Because the cumulant estimators require a great deal of data, the large number of observations is important.

As discussed in the previous section, we exclude observations for which the absolute value of the difference between the left-hand and right-hand sides of Eq.(8) is greater than 1% of total assets. Thus, the cash flow identity holds well in our sample, albeit not perfectly. DIF is the difference between the left-hand and right-hand sides of the cash flow identity. The mean, median, and standard deviation of DIF are 0, 0, and 0.001, respectively.

The mean of the cycle component of cash flow is close to zero, confirming its basic feature of a zero-mean stationary process. In contrast, the trend component has the mean of 7.2%, which is almost the same as the mean value of the level of cash flow. The untabulated correlation coefficient between the trend and the cycle components, both scaled by book value of assets, is -0.08, which is significant at the 1% level. The negative correlation coefficient between the two components confirms that the cycle component reflects short-term momentum, while the trend component captures a persistent shock to future cash flow growth.

The untabulated pairwise correlation between $\Delta Cash$ and CF is 0.22 and significant at the 1% level. A positive correlation coefficient makes sense in that, on average, firms should save part of their cash flows and invest the rest or return it to shareholders/creditors. Also, because CF and q are positively correlated, a small downward bias in q can cause a large upward bias in the linear regression estimate of the cash flow coefficient. Hence, the use of measurement-error consistent estimators is warranted.

4 Results

4.1 The corporate propensity to (dis)save

Table 3 presents the results of a baseline saving model in Eq.(9). We report the results obtained using the OLS (column 1) and the third- through fifth-order cumulant estimators (columns 2 though 4), and using data in the level form (Panel A) and in the within-transformation form (Panel B).[12] The results from the cumulant estimators are sharply different from the OLS results but nearly identical to each other in the higher orders. OLS produces a positive coefficient on $CF*(1-NEG)$ and a small coeffcient on q, while the cumulant estimators produce a negative coefficient on $CF*(1-NEG)$ and a much larger coeffcient on q. The measurement error in q biases the OLS estimate of cash flow upward and that of q downward. The cumulant estimators also deliver higher estimates of the regression R^2 than does OLS, and we estimate the measurement quality of q to be quite low, approximately 28%. Controlling for the measurement bias, the propensity to dissave out of (positive) cash flow holds in the data. Firms dissave up to 35 cents out of a dollar of cash flow. This result is consistent with that by Riddick and Whited (2009).

More importantly for our study, the estimated coefficient on a negative cash flow

[12] Transforming the observations for each firm into deviations from the firm-specific average is a remedy for biases caused by the correlation between firm fixed effects and regressors. However, within transformation may cause the identification condition to be violated in the resulting model. Erickson and Whited (2000, 2012) therefore use data in the level form. We report the results obtained using data in both the within-transformation and the level forms.

($CF * NEG$) is positive and significant in all tests performed. Firms dissave up to 45 cents in response to a dollar of negative cash flow. This new result indicates that the propensity to dissave holds in a negative cash flow environment; that is, firms with negative cash flows experience a downward drift in cash holdings. They find it optimal not to liquidate unproductive assets but to use cash holdings to absorb negative shocks and wait for new information about assets' future cash flows. The results support our hypothesis.

Next, we decompose cash flow into a trend (permanent) and a cycle (transitory) component. The results are reported in **Table 4**. While the trend component contains information about future growth opportunities, the cycle component should be less subject to this critique. We first notice that for both components, the coefficient estimates on positive cash flow are positive in OLS and are negative in error-corrected regressions. Consistent with the critique that cash flow contains information about future growth, and that the trend component is much more subject to this concern than the cycle component, we find that the OLS coefficient of the trend component (0.08, t = 9.2) is two times smaller than that of the cycle component (0.17, t = 13.4). Firms tend to save less (invest more) in response to the information about future growth contained in the trend component. However, once we control for the q attenuation bias, the cumulant estimators return no significant difference between the trend component and the cycle component. This result is expected because the treated (corrected) q summarizes information about the attractiveness of future growth opportunities and thus capitalizes the value of holding cash to the firm. Finally, and most importantly, regardless of whether the cash flow decomposition or the error-corrected cumulant estimator is used, the coefficient estimate on negative cash flow remains positive and statistically significant. The propensity to dissave in response to negative cash flow shocks continues to hold.

Table 5 presents the results returned from an augmented saving model. We extend the baseline saving model in Eq.(9) by adding several control variables, namely the lagged value of the net PPE-to-assets ratio ($L.Tangibility$) to measure the tangibility of firm assets; the lagged value of the total debt-to-assets ratio ($L.Leverage$) to control for leverage; the lagged value of the cash-to-assets ratio ($L.Cash$) and the lagged value of the change in cash holdings ($L.\Delta Cash$) to account for the dynamic nature of the saving process. The addition of these new controls does not significantly change the statistical inferences drawn in the previous tests. The error-corrected coefficient estimate on q is up to seven times the size of its OLS estimate. The OLS estimator produces a positive coefficient on the positive cash flow variable, whereas the cumulant estimator - a negative coefficient. Both the OLS and cumulant estimators produce a consistently positive coefficient on the negative cash flow variable. The results continue to support our hypothesis that negative cash flow (productivity) shocks cause a downward drift in cash holdings. The control variables have their expected signs.

4.2 The corporate propensity to (dis)save and cash flow losses

It is natural to examine the conjecture that firms with different magnitudes of cash flow losses may exhibit different magnitudes of dissaving propensity. It is possible that firms suffering from large operating losses may abandon/scale down some of their investment projects to stop/reduce their cash outflows. This decision to abandon or cut funding for the unproductive assets should manifest itself in a *lower* propensity to dissave. Conversely, firms experiencing relatively small operating losses may continue to fund their projects and draw down their cash reserves. This decision to continue to hold the unproductive assets should result in a *higher* propensity to dissave. To examine this possibility, we estimate dissaving propensities in the subsample of firms with strictly large and small cash flow losses. We classify the current-period negative cash flow as large (small) if it exceeds (falls below) the sum of the beginning-of-period cash holdings and tangible assets. The reason for this classification is that the firm should hold sufficient liquid and collateral assets to buffer against cash flow losses. We then introduce the indicator variable $Shock$, which is equal to unity (zero) if the current-period negative cash flow is classified as large (small), and its cross-product terms with cash flow $CF * Shock$ and $CF * (1 - Shock)$.

Table 6 reports the results, again with Panels A and B and containing results from using data in the level form and in the within-transformation form, respectively. Three results stand out in the table. First, the OLS and error-corrected coefficient estimates on negative cash flow are consistently positive. These results indicate that firms spend cash reserves and absorb cash flow losses, regardless of the absolute magnitudes of the losses. Second, firms with large cash flow losses dissave significantly less than do firms with small losses. Specifically, the OLS coefficient estimate on $CF * Shock$ stands at 0.07 (t = 3.8), while the coefficient estimate on $CF * (1 - Shock)$ - at 0.47 (t = 9.3). The error-corrected coefficient estimate on $CF * Shock$ varies from 0.26 (z = 6.6) to 0.37 (z = 10.0), while the coefficient estimate on $CF * (1 - Shock)$ - from 0.64 (z = 8.0) to 0.92 (z = 13.1). These results suggest that, facing deep negative producivity shocks, firms are likely to abandon/scale down some of their unproductive projects and thus spend less from their cash reserves. Third, the Sargan tests of the overidentifying restrictions do not reject. Our saving model is likely to be well specified.

4.3 The corporate propensity to (dis)save and financial constraints

We test the possibility that firms with costly external finance save/dissave differently from those with more established access to external finance. No perfect measure of the severity of finance constraints exists. Still, we use two popular schemes to sort firms into financially constrained and unconstrained categories: cash payout and asset size.[13] First, financial constraints are more binding on firms not paying dividends and not returning cash to shareholders. Consequently, non-dividend-paying and non-stock-repurchasing firms are treated as financially constrained, while dividend-paying or stock-repurchasing firms - as unconstrained. The sortings are performed on an annual basis. Second, the size of the firm is often used as an indicator of the cost of raising external funds. Large and mature firms are considered to have better access to external finance than small and young firms. Consequently, firms with an asset size above the 67th percentile (below the 33rd percentile) of the size distribution in year t are considered financially unconstrained (constrained).

We report the results in **Table 7**. In OLS, the set of constrained firms displays a stronger response of saving to positive cash flow than does the set of unconstrained counterparts. The OLS coefficient estimate on cash flow varies between 0.17 (t = 13.0) and 0.27 (t = 13.2) for constrained firms, while it varies between 0.03 (t = 2.5) and 0.14 (t = 7.7) for unconstrained firms. The difference between the two sets is significant at better than the 1% level. When we apply higher-order cumulant estimators, the coefficient estimate on positive cash flow is negative and significant at better than the 1% level. The set of constrained firms displays a smaller negative response of saving to cash flow than does the set of unconstrained firms. The error-corrected cash flow coefficient varies between -0.07 (z = -1.8) and -0.30 (z = -8.8) for constrained firms, while it varies between -0.38 (z = -5.9) and -0.51 (z = -10.7) for unconstrained firms. The difference between the two sets is significant at better than the 1% level. This result is similar to that in OLS inasmuch as the cash flow coefficient for the constrained firms exceeds that for the unconstrained firms. The error-corrected cash flow coefficient is

[13]For robustness check, we also consider the Whited-Wu index (Whited and Wu, 2006) Firms with index values above the 67th percentile (below the 33rd percentile) of the index distribution for one-digit SIC industry f in year t are considered financially constrained (unconstrained). The unreported results are similar to those reported for the cash payout and asset size classification schemes.

simply shifted down from its inflated counterpart in OLS.

Importantly, the estimated coefficient on negative cash flow is positive. The OLS coefficient varies between 0.18 (t = 3.3) and 0.32 (t = 7.3), while the error-corrected coefficient - between 0.38 (z = 6.5) and 0.67 (z = 14.9). The propensity to dissave in response to negative cash flow holds for both financially constrained and unconstrained firms. The coefficient for the unconstrained firms is somewhat larger (but not always significantly larger) than that for the constrained firms. This result may suggest that, facing negative cash flows, unconstrained firms are more likely to support their existing projects and exploit new growth opportunities. They are more prone to dissave (in order to invest) because they find it easier to obtain external finance. In contrast, constrained firms cannot support all their projects and must give up new investment opportunities. They are more likely to spend less from their cash reserves. Our constraint measures can proxy for project sustainability so it is harder for financially constrained firms to keep funding current projects using cash reserves. As a result, they may find it optimal to terminate/scale down some projects with negative cash flows.

4.4 The corporate propensity to (dis)save and cash flow uncertainty

In this section, we test the possibility that firms with uncertain cash flows save/dissave differently from those with stable cash flows. To differentiate sample firms according to their degree of cash flow uncertainty, we estimate the standard deviation of the residuals from a first-order AR(1) autoregression of cash flow by firm. Firms with their respective volatilities in the top (bottom) third of the distribution are considered as having high (low) cash flow uncertainty (σ).

We report the estimation results in **Table 8**. The high uncertainty group has a cash flow coefficient that is statistically different both from zero and from the coefficient in the low uncertainty group. The OLS coefficient on positive cash flow ranges from 0.17 (t = 11.3) to 0.22 (t = 11.8) in the high uncertainty group, whereas it ranges from 0.00 (t = 0.3) to 0.02 (t = 0.7) in the low uncertainty group. The difference is significant at better than the 1% level. The error-corrected coefficient on positive cash flow ranges from -0.15 (z = -3.8) to -0.20 (z = -5.5) in the high uncertainty group, whereas it ranges from -0.69 (z = -6.0) to -0.92 (z = -8.3) in the low uncertainty group. The difference is significant at better than the 1% level. The results confirm that saving (dissaving) propensities are higher (lower) if cash flow uncertainty is higher. As a firm's cash flow environment becomes more uncertain, the firm will become less willing to dissave because it does not react to the small amount of information on productivity contained in highly uncertain cash flows. Further, this decrease in cash spending accompanying an increase in cash flow uncertainty has a real options interpretation in which a higher cash flow uncertainty leads to a higher option value of holding cash.

The estimated coefficients on negative cash flow are positive. The OLS coefficient varies between 0.22 (t = 15.9) and 0.33 (t = 3.3), while the error-corrected coefficient - between 0.38 (z = 16.1) and 1.16 (z = 6.0). The propensity to dissave in response to negative cash flow holds for firms with both high and low degrees of uncertainty. Also, the error-corrected coefficient on negative cash flow in the low uncertainty group is significantly larger than that in the high uncertainty group. These results indicate that firms that do not face a great deal of uncertainty dissave more in response to negative cash flow (productivity) shocks. They find it easier to absorb negative shocks. Otherwise identical firms facing a great deal of uncertainty do not make large changes in cash reserves in response to negative shocks. They simply cannot dissave as much.

4.5 The corporate propensity to (dis)save and cash reserves

We now proceed to examine how saving/dissaving propensities vary with the level of cash available to the firm. For instance, firms with high (low) cash reserves may tend to dissave more (less) in response to negative cash flow shocks because they are less (more) liquidity constrained. To test this possibility, we sort our sample firms by the cash ratio which is defined as cash and its equivalents over total assets. Firms in the top (bottom) third of the distribution are defined as cash-rich (cash-poor). The sortings are performed on an annual basis. The mean cash-to-assets ratio for cash-rich firms is 0.38, whereas it is only 0.02 for cash-poor firms.

The estimation results are in **Table 9**. The most interesting finding from our point of view is that, in a negative cash flow environment, cash-poor firms do not dissave (the estimated OLS coefficient on $CF * NEG$ is insignificant) or dissave less (the estimated error-corrected coefficient on $CF * NEG$ is significantly smaller) than cash-rich firms. Cash-poor firms cannot completely aborb negative cash flow shocks because they are more liquidity constrained. The regression results on the saving/dissaving behavior in a positive cash flow environment are rather mixed: cash-poor firms exhibit smaller propensities to save in the OLS regression, but do not exibit differential propensities to dissave in the error-corrected regression. In sum, the evidence obtained here confirms the important role of liquidity in determing the firm's dissaving behavior in a negative cash flow environment.

In unreported results, we also estimate saving/dissaving propensities in a small subsample of firms with zero cash balances (324 firm-year observations with reported zero values). Not suprisingly, the estimated coefficients on $CF * (1 - NEG)$ and $CF * NEG$ are insignificant in both OLS and q error-corrected regressions. This result further affirms the important role of cash reserves for firms' propensities to save/disburse funds out of cash flow.

4.6 Do firms ever save in response to negative cash flows?

Our disinvestment model predicts that firms rationally tolerate negative cash flow (productivity) shocks and do not liquidate/terminate their unproductive assets/projects. Instead, they prefer to reduce their cash balances (dissave) to absorb negative shocks. Our empirical results strongly support this prediction. Further, the model indicates a disinvestment trigger, or the critical level of the negative cash flow, where it becomes optimal to disinvest and thus return the proceeds from disinvestment to the "savings account" (save). Unfortunately, we cannot directly estimate the disinvestment triggers because we do not have the data on individual projects. However, at the firm level, we can observe the rates of aggregate disinvestment and the sizes of negative cash flows. According to our disinvestment model and accounting identity (discussed in section 3.1), the firm should increase its cash balances (save) in periods when the cash inflows from disinvestment exceed the cash outlows caused by negative income shocks.

To test this prediction, we impose the following restrictions to the firm in year t: (i) negative cash flow ($CF < 0$), (ii) negative investment (disinvestment) ($Inv < 0$), and (iii) the absolute value of negative investment must exceed that of negative cash flow ($|CF| < |Inv|$). The resulting sample includes 1,074 observations, or nearly 12% of the total number of firm-year observations with negative cash flow. Because of a relatively small number of observations, the saving model is estimated using the OLS estimator only (recall that the higher-order cumulant estimators require a greater deal of data). As before, we tabulate the regression results obtained using data in the level form and in the within-transformation form.

Table 10 reports the results. The estimated coefficient on negative cash flow is *negative* at a statistically significant level. This result suggests that the firm saves in response to negative cash flow when its rate of disinvestment exceeds its level of cash flow loss. This empirical result is however rare and observed only in a small subsample of firms with negative income. It also requires often implausible conditions. In contrast, when the rate of disinvestment falls below the level of cash flow loss, which is the most common and plausible scenario (corresponds to 88% of the total number of firm-year observations with negative income), the propensity to dissave continues to hold.

5 Conclusion

We study the effect of disinvestment inertia on firms' propensity to save/dissave out of cash flow. We apply real options reasoning to explain the tendency to postpone disinvestment decisions and, contrary to previous evidence, find that firms do not disinvest and do not save the proceeds from disinvestment in response to negative cash flows. In contrast, firms tolerate both large and small negative cash flows and dissave from their cash reserves. This behavior reflects firms' rational choices to absorb cash flow losses and to retain the flexibility to continue with temporarily unproductive assets. Our findings are remarkably robust to the degrees of financial constraints and cash flow uncertainty, and also to the level of cash reserves. Finally, we find only a relatively small subsample of firms in which negative cash flows cause the firm to save cash. In conclusion, the corporate propensity to dissave dominates in a negative cash flow environment.

References

[1] Almeida, H., Campello, M., Weisbach, M., 2004. The cash flow sensitivity of cash. *Journal of Finance* 59, 1777-1804.

[2] Almeida, H., Campello, M., Galvao, A., 2010. Measurement errors in investment equations. *Review of Financial Studies* 23, 3279-3382.

[3] Arrow, K., Fisher, A., 1974. Environmental preservation, uncertainty, and irreversibility. *Quarterly Journal of Economics* 88, 312-319.

[4] Butterworth, S., 1930. On the theory of filter amplifiers. *Experimental Wireless and the Wireless Engineer* 7, 536-541.

[5] Chang, X., Dasgupta, S., Wong, G., Yao, J., 2014. Cash flow sensitivities and the allocation of internal cash flow. *Review of Financial Studies* 27, 3628-3657.

[6] Dasgupta, S., Noe, T., Wang, Z., 2011. Where did all the dollars go? The effect of cash flows on capital and asset structure. *Journal of Financial and Quantitative Analysis* 46, 1259-94.

[7] Dewatripont, M., Roland, G., 1995. The design of reform packages under uncertainty. *American Economic Review* 85, 1207-1223.

[8] Dixit, A., 1992. Investment and hysteresis. *Journal of Economic Perspectives* 6, 107-132.

[9] Dixit, A., Pindyck, R., 1994. Investment under uncertainty. *Princeton University Press.*

[10] Erickson, T., Whited, T., 2000. Measurement error and the relationship between investment and q. *Journal of Political Economy* 108, 1027-1057.

[11] Erickson, T., Whited, T., 2002. Two-step GMM estimation of the errors-in-variables model using higher order moments. *Econometric Theory* 18, 776-799.

[12] Erickson, T., Whited, T., 2012. Treating measurement error in Tobin's q. *Review of Financial Studies* 25, 1286-1329.

[13] Erickson, T., Jiang, C., Whited, T., 2014. Minimum distance estimation of the errors-in-variables model using linear cumulant equations. *Journal of Econometrics* 183, 211-221.

[14] Gatchev, V., Pulvino, T., Tarhan, V., 2010. The interdependent and intertemporal nature of financial decisions: an application to cash flow sensitivities. *Journal of Finance* 65, 725-763.

[15] Paddock, J., Siegel, D., Smith, J., 1988. Option valuation of claims on real assets: the case of offshore petroleum leases. *Quarterly Journal of Economics* 103, 479-508.

[16] Pollock, D., 2000. Trend estimation and de-trending via rational square-wave filters. *Journal of Econometrics* 99, 317-334.

[17] Quigg, L., 1993. Empirical testing of real option-pricing models. *Journal of Finance* 48, 621-640.

[18] Richards, J., Patterson, M., 2004. Slotting allowances as real options: an alternative explanation. *The Journal of Business* 77, 675-696.

[19] Riddick, L., Whited, T., 2009. The corporate propensity of save. *Journal of Finance* 64, 1729-1766.

[20] Sandri, S., Schade, C., Musshoff, O., Odening, M., 2010. Holding on for too long? An experimental study on inertia in entrepreneurs' and non-entrepreneurs' disinvestment choices. *Journal of Economic Behavior and Organization* 76, 30-44.

[21] Sufi, A., 2009. Bank lines of credit in corporate finance: an empirical analysis. *Review of Financial Studies* 22, 1057-1088.

[22] Titman, S., 1985. Urban land prices under uncertainty. *The American Economic Review* 75, 505-514.

[23] Trigeorgis, L., 1996. Real option: managerial flexibility and strategy in resource allocation. *MIT Press*, Cambridge, MA.

[24] Whited, T., Wu, G., 2006. Financial constraint risk. *Review of Financial Studies* 19, 531-559.

Table 1: Variables definitions. Variables are defined using flow-of-funds data of Compustat. The variable definitions vary according to the format code (scf) a firm follows in reporting flow-of-funds data. Effective for fiscal years ending July 15, 1988, SFAS 95 requires U.S. companies to report the Statement of Cash Flows (scf = 7). Prior to adoption of SFAS 95, companies may have reported one of the following statements: Working Capital Statement (scf = 1), Cash Statement by Source and Use of Funds (scf = 2), and Cash Statement by Activity (scf = 3). Variables include the change in cash holdings ($\Delta Cash$), cash flow (CF), investment (Inv), cash dividends (Div), the change in working capital (ΔWC), net debt issued (ΔD), and net equity issued (ΔE). We include in parentheses the Compustat XPF variable names.

Variables	scf = 1	scf = 2	scf = 3	scf = 7
$\Delta Cash$	cash and cash equivalents increase/decrease (chech)	same as scf = 1	same as scf = 1	same as scf = 1
CF	income before extra items (ibc) + extra items & discontinued operation (xidoc) + depreciation & amortization (dpc) + deferred taxes (txdc) + equity in net loss (esubc) + gains in sale of PPE & investment (sppiv) + other funds from operation (fopo) + other sources of funds (fsrco)	same as scf = 1	same as scf = 1	income before extra items (ibc) + extra items & discontinued operation (xidoc) + depreciation & amortization (dpc) + deferred taxes (txdc) + equity in net loss (esubc) + gains in sale of PPE & investment (sppiv) + other funds from operation (fopo) + exchange rate effect (exre)
Inv	capital expenditure (capx) + increase in investment (ivch) + acquisition (aqc) + other uses of funds (fuseo) - sale of PPE (sppe) - sale of investment (siv)	same as scf = 1	same as scf = 1	capital expenditure (capx) + increase in investment (ivch) + acquisition (aqc) - sale of PPE (sppe) - sale of investment (siv) - change in short-term investment (ivstch) - other investing activities (ivaco)
Div	cash dividends (dv)	same as scf = 1	same as scf = 1	same as scf = 1
ΔWC	change in working capital (wcapc)	- change in working capital (wcapc)	same as scf = 2	- change in account receivable (recch) - change in inventory (invch) - change in account payable (apalch) - accrued income taxes (txach) - other changes in assets and liabilities (aoloch) - other financing activities (fiao)
ΔD	long-term debt issuance (dltis) - long-term debt reduction (dltr) - changes in current debt (dlcch)	long-term debt issuance (dltis) - long-term debt reduction (dltr) + changes in current debt (dlcch)	same as scf = 2	same as scf = 2
ΔE	sale of common and preferred stock (sstk) - purchase of common and preferred stock (prstkc)	same as scf = 1	same as scf = 1	same as scf = 1

Table 2: Summary statistics. The sample consists of 53,463 firm-year observations jointly covered in Compustat and CRSP between 1984 and 2016. Average number of observations per year is 1,620. The variables in the cash flow identity in Eq.(8) include the change in cash holdings ($\Delta Cash$), cash flow (CF), investment (Inv), the change in working capital (ΔWC), cash dividends (Div), net debt issued (ΔD), and net equity issued (ΔE). The variables are deflated by total assets. DIF is the difference between the left-hand and right-hand sides of the cash flow identity. Observations with $|DIF|$ >1% are deleted. The variables in the baseline saving model in Eq.(9) includes the negative cash-flow indicator variable (NEG), the natural log of the book value of total assets ($Size$), and the ratio of the market value of assets to the book value of assets (q). CF_cycle and CF_trend are the cycle and the trend components of CF, respectively. The cash flow components are deflated by total assets. Dollar values are converted into 2005 constant dollars. M3 stands for skewness. All variables are trimmed at the top and bottom 0.5% of their distributions.

Variable	Obs.	Mean	St.D.	Median	M3
$\Delta Cash$	53,463	0.007	0.103	0.002	-0.076
CF	53,463	0.070	0.137	0.090	-2.274
Inv	53,463	0.074	0.118	0.055	0.408
ΔWC	53,463	0.013	0.089	0.012	-0.807
Div	53,463	0.009	0.023	0.000	5.396
ΔD	53,463	0.008	0.099	0.000	0.865
ΔE	53,463	0.024	0.118	0.000	4.275
DIF	53,463	0.000	0.001	0.000	5.578
NEG	53,463	0.167	0.373	0.000	1.787
$1 - NEG$	53,463	0.833	0.373	1.000	-1.787
$CF * NEG$	53,463	-0.026	0.090	0.000	-5.177
$CF * (1 - NEG)$	53,463	0.096	0.075	0.090	0.866
CF_cycle	53,463	-0.002	0.065	0.001	-0.474
CF_trend	53,463	0.072	0.125	0.087	-2.198
$Size$	53,463	4.739	2.203	4.571	0.360
q	53,463	1.781	1.229	1.375	2.484

Table 3: The corporate propensity to (dis)save. The baseline saving model in Eq.(9) is estimated using OLS and the third- through fifth-order cumulant estimators. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0, 1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS	Third	Fourth	Fifth
	Level			
$CF * (1 - NEG)$	**0.10**	**-0.71**	**-0.42**	**-0.45**
	(11.3)	(-10.3)	(-15.1)	(-15.8)
$CF * NEG$	**0.23**	**0.86**	**0.63**	**0.65**
	(19.0)	(15.6)	(28.4)	(28.7)
q	0.01	0.14	0.10	0.10
	(20.5)	(14.5)	(32.4)	(34.8)
$Size$	0.00	0.00	0.00	0.00
	(-7.84)	(0.86)	(-0.06)	(-0.07)
Obs.	53,463	53,463	53,463	53,463
Rho	6.8%	26.8%	19.8%	20.4%
Tau	-	0.25	0.28	0.28

Panel B	OLS	Third	Fourth	Fifth
	Within-transformation			
$CF * (1 - NEG)$	**0.17**	**-0.58**	**-0.31**	**-0.33**
	(13.5)	(-5.10)	(-10.5)	(-11.6)
$CF * NEG$	**0.25**	**0.55**	**0.44**	**0.45**
	(16.9)	(10.3)	(20.9)	(20.9)
q	0.01	0.17	0.12	0.12
	(14.7)	(7.40)	(25.5)	(28.0)
$Size$	0.00	0.02	0.02	0.02
	(1.81)	(6.08)	(11.1)	(11.4)
Obs.	53,463	53,463	53,463	53,463
Rho	5.1%	21.1%	15.9%	16.4%
Tau	-	0.22	0.26	0.25

Table 4: The corporate propensity to (dis)save and cash flow decomposition. The baseline saving model in Eq.(9) is estimated using OLS and the third- through fifth-order cumulant estimators. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. CF_cycle and CF_trend are the cycle and the trend components of cash flow, respectively. The cash flow components are deflated by total assets. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0, 1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS	Third	Fourth	Fifth
		Level		
CF_trend	**0.08**	**-0.71**	**-0.42**	**-0.45**
	(9.15)	(-10.2)	(-14.6)	(-15.5)
CF_cycle	**0.17**	**-0.75**	**-0.41**	**-0.45**
	(13.4)	(-9.26)	(-13.1)	(-13.9)
$CF * NEG$	**0.12**	**1.59**	**1.05**	**1.10**
	(7.08)	(12.7)	(22.8)	(23.6)
q	0.01	0.15	0.10	0.10
	(20.4)	(14.0)	(31.5)	(34.1)
Size	0.00	0.00	0.00	0.00
	(-6.42)	(0.77)	(-0.02)	(0.08)
Obs.	53,463	53,463	53,463	53,463
Rho	7.1%	27.0%	19.7%	20.4%
Tau	-	0.25	0.28	0.28

Panel B	OLS	Third	Fourth	Fifth
		Within-transformation		
CF_trend	**0.15**	**-0.62**	**-0.33**	**-0.36**
	(10.9)	(-5.31)	(-10.6)	(-11.6)
CF_cycle	**0.20**	**-0.56**	**-0.27**	**-0.30**
	(13.4)	(-4.68)	(-8.92)	(-9.83)
$CF * NEG$	**0.08**	**1.15**	**0.75**	**0.79**
	(3.67)	(6.93)	(17.3)	(18.1)
q	0.01	0.18	0.12	0.12
	(14.8)	(7.36)	(25.6)	(28.1)
Size	0.00	0.02	0.02	0.02
	(2.08)	(6.08)	(11.1)	(11.4)
Obs.	53,463	53,463	53,463	53,463
Rho	5.2%	21.4%	16.0%	16.5%
Tau	-	0.22	0.26	0.25

Table 5: The corporate propensity to (dis)save: augmented saving model. The augmented saving model with additional control variables is estimated using OLS and the third- through fifth-order cumulant estimators. The additional control variables include the lagged value of the net PPE-to-assets ratio ($L.Tangibility$), the lagged value of the total debt-to-assets ratio ($L.Leverage$), the lagged value of the cash-to-assets ratio ($L.Cash$), and the lagged value of the change in cash holdings ($L.\Delta Cash$). Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0, 1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS	Third	Fourth	Fifth
		Level		
$CF * (1 - NEG)$	**0.11**	**-0.33**	**-0.46**	**-0.47**
	(10.0)	(-6.88)	(-13.6)	(-14.2)
$CF * NEG$	**0.21**	**0.48**	**0.56**	**0.57**
	(15.3)	(15.0)	(24.1)	(24.4)
q	0.02	0.08	0.10	0.11
	(21.1)	(12.7)	(28.6)	(30.5)
$Size$	0.00	0.00	0.00	0.00
	(-8.20)	(-3.60)	(-2.95)	(-2.90)
$L.Tangibility$	-0.02	0.01	0.02	0.02
	(-10.7)	(2.13)	(3.97)	(4.09)
$L.Leverage$	-0.01	-0.04	-0.04	-0.05
	(-3.91)	(-7.02)	(-8.08)	(-8.12)
$L.\Delta Cash$	-0.14	-0.15	-0.15	-0.15
	(-16.2)	(-15.5)	(-14.7)	(-14.6)
$L.Cash$	-0.08	-0.18	-0.21	-0.22
	(-16.1)	(-14.4)	(-19.5)	(-19.9)
Obs.	43,941	43,941	43,941	43,941
Rho	11.0%	23.2%	26.9%	27.2%
Tau	-	0.39	0.36	0.36

Panel B	OLS	Third	Fourth	Fifth
		Within-transformation		
$CF * (1 - NEG)$	**0.18**	**-0.31**	**-0.31**	**-0.32**
	(12.3)	(-4.00)	(-9.55)	(-10.1)
$CF * NEG$	**0.23**	**0.41**	**0.41**	**0.41**
	(14.1)	(12.1)	(18.6)	(18.5)
q	0.02	0.12	0.12	0.12
	(15.3)	(7.70)	(24.0)	(25.6)
$Size$	0.00	0.02	0.02	0.02
	(2.31)	(5.81)	(10.2)	(10.4)
$L.Tangibility$	-0.02	0.01	0.01	0.01
	(-3.25)	(0.54)	(0.58)	(0.62)
$L.Leverage$	-0.01	-0.06	-0.06	-0.06
	(-2.42)	(-5.47)	(-7.45)	(-7.50)
$L.\Delta Cash$	-0.14	-0.15	-0.15	-0.15
	(-14.4)	(-13.1)	(-13.7)	(-13.6)
$L.Cash$	-0.23	-0.28	-0.28	-0.28
	(-24.6)	(-18.6)	(-22.6)	(-22.6)
Obs.	43,941	43,941	43,941	43,941
Rho	14.3%	26.4%	26.5%	26.7%
Tau	-	0.29	0.29	0.29

Table 6: The corporate propensity to (dis)save and cash flow losses. The sample is restricted to firms with large and small cash flow losses. The current-period negative cash flow is classified as large (small) if it exceeds (falls below) the sum of the beginning-of-period cash holdings and tangible assets. The indicator variable *Shock* is equal to unity (zero) if the negative cash flow is classified as large (small). The saving model is estimated using OLS and the third- through fifth-order cumulant estimators. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. *Size* is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. *Rho* is an estimate of the R^2 of the regression. $Tau \in (0, 1)$ is an index of measurement quality for the q proxy for investment opportunities. *Jstat* refers to the Sargan-Hansen J-statistics for overidentifying restrictions. *Jval* refers to the p-value for the Sargan-Hansen test.

Panel A	OLS	Third	Fourth	Fifth
		Level		
$CF * Shock$	**0.07**	**0.41**	**0.37**	**0.36**
	(3.83)	(7.10)	(10.0)	(10.3)
$CF * (1 - Shock)$	**0.47**	**0.98**	**0.92**	**0.90**
	(9.25)	(9.94)	(13.1)	(13.2)
q	0.02	0.12	0.11	0.11
	(12.5)	(8.34)	(14.5)	(16.2)
$Size$	0.01	0.01	0.01	0.01
	(5.26)	(5.91)	(6.75)	(6.86)
Obs.	5,032	5,032	5,032	5,032
Rho	9.0%	30.3%	28.1%	27.1%
Tau	-	0.35	0.37	0.37
$Jstat$	-	-	5.15	7.75
$Jval$	-	-	0.08	0.17

Panel B	OLS	Third	Fourth	Fifth
		Within-transformation		
$CF * Shock$	**0.12**	**0.24**	**0.26**	**0.26**
	(3.33)	(4.62)	(6.60)	(6.62)
$CF * (1 - Shock)$	**0.48**	**0.62**	**0.64**	**0.64**
	(5.62)	(6.97)	(8.02)	(8.04)
q	0.02	0.11	0.12	0.12
	(5.73)	(3.80)	(9.56)	(9.85)
$Size$	0.03	0.06	0.06	0.06
	(3.62)	(4.53)	(7.48)	(7.52)
Obs.	5,032	5,032	5,032	5,032
Rho	2.5%	20.0%	21.7%	21.9%
Tau	-	0.32	0.30	0.30
$Jstat$	-	-	3.52	4.83
$Jval$	-	-	0.17	0.44

Table 7: The corporate propensity to (dis)save and financial constraints. The baseline saving model in Eq.(9) is estimated using OLS and the fourth-order cumulant estimators. Two schemes are applied to sort firms into financially constrained and unconstrained categories: firm size and cash payout. Firms with an asset size above the 67th percentile of the size distribution in year t ($Large$) are considered unconstrained, while those below the 33rd percentile ($Small$) - constrained. Dividend-paying or stock-repurchasing firms in year t (Pay) are treated as unconstrained, while non-dividend-paying and non-stock-repurchasing firms ($NoPay$) - as constrained. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0,1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS		Fourth		OLS		Fourth	
	Large	Small	Large	Small	Pay	NoPay	Pay	NoPay
	Level				**Level**			
$CF*(1-NEG)$	**0.03**	**0.20**	**-0.43**	**-0.16**	**0.08**	**0.17**	**-0.51**	**-0.30**
	(2.47)	(13.4)	(-7.97)	(-4.15)	(6.63)	(13.0)	(-10.7)	(-8.79)
$CF*NEG$	**0.18**	**0.21**	**0.53**	**0.57**	**0.26**	**0.21**	**0.67**	**0.60**
	(3.66)	(15.4)	(7.38)	(20.3)	(9.41)	(16.2)	(14.9)	(22.3)
q	0.01	0.01	0.07	0.10	0.01	0.01	0.09	0.10
	(9.74)	(15.0)	(11.0)	(21.3)	(10.4)	(17.9)	(16.4)	(25.3)
$Size$	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	(-4.70)	(2.73)	(-4.44)	(4.51)	(-3.85)	(1.80)	(-4.74)	(3.43)
Obs.	17,643	17,649	17,643	17,649	30,148	23,315	30,148	23,315
Rho	2.7%	9.3%	12.6%	22.1%	4.9%	8.9%	14.1%	23.9%
Tau	-	-	0.34	0.26	-	-	0.31	0.26

Panel B	OLS		Fourth		OLS		Fourth	
	Large	Small	Large	Small	Pay	NoPay	Pay	NoPay
	Transformation				**Transformation**			
$CF*(1-NEG)$	**0.07**	**0.27**	**-0.38**	**-0.07**	**0.14**	**0.23**	**-0.41**	**-0.17**
	(3.54)	(13.2)	(-5.90)	(-1.76)	(7.66)	(12.1)	(-8.10)	(-4.47)
$CF*NEG$	**0.18**	**0.23**	**0.38**	**0.38**	**0.32**	**0.24**	**0.53**	**0.39**
	(3.31)	(13.2)	(6.47)	(15.1)	(7.25)	(13.5)	(9.15)	(16.6)
q	0.01	0.01	0.09	0.11	0.01	0.02	0.11	0.11
	(5.75)	(9.96)	(8.84)	(14.6)	(6.66)	(10.8)	(14.2)	(17.0)
$Size$	0.00	0.01	0.01	0.04	0.00	0.01	0.01	0.03
	(1.81)	(4.37)	(3.71)	(9.70)	(1.08)	(3.88)	(4.02)	(10.9)
Obs.	17,643	17,649	17,643	17,649	30,148	23,315	30,148	23,315
Rho	2.5%	7.9%	8.9%	17.6%	8.9%	4.9%	11.4%	17.7%
Tau	-	-	0.28	0.25	-	-	0.28	0.25

Table 8: The corporate propensity to (dis)save and cash flow uncertainty. The baseline saving model in Eq.(9) is estimated using OLS and the fourth-order cumulant estimators. The standard deviation of the residuals from a first-order AR(1) autoregression of cash flow is estimated by firm. Firms with their respective volatilities in the top (bottom) third of the distribution are considered as having high (low) cash flow uncertainty (σ). Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0,1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS		Fourth	
	Small σ	High σ	Small σ	High σ
		Level		
$CF * (1 - NEG)$	**0.00**	**0.17**	**-0.92**	**-0.20**
	(0.27)	(11.3)	(-8.31)	(-5.50)
$CF * NEG$	**0.33**	**0.22**	**1.16**	**0.54**
	(3.32)	(15.9)	(6.00)	(20.3)
q	0.01	0.02	0.10	0.10
	(9.17)	(16.3)	(10.3)	(22.2)
$Size$	0.00	0.00	0.00	0.00
	(-6.70)	(1.02)	(-5.26)	(2.11)
Obs.	17,318	17,327	17,318	17,327
Rho	3.0%	9.3%	17.6%	23.4%
Tau	-	-	0.41	0.25

Panel B	OLS		Fourth	
	Small σ	High σ	Small σ	High σ
		Transformation		
$CF * (1 - NEG)$	**0.02**	**0.22**	**-0.69**	**-0.15**
	(0.73)	(11.8)	(-5.98)	(-3.78)
$CF * NEG$	**0.26**	**0.23**	**0.68**	**0.38**
	(2.11)	(14.5)	(3.96)	(16.1)
q	0.01	0.02	0.11	0.11
	(6.61)	(12.1)	(7.17)	(16.3)
$Size$	0.00	0.01	0.00	0.03
	(-3.30)	(4.18)	(1.08)	(9.66)
Obs.	17,318	17,327	17,318	17,327
Rho	2.4%	7.4%	9.7%	19.4%
Tau	-	-	0.31	0.28

Table 9: The corporate propensity to (dis)save and cash reserves. The baseline saving model in Eq.(9) is estimated using OLS and the fourth-order cumulant estimators. Sample firms are sorted by the cash ratio (cash and its equivalents over total assets). Firms in the top (bottom) third of the distribution are defined as cash-rich (cash-poor). The sortings are performed on an annual basis. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. CF is cash flow. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression. $Tau \in (0, 1)$ is an index of measurement quality for the q proxy for investment opportunities.

Panel A	OLS		Fourth	
	Cash-rich	Cash-poor	Cash-rich	Cash-poor
	Level			
$CF*(1-NEG)$	**0.20**	**0.02**	**-0.42**	**-0.38**
	(10.3)	(1.82)	(-7.16)	(-8.54)
$CF*NEG$	**0.29**	**0.01**	**0.68**	**0.35**
	(13.8)	(0.83)	(18.2)	(8.37)
q	0.01	0.01	0.10	0.10
	(13.2)	(10.3)	(16.2)	(12.6)
$Size$	0.00	0.00	0.00	0.00
	(1.85)	(-12.2)	(-1.75)	(-4.35)
Obs.	14,597	14,594	14,597	14,594
Rho	10.8%	7.1%	22.4%	32.3%
Tau	-	-	0.28	0.30

Panel B	OLS		Fourth	
	Cash-rich	Cash-poor	Cash-rich	Cash-poor
	Transformation			
$CF*(1-NEG)$	**0.34**	**0.03**	**-0.26**	**-0.30**
	(11.1)	(2.12)	(-3.49)	(-6.96)
$CF*NEG$	**0.32**	**0.02**	**0.47**	**0.21**
	(11.5)	(1.53)	(12.7)	(5.89)
q	0.01	0.01	0.12	0.10
	(6.52)	(6.23)	(11.7)	(11.8)
$Size$	0.01	0.00	0.03	0.01
	(3.11)	(-1.66)	(6.89)	(3.43)
Obs.	14,597	14,594	14,597	14,594
Rho	9.8%	31.8%	16.8%	22.3%
Tau	-	-	0.27	0.26

Table 10: Saving/disinvestment in a negative cash flow environment. The following restrictions are imposed to the sample firms in year t: (i) negative cash flow ($CF < 0$), (ii) negative investment ($Inv < 0$), and (iii) the absolute value of negative investment must exceed the absolute value of negative cash flow ($|CF| < |Inv|$). The modified saving model is estimated using the OLS estimator. Columns (1) and (2) report the results obtained using data in the level form and in the within-transformation form, respectively. The change in cash holdings ($\Delta Cash$) is the dependent variable. $Size$ is the natural log of the book value of total assets. Tobin's q is the market value of assets divided by the book value of assets. Rho is an estimate of the R^2 of the regression.

	(1)	(2)
$CF < 0$	**-0.14**	**-0.13**
	(-3.29)	(-3.02)
q	0.00	0.00
	(0.53)	(0.54)
$Size$	0.00	0.00
	(1.73)	(0.78)
Obs.	1,074	1,074
Rho	1.2%	2.9%

Appendix 1: The allocation of cash flow across various uses. This appendix reports the OLS results obtained by estimating Eq.(9) to (14) as standalone equations. Although the equations are estimated separately, constraints in Eq.(15) to (18) hold automatically because the dependent variables are linked implicitly through the cash flow identity. Panel A and Panel B report the results obtained using data in the level form and in the within-transformation form, respectively. The variables in the cash flow identity in Eq.(8) include the change in cash holdings ($\Delta Cash$), cash flow (CF), investment (Inv), the change in working capital (ΔWC), cash dividends (Div), net debt issued (ΔD), and net equity issued (ΔE). The variables are deflated by total assets. NEG is equal to unity if the firm has a negative cash flow in year t, and zero otherwise. $Size$ is the natural log of the total book value of assets. Tobin's q is the market value of assets divided by the book value of assets. *Rho* is an estimate of the R^2 of the regression. The adding-up constraints are in the column *Sum*.

Panel A	$\Delta Cash$	Inv	ΔWC	Div	ΔD	ΔE	Sum
				Level			
$CF * (1 - NEG)$	**0.10**	**0.26**	**0.15**	**0.08**	**-0.16**	**-0.25**	**1.00**
	(11.3)	(21.7)	(14.8)	(16.2)	(-20.8)	(-22.6)	
$CF * NEG$	**0.23**	**0.18**	**0.27**	**0.00**	**-0.07**	**-0.25**	**1.00**
	(19.0)	(15.1)	(19.5)	(-0.84)	(-6.83)	(-13.4)	
q	0.01	0.01	0.01	0.00	0.00	0.03	**0.00**
	(20.5)	(16.8)	(10.8)	(3.80)	(7.53)	(28.8)	
$Size$	0.00	0.00	0.00	0.00	0.00	-0.01	**0.00**
	(-7.84)	(4.07)	(-15.2)	(10.4)	(18.6)	(-20.3)	
Obs.	53,463	53,463	53,463	53,463	53,463	53,463	
Rho	6.8%	8.4%	11.4%	8.8%	2.7%	19.9%	

Panel B	$\Delta Cash$	Inv	ΔWC	Div	ΔD	ΔE	Sum
				Within-transformation			
$CF * (1 - NEG)$	**0.17**	**0.11**	**0.23**	**0.04**	**-0.24**	**-0.22**	**1.00**
	(13.5)	(9.33)	(20.9)	(11.0)	(-22.5)	(-17.4)	
$CF * NEG$	**0.25**	**0.18**	**0.33**	**0.00**	**-0.10**	**-0.15**	**1.00**
	(16.9)	(13.0)	(21.4)	(-1.89)	(-8.12)	(-8.28)	
q	0.01	0.02	0.01	0.00	0.00	0.03	**0.00**
	(14.7)	(17.7)	(7.65)	(6.10)	(7.26)	(24.3)	
$Size$	0.00	0.02	0.00	0.00	0.02	0.00	**0.00**
	(1.81)	(15.10)	(-3.24)	(0.86)	(20.50)	(-2.93)	
Obs.	53,463	53,463	53,463	53,463	53,463	53,463	
Rho	5.1%	20.1%	19.6%	45.4%	8.5%	28.9%	