The Cash Flow Sensitivity of Cash: Replication, Extension, and Robustness

Heitor Almeida, Murillo Campello, and Michael S. Weisbach*

January 25, 2021

Abstract

This paper reexamines the empirical evidence on the cash flow sensitivity of cash presented by Almeida, Campello, and Weisbach (2004). The original paper introduces a model in which financially constrained firms choose to save cash out of incremental cash flows but financially unconstrained do not. The authors find evidence consistent with this hypothesis on a sample of U.S. public firms between 1971 and 2000. This paper extends that analysis in a number of ways. In particular, it uses a larger sample covering the 1971–2019 window, considers a number of alternative definitions of financial constraints, and incorporates new methods and tests suggested by Welch (2020), Almeida, Campello, and Galvao (2010), and Grieser and Hadlock (2019). The original empirical findings are robust to these alternative specifications.

*Heitor Almeida is at the Gies College of Business, University of Illinois at Urbana-Champaign and the National Bureau of Economic Research (NBER). Murillo Campello is at the Johnson Graduate School of Management, Cornell University and NBER. Michael S. Weisbach is at the Fisher College of Business, Ohio State University and NBER. We are grateful to Hassan Ilyas for excellent research assistance. The programs used to produce the results presented in this work are available upon request. All errors are our own.

1 Introduction

In 2004, the three of us published a paper characterizing the decision of firms to retain incremental cash flows on their balance sheets as cash holdings (see Almeida, Campello, and Weisbach (2004), which we will refer to as ACW). The idea of the paper is that when firms are financially constrained, they would use cash flows to help finance future investments that could not otherwise be funded: constrained firms would display a significantly positive "cash flow sensitivity of cash." Unconstrained firms, which can undertake all valuable investments regardless of their cash positions, have no corresponding reason to save cash out of cash flows. We developed this idea theoretically and found empirical support for it on a sample of publicly traded U.S. firms between 1971 and 2000. We have been surprised by how influential the paper has become. As of this writing, it has 3,645 Google cites. Our results have been replicated multiple times in the past, using data from several different countries.

The world today is markedly different from the late 20^{th} Century, which produced the data used to test our original model's implications. As we document in our survey paper (Almeida, Campello, Cunha, and Weisbach (2014)), aggregate corporate cash levels have increased dramatically, potentially making incremental cash flows superfluous for financing investments. In addition, the importance of saving liquidity in the form of cash for financing has likely declined. Increased access to credit lines and hedging instruments, for example, has improved and firms can now raise funds from a very active private capital market. At a more basic level, the very nature of investment has dramatically changed over recent years. Our original sample was largely populated by firms whose investment opportunities were centered around physical capital spending. Over time, an ever-increasing number of publicly listed firms are investing in technology and human capital. All of these changes potentially affect the importance of saving cash out of incremental cash flows to finance future investments, and consequently the empirical relevance of our 2004 paper.

In this paper, we replicate the empirical tests of the ACW article, showing that their findings extend beyond the sample period originally considered. We also show that the ACW results hold under a set of financial constraints measures not originally considered. Finally, we show that the original ACW inferences hold under a number of methods meant to verify the robustness of our estimations. They include the various critiques and corrections contained in Welch (2020), Almeida, Campello, and Galvao (2010), and Grieser and Hadlock (2019).

2 Data Selection and Testing Specification

We follow ACW and consider the sample of all manufacturing firms (SICs 2000 to 3999) with data from Compustat (CPI-adjusted to 1971 dollars). We require that firms have data available for total assets, sales, market capitalization, capital expenditures, fixed capital, and holdings of cash and marketable securities. We eliminate firm-years for which cash holdings exceed the value of total assets, market capitalization is less than $10 million (in 1971 dollars), fixed capital is less than $5 million (in 1971 dollars), and asset or sales growth exceed 100%. We also drop any firm-years that have a negative Tobin's Q, as well as a value greater than 10. All the variable definitions are provided in Table 1.

In the analysis that follows, we first restrict sampling to the original ACW period of 1971–2000. We subsequently extend the analysis to the longer 1971–2019 window. The summary statistics for each of these sample periods are presented in Table 2.

As we discuss in turn, we use six measures of financial constraints. The first four are the same as in ACW, to which we add the financial constraints proxies proposed by Hadlock and Pierce (2010) and Whited and Wu (2006). Another improvement over the original ACW work comes from the approach we use for classifying firms as financially constrained based on ratings. Compustat data on bond and commercial paper ratings are sparse and noisy in the 1970s, which was a concern for the original ACW constraint classification schemes based on ratings.[1] When extending the analysis to encompass more recent data, we follow Almeida and Campello (2007) and classify firms as financially constrained or unconstrained based on annually-updated information on ratings. Tests on the extended sample thus allow for better-informed variation in firm financial constraints.

Here is a description of the schemes used:

- Scheme #1 [Payout]: In each year over the sample period, we rank firms based on their payout ratio and assign to the financially constrained (unconstrained) group firms that are in the bottom (top) three deciles of the annual payout distribution. We compute the payout ratio as the ratio of total distributions (dividends plus stock repurchases) to operating income. This scheme applies equally to the two sample periods considered.

- Scheme #2 [Size]: In each year over the sample period, we rank firms based on their asset size and assign firms that are in the bottom (top) three deciles of the size distribution to the financially constrained (unconstrained) group. This scheme applies equally to the two sample periods considered.

- Scheme #3 [Bond Ratings]: We use two approaches based on the sample period considered.
  - Original ACW Period: We retrieve data on firms' bond ratings and categorize those firms that never had their public debt rated over the 1971–2000 period as financially

[1] ACW classified a firm as unconstrained across the *entire sample period* if it registered ratings data *at any point* in time during the 1971–2000 window.

constrained. Observations from those firms are only assigned to the constrained category in years when the firms report positive debt. Financially unconstrained firms are those whose bonds have been rated during the sample period.

  - Extended Period: We follow Almeida and Campello (2007) and in each year over the 1985–2019 period retrieve data on bond ratings. We categorize firm-years with debt outstanding but without a bond rating as financially constrained. Financially unconstrained firms are those whose bonds are rated.

- Scheme #4 [CP Ratings]: We use two approaches based on the sample period considered.

  - Original ACW Period: We retrieve data on firms' commercial paper ratings and assign to the financially constrained group those firms that never had their issues rated over the 1971–2000 period. Observations from those firms are only assigned to a financially constrained category when the firms report positive debt. Financially unconstrained firms are those whose commercial papers have been rated during the sample period.

  - Extended Period: We follow Almeida and Campello (2007) and in each year over the 1985–2019 period retrieve data on commercial paper ratings. We categorize firm-years with debt outstanding but without a commercial paper rating as financially constrained. Financially unconstrained firms are those whose commercial papers are rated.

- Scheme #5 [HP Index]: We construct an index of firm financial constraints based on Hadlock and Pierce (2010) and separate firms according to this measure, called the "HP Index." We first construct an index of the likelihood that a firm faces financial constraints by applying the following linearization to the data:

$$HPIndex = -0.737 \times Size + 0.043 \times Size^2 - 0.040 \times Age. \tag{1}$$

  Firms in the bottom (top) three deciles of the HP Index ranking are considered financially unconstrained (constrained). We allow firms to change their status over the sample period by ranking firms on an annual basis.

- Scheme #6 [WW Index]: We construct an index of firm financial constraints based on Whited and Wu (2006) and separate firms according to this measure, called the "WW Index." We first construct an index of the likelihood that a firm faces financial constraints by applying the following linearization to the data:

$$\begin{aligned} WWIndex = {} & -0.091 \times CashFlow - 0.062 \times POSDIV + 0.021 \times LTLEV \\ & - 0.044 \times LNAT + 0.102 \times ISG - 0.035 \times SG. \end{aligned} \tag{2}$$

Firms in the bottom (top) three deciles of the WW Index ranking are considered financially unconstrained (constrained). We allow firms to change their status over the sample period by ranking firms on an annual basis.

We empirically estimate the cash flow sensitivity of cash via OLS-FE using the main model specified by Equation (8) in ACW:[2]

$$\Delta CashHoldings_{i,t} = \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_2 Q_{i,t} + \alpha_3 Size_{i,t} + \epsilon_{i,t}. \tag{3}$$

where $CashHoldings$ is the ratio of holdings of cash and marketable securities to total assets, $CashFlow$ is the ratio of earnings before extraordinary items and depreciation (minus dividends) to total assets, Q is the market value divided by the book value of assets, and $Size$ is the natural log of total assets. All estimations include firm fixed effects.

3 Replication over the Original ACW Sample Period

Table 3 presents the results of our replication of the original ACW paper. Despite differences in the underlying data, the results presented in the table are similar to those in Table 3 (the baseline table) of ACW. All of the 10 constrained–unconstrained contrasts in Table 3 point in the same direction: cash–cash flow sensitivities are larger for firms that are more likely to be financially constrained. Notably, this inference holds true even under the newly introduced measures of financial constraints (the HP Index and the WW Index). Contrasts are weaker, nonetheless, under the bond ratings constraint characterization.

4 Results for the Extended Sample Period

We proceed to extend the sample to 2019 and perform all of the ACW estimations again. Table 4 exhibits the results of this updated analysis. The new estimations corroborate the original findings of ACW across all financial constraint proxies. Only one of the constraint measures yields weak support for the ACW model; the one based on payout ratios. We believe that a number of recent developments in both the equity and credit markets may help explain this anomaly. In particular, the unprecedented increase in stock repurchases over the last 20 years suggests that payout behavior may no longer provide a useful indicator of constraints (see Farre-Mensa, Michaely, and Schmalz (2014) for a survey). Note that the original insight for using payout to measure financing constraints is based on the notion that payout is a central liquidity management tool (Faz-

[2]While the reported estimates are only for the main specification, we verify that all the original results of ACW hold for the IV specification as well (Equation (9) in ACW).

zari, Hubbard, and Petersen (1988)). Recent empirical analyses challenge this notion, nonetheless. Almeida, Fos, and Kronlund (2016), for example, show that stock repurchases are conducted not only to manage liquidity but also to manage earnings-per-share, or EPS. The usefulness of payout policy as a measure of financial constraint is likely to have declined over time.

We use a table to help with comparisons between the two periods (original and extended) that we consider. Table 5 collects cash flow coefficient pair-comparisons for financially constrained versus unconstrained firms (across each of our different measures of constraints). In it, we use a simple Wald test to make pairwise comparisons of cash–cash flow coefficients across samples. We do so based on the coefficients published in Table 3 of the original ACW paper (Panel A) and those in Table 4 of the current paper (Panel B). There are 4 possible constrained–unconstrained comparisons in Panel A and 6 on Panel B. In addition, we can compare results across the two panels.

In short, 4 out of 4 constrained–unconstrained comparisons in Panel A of Table 5 support the original ACW model predictions. For Panel B, the ACW inferences hold strongly across 5 out of 6 comparison pairs (1 pair only weakly agrees with ACW). There is some degree of variation as one takes contrasting to the next step and makes comparisons across panels. Some constrained–unconstrained differences seem stronger in Panel A (e.g., payout and size), while others are stronger in Panel B. Reassuringly, all of the results point in the same direction.

5 Robustness to Econometric Critiques and Corrections

5.1 The Welch Correction

We apply the correction proposed in Welch (2020) and re-estimate a differenced version of Equation (3) where we remove the firm fixed effects. Additionally, we use the change of ratios (CORs) instead of ratios of changes (ROCs) to calculate the change in cash holdings and changes in cash flow. Table 6 shows the results for the new estimations. It is evident that the cash holdings are still sensitive to cash flow — in fact they are even more sensitive now. Notably, under this modified testing, even unconstrained firms exhibit cash sensitivity to cash flow. Regardless, across virtually all of the schemes considered constrained firms have significantly higher sensitivity than unconstrained firms, which is consistent with the findings of ACW.

5.2 Addressing Measurement Error in Q

A potential issue with the estimation of Equation (3) is measurement error in the proxy for investment opportunities, Q. Specifically, measurement errors in Q could bias our cash flow coefficients. As discussed in the original ACW paper, measurement error is less of an issue in cash regressions than in investment regressions because under the null hypothesis of no financing frictions cash holdings should not depend on investment opportunities. Because of this independence, a positive cash flow sensitivities of cash is stronger evidence for financing frictions than a positive investment–cash flow sensitivity (which can simply be capturing variation in the demand for investment).

Nevertheless, it is possible that measurement error in Q affects cash flow sensitivities of cash for constrained firms, as pointed out by Riddick and Whited (2009). To verify the impact of measurement error on cash flow sensitivities of cash, we follow Almeida, Campello, and Galvao (2010) and re-estimate our model using the corrections suggested by those authors in their Table 9. These corrections involve using lagged values of Q to estimate Equation (3) after taking first differences (OLS-IV), and the Arellano and Bond GMM estimator (AB-GMM), which also uses lagged values of Q as instruments in the estimation.

The relevant results are reported in Table 7. For all of the comparison pairs in the table, we continue to observe that constrained firms have higher cash flow sensitivities of cash than unconstrained firms, for which cash flow sensitivities of cash are mostly statistically insignificant.

5.3 The Grieser and Hadlock Critique

Grieser and Hadlock (2019) raise concerns about the common use of fixed-effects (FE) and first-differences (FD) estimators in corporate finance data. The authors argue that researchers typically fail to test for the (needed) strict-exogeneity assumption for explanatory variables when using those approaches. Indeed, they show that this assumption fails in several common applications, leading to large inference errors. One of their recommendations is to diagnose the problem by comparing estimates of interest under FE and FD model estimations. Significant differences in coefficients across these estimators are usually a sign that the strict-exogeneity assumption is violated. Following their recommendation, we estimate Equation (3) using FD estimators as well and present the results in Table 8. A comparison of FE and FD results across all of our tests suggests that the two estimators always agree in sign and significance, with the exception of the unconstrained sample of firms under the WW Index.

6 Conclusion

We replicate the results of ACW, extend them beyond their original sample period, and subject them to corrections proposed by Welch (2020), Almeida, Campello, and Galvao (2010), and Grieser and Hadlock (2019). Consistent with the original findings of ACW, we continue to observe that constrained firms exhibit a higher positive cash flow sensitivity of cash and this holds true in the vast majority of cases even when we consider more modern financial constraints schemes.

References

Almeida, H. and M. Campello (2007). Financial constraints, asset tangibility, and corporate investment. *The Review of Financial Studies 20*(5), 1429–1460.

Almeida, H., M. Campello, I. Cunha, and M. S. Weisbach (2014). Corporate liquidity management: A conceptual framework and survey. *Annu. Rev. Financ. Econ. 6*(1), 135–162.

Almeida, H., M. Campello, and A. F. Galvao (2010). Measurement errors in investment equations. *The Review of Financial Studies 23*(9), 3279–3328.

Almeida, H., M. Campello, and M. S. Weisbach (2004). The cash flow sensitivity of cash. *The Journal of Finance 59*(4), 1777–1804.

Almeida, H., V. Fos, and M. Kronlund (2016). The real effects of share repurchases. *Journal of Financial Economics 119*(1), 168–185.

Farre-Mensa, J., R. Michaely, and M. Schmalz (2014). Payout policy. *Annu. Rev. Financ. Econ. 6*(1), 75–134.

Fazzari, S., R. G. Hubbard, and B. C. Petersen (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*.

Grieser, W. D. and C. J. Hadlock (2019). Panel-data estimation in finance: testable assumptions and parameter (in) consistency. *Journal of Financial and Quantitative Analysis 54*(1), 1–29.

Hadlock, C. J. and J. R. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies 23*(5), 1909–1940.

Riddick, L. A. and T. M. Whited (2009). The corporate propensity to save. *The Journal of Finance 64*(4), 1729–1766.

Welch, I. (2020). Ratios of changes: How real estate shocks did not affect corporate investment. *Working Paper*.

Whited, T. M. and G. Wu (2006). Financial constraints risk. *The Review of Financial Studies 19*(2), 531–559.

Table 1: Variable Definitions and Construction

This table provides a description of the variables in the empirical analysis and their construction. The precise construction (indicated under Column 3) is based on Compustat mnemonics.

Variable	**Definition**	**Construction**
$CashHoldings$	Firm's holdings of cash and marketable securities	$\frac{che_t}{at_t}$
$CashFlow$	Firm's cash flow in a year	$\frac{ib_t+dp_t-dvt_t}{at_t}$
$TobinQ$	Market-to-Book value of assets	$\frac{prccf_t \times csho_t+at_t-ceq_t-txdb_t}{at_t}$
$Size$	Firm's total assets	$\ln(at_t)$

Table 2: Summary Statistics

This table reports summary statistics for all the firms considered in our empirical analysis. Variable descriptions are in Table 1.

	A. Original Sample Period (1971–2000)					
	N	**Mean**	**SD**	**Min**	**Median**	**Max**
$\Delta CashHoldings$	24,390	–0.001	0.057	–0.552	–0.001	0.485
$CashHoldings$	27,992	0.091	0.100	–0.002	0.054	0.825
$CashFlow$	27,946	0.080	0.077	–2.148	0.084	0.484
$TobinQ$	27,992	1.458	0.894	0.276	1.194	9.995
$Size\ (Log\ Assets)$	27,992	5.193	1.496	2.070	4.894	11.146
	B. Extended Sample Period (1971–2019)					
	N	**Mean**	**SD**	**Min**	**Median**	**Max**
$\Delta CashHoldings$	41,997	0.000	0.061	–0.665	0.000	0.584
$CashHoldings$	47,206	0.116	0.126	–0.002	0.071	0.912
$CashFlow$	47,046	0.071	0.095	–2.620	0.079	0.986
$TobinQ$	47,206	1.609	0.993	0.206	1.312	9.995
$Size\ (Log\ Assets)$	47,206	5.509	1.622	1.837	5.224	11.512

Table 3: The Baseline Regression Model (Table III in ACW)

This table displays results for OLS estimations of the baseline regression model (Equation (3)). All data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000 to 3999) and the sample period is 1971–2000. The estimations include firm effects and correct the error structure for heteroskedasticity and for within-period error correlation using the White–Huber estimator. The associated *t*-statistics are reported in parentheses.

	$\Delta CashHoldings$											
	Payout				Size				Bond Ratings			
	Constrained		Unconstrained		Constrained		Unconstrained		Constrained		Unconstrained	
	Replication	Original ACW	Replication	Original ACW	Replication	Original ACW	Replication	Original ACW	Replication	Original ACW	Replication	Original ACW
$CashFlow$	0.051**	0.059***	0.011	–0.007	0.093***	0.062***	0.003	0.010	0.047***	0.058***	0.037**	0.018
	(2.38)	(4.53)	(0.54)	(–0.28)	(4.08)	(4.12)	(0.18)	(0.47)	(2.69)	(4.80)	(2.44)	(1.35)
Q	0.007**	0.003**	–0.002	0.000	0.006**	0.002	0.001	0.002	0.003**	0.002**	0.003***	0.003
	(2.54)	(2.41)	(–1.22)	(0.01)	(2.30)	(1.65)	(1.14)	(1.52)	(2.01)	(2.31)	(2.61)	(1.91)
$Size$	–0.000	0.002	0.004	0.000	–0.005	0.002	–0.003**	–0.004	–0.004**	–0.003	–0.002	–0.002
	(–0.08)	(0.61)	(1.55)	(0.05)	(–1.11)	(1.52)	(–1.96)	(–1.55)	(–1.99)	(–1.07)	(–1.48)	(–0.92)
R^2	0.14	0.28	0.13	0.28	0.12	0.26	0.05	0.17	0.08	0.20	0.06	0.15

	$\Delta CashHoldings$							
	CP Ratings				HP Index		WW Index	
	Constrained		Unconstrained		Constrained	Unconstrained	Constrained	Unconstrained
	Replication	Original ACW	Replication	Original ACW	Extension	Extension	Extension	Extension
$CashFlow$	0.046***	0.051***	0.017	0.011	0.075***	–0.003	0.070***	–0.017
	(3.63)	(4.83)	(0.86)	(0.49)	(3.69)	(–0.17)	(3.41)	(–1.04)
Q	0.003**	0.002***	0.003**	0.002	0.005*	0.002**	0.003	0.003**
	(2.28)	(2.93)	(2.37)	(1.78)	(1.95)	(2.05)	(0.91)	(2.26)
$Size$	–0.004**	–0.003	–0.001	–0.001	–0.004	–0.004**	–0.005	–0.002
	(–2.46)	(–1.37)	(–0.61)	(–0.46)	(–0.82)	(–2.07)	(–1.17)	(–1.58)
R^2	0.07	0.17	0.06	0.12	0.14	0.03	0.13	0.05

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.

Table 4: The Baseline Regression Model Extended to 2019 (Table III in ACW)

This table displays results for OLS estimations of the baseline regression model (Equation (3)). All data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000 to 3999) and the sample period is 1971–2019. The estimations include firm effects and correct the error structure for heteroskedasticity and for within-period error correlation using the White–Huber estimator. The associated t-statistics are reported in parentheses.

	$\Delta CashHoldings$					
	Payout		Size		Bond Ratings	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$CashFlow$	0.026*	0.015	0.056***	–0.014	0.071***	–0.006
	(1.89)	(0.49)	(3.58)	(–1.07)	(3.71)	(–0.40)
Q	0.002	–0.002**	0.002	0.002	–0.000	0.002*
	(1.50)	(–2.01)	(1.20)	(1.63)	(–0.19)	(1.82)
$Size$	–0.001	0.005***	–0.000	–0.002*	–0.001	–0.001
	(–0.83)	(3.56)	(–0.02)	(–1.77)	(–0.50)	(–0.97)
R^2	0.13	0.11	0.10	0.04	0.10	0.05

	$\Delta CashHoldings$					
	CP Ratings		HP Index		WW Index	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$CashFlow$	0.040***	–0.029	0.068***	–0.008	0.041***	–0.011
	(2.96)	(–1.09)	(3.09)	(–0.59)	(2.84)	(–0.80)
Q	0.001	0.001	0.002	0.001	0.001	0.001
	(0.46)	(0.95)	(0.89)	(0.68)	(0.86)	(1.51)
$Size$	–0.000	0.001	–0.006*	–0.001	–0.001	–0.000
	(–0.40)	(0.72)	(–1.79)	(–0.79)	(–0.54)	(–0.19)
R^2	0.08	0.03	0.12	0.02	0.11	0.05

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.

Table 5: Testing for the Differences in Cashflow Coefficients

This table displays results for testing the difference in coefficients between the financially constrained and financially unconstrained firms. Panel A provides this difference for the original ACW period 1971–2000 and Panel B provides the difference for the extended period 1971–2019. In order to test for the difference in coefficients across the two samples we use the following statistic:

$$Z = \frac{\beta_{Constrained} - \beta_{Unconstrained}}{\sqrt{SE(\beta_{Constrained})^2 + SE(\beta_{Unconstrained})^2}}$$

All data are from the annual COMPUSTAT industrial tapes and the sampled firms include only manufacturers (SICs 2000 to 3999). The associated t-statistics are reported in parentheses.

	A. Original ACW Period					
	Payout	Size	Bond Ratings	CP Ratings	HP Index	WW Index
$Coefficient\ Difference$	0.067**	0.052**	0.040**	0.040**		
	(2.26)	(2.01)	(2.24)	(1.63)		
	B. Extended Period					
	Payout	Size	Bond Ratings	CP Ratings	HP Index	WW Index
$Coefficient\ Difference$	0.011	0.070***	0.077***	0.069**	0.076***	0.052***
	(0.33)	(3.44)	(3.18)	(2.32)	(2.94)	(2.60)

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.

Table 6: The Baseline Regression Model with Welch Correction (Table III in ACW)

This table displays results for OLS estimations of the baseline regression model (a first difference version of Equation (3)). $\Delta(\Delta CashHoldings)$ is defined as the change in cash between time t and $t-1$ minus the change in cash between time $t-1$ and $t-2$, scaled by the time $t-1$ assets. $\Delta CashFlow$ is defined as the change in cash flow between time t and $t-1$ scaled by the time $t-1$ assets. The sampled firms include only manufacturers (SICs 2000 to 3999) and the sample period is 1971–2019. The estimations correct the error structure for heteroskedasticity and for within-period error correlation using the White–Huber estimator. The associated t-statistics are reported in parentheses.

	$\Delta(\Delta CashHoldings)$					
	Payout		Size		Bond Ratings	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$\Delta CashFlow$	0.137***	0.099***	0.202***	0.064***	0.229***	0.077***
	(7.51)	(3.83)	(9.43)	(2.98)	(4.42)	(4.30)
	$\Delta(\Delta CashHoldings)$					
	CP Ratings		HP Index		WW Index	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$\Delta CashFlow$	0.168***	0.048	0.238***	0.067***	0.176***	0.097***
	(4.98)	(1.06)	(3.83)	(3.30)	(8.32)	(3.63)

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.

Table 7: GMM and OLS-IV Results

This table shows the coefficients and t-statistics of $CashFlow$ that we obtain when we use the OLS-IV and GMM estimators in equation (3). All data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000 to 3999) and the sample period is 1971–2019. The OLS-IV results are clustered at the firm level. The associated t-statistics are reported in parentheses.

	$\Delta CashHoldings$					
	Payout		Size		Bond Ratings	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$OLS-IV$	0.069***	0.000	0.107***	0.031	0.100***	0.021
	(3.68)	(0.02)	(4.32)	(1.27)	(4.961)	(1.06)
$AB-GMM$	0.042**	0.035	0.084***	0.005	0.084***	–0.006
	(2.00)	(1.53)	(3.32)	(0.32)	(3.66)	(–0.30)
	$\Delta CashHoldings$					
	CP Ratings		HP Index		WW Index	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
$OLS-IV$	0.066***	0.017	0.095***	0.023	0.089***	0.060**
	(4.32)	(0.423)	(3.90)	(1.02)	(4.00)	(2.19)
$AB-GMM$	0.045***	–0.006	0.082*	–0.008	0.072**	0.027
	(2.91)	(–0.09)	(1.79)	(–0.39)	(2.34)	(1.50)

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.

Table 8: Comparison of the FE and FD Estimators in the Extended Sample

This table shows the coefficients and t-statistics of $CashFlow$ for OLS estimations of the baseline regression model (Equation (3)) and a first difference (FD) version of it. All data are from the annual COMPUSTAT industrial tapes. The sampled firms include only manufacturers (SICs 2000 to 3999) and the sample period is 1971–2019. The fixed effect (FE) estimations include firm effects and both FE and FD estimations correct the error structure for heteroskedasticity and for within-period error correlation using the White–Huber estimator. The associated t-statistics are reported in parentheses.

	$\Delta CashHoldings$											
	Payout				Size				Bond Ratings			
	Constrained		Unconstrained		Constrained		Unconstrained		Constrained		Unconstrained	
	FE	FD	FE	FD	FE	FD	FE	FD	FE	FD	FE	FD
$CashFlow$	0.026*	0.041***	0.015	0.045	0.063***	0.067***	–0.010	0.015	0.071***	0.101***	–0.006	0.009
	(1.89)	(2.80)	(0.49)	(1.13)	(4.36)	(3.77)	(–0.77)	(0.90)	(3.71)	(4.10)	(–0.40)	(0.61)

	$\Delta CashHoldings$											
	CP Ratings				HP Index				WW Index			
	Constrained		Unconstrained		Constrained		Unconstrained		Constrained		Unconstrained	
	FE	FD	FE	FD	FE	FD	FE	FD	FE	FD	FE	FD
$CashFlow$	0.040***	0.066***	–0.029	–0.005	0.068***	0.097***	–0.008	0.009	0.041**	0.047**	–0.011	0.039**
	(2.96)	(3.80)	(–1.09)	(–0.16)	(3.09)	(3.45)	(–0.59)	(0.62)	(2.84)	(2.90)	(–0.80)	(2.01)

Statistical significance levels: *** p-value<0.01, ** p-value<0.05, * p-value<0.10.