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Is the cash flow sensitivity of cash asymmetric? African evidence

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Highlights

- The cash flow sensitivity of cash is examined within an overlooked emerging market context.
- African firms save a high proportion of internally generated cash flow.
- The cash flow sensitivity is asymmetric conditional on cash flow and financial constraints.

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Is the cash flow sensitivity of cash asymmetric? African evidence*

Michael Machokoto†, Geofry Areneke‡

January 22, 2020

Abstract

We examine whether the cash flow sensitivity of cash is asymmetric using a sample of 745 firms from understudied African countries over the period from 2000–2015. We hypothesise and find significant asymmetry in the cash flow sensitivity of cash conditional on cash flow and financial constraints. Firms with positive cash flow save while those with negative cash flow dissave. These differences are more apparent in the presence of financial constraints. Our results affirm the asymmetry in the cash flow sensitivity of cash and highlight the severity of the impact of financial constraints on corporate decisions in emerging markets.

Keywords: Asymmetry, financial constraints, the cash flow sensitivity of cash.
JEL classification: G01; G31; G32

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1 Introduction

The relationship between cash and cash flow, the cash flow sensitivity of cash, is a contentious issue in the literature. Almeida et al. (2004), Grullon et al. (2018), Khurana et al. (2006) and McLean and Zhao (2018) find a positive cash flow sensitivity of cash, which they link to the need to hedge against future shortfalls. On the other hand, Riddick and Whited (2009) report a negative cash flow sensitivity of cash. They attribute the positive relationship in prior studies to mismeasurement error in Tobin's q that if corrected *via* general method of moments (GMM) estimators results in negative relation. Using an augmented framework of Riddick and Whited (2009), Bao et al. (2012) affirm the negative cash flow sensitivity of cash. However, Chang et al. (2014) have subsequently shown

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that estimates of cash flow sensitivities based on higher-order moments of the modified generalised method of moments (GMM) (see Erickson and Whited, 2000, 2002, 2012) are in some cases economically implausible. Similarly, Almeida et al. (2010) show that estimators using high-order moments are inefficient and return unstable coefficients that are not economically meaningful in the real world. Therefore, these mixed findings and conclusions highlight the need for further research.

It is interesting to note that all the above studies, except for the cross-country studies of Khurana et al. (2006) and McLean and Zhao (2018), focus on developed economies, which limits the generalisability of the findings to emerging economies with markedly different institutions. Yet, the few extant studies in emerging economies find significant heterogeneity in firm financing arising from differences in the level of access to capital markets. For example, Gwatidzo and Ojah (2014) find that institutional infrastructure and non-traditional factors significantly influence corporate debt in underdeveloped African markets. Similarly, Amaeshi et al. (2016) document that institutional voids (the absence of intermediaries) in Africa limit access to external finance, and where the finance is available, it is costly and accompanied by restrictive covenants.[1] Guariglia and Yang (2018) also report that 90% of total financing for individually owned Chinese firms is from self-financing sources such as cash reserves, loans from relatives and retained earnings. To the extent that African firms rely mostly on internal financing sources, they provide an ideal independent sample to reconcile and generalise empirical findings on the cash flow sensitivity of cash as savings from internally generated cash flow are likely to be high and heterogeneous within this context. To the extent that capital markets in Africa are different from developed economies where studies are concentrated, they offer unique institutional settings to validate extant propositions or theories.[2] Understanding whether the cash flow sensitivity of cash for African firms is positive or negative and if it is asymmetric or not represents, therefore, an interesting research question.[3]

In this paper, we contribute to the ongoing debate on the cash flow sensitivity of cash by providing further empirical evidence from emerging markets which are understudied in the literature. We conjure that limited access to finance in emerging economies is likely to make changes in cash (savings) more sensitive to operating cash flow and that this sensitivity is asymmetric conditional on cash flow (positive *versus* negative cash flow) and financial constraints. Using a sample of 745 firms (7,280 firm-year observations) drawn from eight African countries over the period from 2000 to 2015, we examine whether the cash flow sensitivity of cash is asymmetric and how financial constraints impact on the cash flow sensitivity of cash. Our findings which are robust to the choice of estimation technique show that the cash flow sensitivity of cash is positive and asymmetric conditional on cash flow. Specifically, for a one standard deviation increase in cash flow, the average firm increases cash holdings by 3.28%. When comparing the cash flow sensitivity of cash conditional on cash flow, we find that firms with positive cash flow

[1] Bae and Goyal (2009) find that lenders shorten maturities, reduce loan amounts and increase spread when lending in environments characterised by poor legal enforcement.

[2] Notwithstanding the contributions of the cross-country studies of Khurana et al. (2006) and McLean and Zhao (2018), they do not provide a complete picture of firms operating in African markets as their sample only includes South Africa.

[3] The extant studies in emerging markets do not examine corporate savings behaviour which is somewhat surprising given the surge in cash holdings documented in developed countries (see Foley et al., 2007; Dittmar and Thakor, 2007; Brown and Petersen, 2011; Bates et al., 2009).

increase their cash holdings by 3.71% for a one standard deviation increase in cash flow, which is 52% higher than firms with negative cash flow (2.44%). We further find that the asymmetry between firms with positive and negative cash flow varies significantly with financial constraints. Consistent with our hypothesis, only constrained firms with positive cash flow to save relatively more than unconstrained firms, while constrained firms with negative cash flows save much more than their unconstrained counterparts. These differences show that financial constraints increase the asymmetry in the cash flow sensitivity of cash in the context of emerging economies where firms have limited access to external sources of finance.

The rest of the paper is organised as follows. Section 2 presents the methodology, Section 3 presents the data used in the analyses, Section 4 discusses the empirical results, and Section 5 concludes.

2 Methodology

To examine the asymmetry in the cash flow sensitivity of cash, we estimate the following model:

$$\Delta Cash_{ijt} = \gamma_0 + \gamma_1 CF_{ijt} + \gamma_2 DNeg_{ijt} + \gamma_3 CF_{ijt} \times DNeg_{ijt} + \boldsymbol{\beta} \boldsymbol{X}_{ijt-1} + \epsilon_{ijt} \tag{1}$$

where $\Delta Cash_{ijt}$ is the change in cash holdings for firm i in country j at time t, γ_0 is a constant, and $\gamma_1 - \gamma_3$ and $\boldsymbol{\beta}$ are parameters to be estimated, CF_{ijt} is the firm's cash flow, $DNeg_{ijt}$ is a dummy variable that takes the value of one for firms that report negative cash flow and otherwise, zero, $\boldsymbol{X}_{ijt-1}$ is vectors of firm-specific characteristics explained below, ν_j and ν_t are the country and time fixed effects, and ϵ_{ijt} is the error term. The vector, $\boldsymbol{X}_{ijt-1}$, consists of Tobin's q (Q), the logarithm of total assets ($Size$), change in total debt (ΔTDA) and change in property, plant and equipment (ΔPPE).

The extant literature informs the control variables used. For example, Almeida et al. (2004), Khurana et al. (2006) and Bao et al. (2012) find that Tobin's q has a positive effect on changes in cash holdings as high-growth firms save to finance future growth opportunities. For firm-size, Khurana et al. (2006) find it has a positive effect on changes in cash. This arises as firm-size is an indicator of access to external finance and the cost of capital (Hennessy and Whited, 2007; Riddick and Whited, 2009). Larger firms are more able to save as they have better access to external finance (Almeida et al., 2004; Almeida and Campello, 2007) and economies of scale in managing cash holdings (Khurana et al., 2006; Bao et al., 2012). Several studies find that collateral (PPE) is associated with better access to external finance (Campello and Giambona, 2013; Flor and Hirth, 2013; Lei et al., 2018). This should reduce the need to hoard cash and lead to a negative relationship between $\Delta Cash$ and ΔPPE. However, the effect of $\Delta Debt$ is not apparent as some studies find that debt is a substitute for cash Opler et al. (1999); Gamba and Triantis (2008); Kling et al. (2014), while others find a complementary relationship (Acharya et al., 2007; Gamba and Triantis, 2008; Flannery and Lockhart, 2009). Based on the aforementioned studies, we expect firm-size and Tobin's q to have a positive effect on $\Delta Cash$, while ΔPPE should have a negative effect. As literature is not clear on what effect $\Delta Debt$ has on $\Delta Cash$, we, therefore, do make a prediction for this variable.

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We next estimate a modified version of our initial model to capture the effect of financial constraints on cash flow sensitivity as follows:-

$$\Delta Cash_{ijt} = \alpha_0 + \alpha_2 CF_{ijt} + \alpha_3 DNeg_{ijt} + \alpha_4 CF_{ijt} \times DNeg_{ijt} + \alpha_5 DFC_{ijt} + \alpha_6 DNeg_{ijt} \times DFC_{ijt} + \alpha_7 CF_{ijt} \times DNeg_{ijt} \times DFC_{ijt} + \boldsymbol{\beta X}_{ijt-1} + \epsilon_{ijt} \quad (2)$$

where DFC_{ijt} is a dummy variable that takes the value of one if we categorise a firm as constrained and otherwise zero, and $\alpha_1 - \alpha_7$ are parameters to be estimated. We categorise a firm in each year as constrained (unconstrained) if it is below (above) the median distribution of the logarithm of market capitalisation (MktCap), firm-age and tangibility. For our categorisation based on the WW Index (Whited, 2006), we consider a firm to be constrained (unconstrained) if it is above (below) the median distribution of the WW Index in each year. We use the median to categorise firms into regimes rather than the upper (lower) quartiles or deciles as this reduces the likelihood of finding significant cross-sectional differences between constrained and unconstrained sub-samples.

To facilitate comparison with prior studies and for robustness, we estimate Equations (1) using pooled ordinary least squares (OLS), fixed effects (FE), instrumental variables (IV) and general method of moments (GMM3-GMM5). We estimate our main model, Equation (2), using the general method of moments (GMM5) based on higher-order moments that account for potential mis-measurement errors in Tobin's q (see, Erickson and Whited, 2000, 2002; Bao et al., 2012).

3 Data

We collect data from *Datastream* over period 2000–2015 and exclude firms in the financial and utility sectors, and those with missing data. To reduce the effects of outliers, we winsorise all variables at the upper and bottom 1% percentiles of the distribution. Our final sample consists of 7,280 firm-year observations for 745 firms from Egypt, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, South Africa and Tunisia. We describe in detail each of the variables in Appendix A.

PLEASE INSERT TABLE 1 HERE

Table 1 presents the summary statistics and correlations for all variables. The mean (median) change in cash ($\Delta Cash$), cash flow (CF), Tobin's q (Q), size ($Size$), change in debt ($\Delta Debt$), change in property, plant and equipment (ΔPPE), and R&D are 1.3% (0.6%), 15.3% (14.3%), 1.60 (1.35), 15.08 (15.20), 2.1% (0.1%), 3.6% (1.9%), 0.1% (0), respectively. The pairwise correlations in Panel B show that change in cash ($\Delta Cash$) is positively correlated with cash flow (CF), Tobin's q (Q) and change in debt ($\Delta Debt$), while it is negatively correlated with size ($Size$), change in property, plant and equipment (ΔPPE), and research and development ($R\&D$).

4 Empirical Results

We first examine whether the cash flow sensitivity of cash is asymmetric conditional on cash flow, and if this asymmetry is affected by financial constraints. Table 2 presents

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the results estimating Equation (1) that relates the change in cash to firm characteristics.

PLEASE INSERT TABLE 2 HERE

Table 2 shows that the cash flow sensitivity of cash ranges between 0.265 and 0.458. Our estimate of the cash flow sensitivity of cash in Columns (4) - (6) using general method of moments (GMM3-GMM5) based on higher-order moments to correct for potential measurement errors are relatively higher than those in Columns (1), (2) and (3) based on pooled ordinary least squares (OLS), fixed effects (FE), and instrumental variables (IV), respectively. Columns (4) - (6) show the average firm increases cash holdings by 26.5% - 44.9%. This result is consistent with the need to preserve financing flexibility, the precautionary motive of holding cash, in order to hedge any future shortfalls, especially in less developed capital markets where access to finance is limited. The coefficients of $CF \times DNeg \times DFC$, in Columns (7) - (12), are consistently negative and significant, indicating that the cash flow sensitivity of cash is asymmetry conditional on cash flow. Specifically, firms with negative cash flow shocks tend to dissave 12.3% - 32.6% while those with positive shocks save 29.9% - 45.8% in anticipation of future cash shortfalls.[4] These findings affirm the asymmetry in the cash flow sensitivity of cash but differ from Bao et al. (2012) in that the cash flow sensitivity of cash is positive (negative) for firms with positive (negative) cash flow rather than negative (positive). We attribute these differences to the overreaching need to enhance or increase financial flexibility by hoarding cash and then drawing down cash reserves cover negative cash flow shocks in environments characterised by limited access to external finance.

Consistent with prior literature, we find that $\Delta Debt$ and ΔPPE have a positive and negative effect on $\Delta Cash$, respectively. The negative effect of ΔPPE is in line with Flannery and Lockhart (2009) and Kling et al. (2014) who find that firms with better access to external finance hold less cash reserves. For the positive effect of $\Delta Debt$, we link this result to a host of studies that find a complementary relationship between debt and cash holdings (see Acharya et al., 2007; Gamba and Triantis, 2008; Flannery and Lockhart, 2009). However, the negative effect of Tobin's q and size on $\Delta Cash$ is inconsistent with the literature (Almeida et al., 2004; Khurana et al., 2006; Bao et al., 2012). This finding is somewhat surprising and suggests that changes in cash holdings within the African context are not due to the need to finance future growth opportunities. Instead, financial constraints appear to be the main reasons for the rise in corporate savings, as evidenced by the negative coefficient of firm-size (which is a proxy for credit constraints). Given our focus and for brevity, we do not further discuss the results of control variables.

We next examine the impact of financial constraints on the cash flow sensitivity conditional on the WW Index (Whited, 2006), market capitalisation (MktCap), firm-age and tangibility. Financial constraints are more likely to be binding for firms in developing markets as access to external finance is limited. This prediction should lead to a high asymmetry in the cash flow sensitivity of cash for African firms. Table 3 presents the results estimating Equation (2) that relates the change in cash to firm characteristics and financial constraint indicators.

[4] Appendix B shows similar asymmetry in the cash flow sensitivity of cash for firms in South Africa and for those in other countries (excluding South Africa).

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PLEASE INSERT TABLE 3 HERE

For all proxies of financial constraints, the coefficient of the interaction term of cash flow and the dummy of financial constraint, $CF \times DFC$, is positive and significant, indicating that constrained firms save 6.4% - 19.3% more than unconstrained firms. The results suggest that constrained firms have a higher need to hoard cash in a bid to enhance financial flexibility and hedge against future shortfalls. However, constrained firms with adverse cash flow shocks dissave 5.2% - 57.9% more than their unconstrained counterparts. A comparison of the pre-crisis (2000–2007) and post-crisis (2008–2015) period shows that the asymmetry increases in the post-crisis period, which is marked by significant contractions in credit supply. This finding suggests that firms draw-down cash when credit supply contracts, and those that can still generate positive cash flow further hoard it to strategically increase financial flexibility.

Overall, our results show significant asymmetry between firms with negative and positive cash flow that is more pronounced with financial constraints.

5 Conclusion

We examine the asymmetry in the cash flow sensitivity of cash using a sample of understudied African firms. Our study affirms that the cash flow sensitivity of cash is asymmetric as it is positive and negative for firms with positive and negative cash flow, respectively. This asymmetry is more pronounced for firms that are subject to financial constraints, as constrained firms with negative cash flow dissave while those with positive cash flow save a higher proportion of their operating cash flow. Our findings are in line with the literature from the developed countries, but the magnitudes and asymmetry of the cash flow sensitivity of cash are much higher as Africa firms face limited access to external finance.

Author Contribution

Conception and design of study: Michael Machokoto Acquisition of data: Michael Machokoto & Geofry Areneke Analysis and/or interpretation of data: Michael Machokoto Drafting the manuscript: Michael Machokoto Critical revision: Michael Machokoto & Geofry Areneke

References

Acharya, V. V., Almeida, H., and Campello, M. (2007). Is Cash Negative Debt? A Hedging Perspective on Corporate Financial Policies. *Journal of Financial Intermediation*, 16(4):515–554.

Almeida, H. and Campello, M. (2007). Financial Constraints, Asset Tangibility, and Corporate Investment. *Review of Financial Studies*, 20(5):1429–1460.

Almeida, H., Campello, M., and Galvao, A. F. (2010). Measurement Errors in Investment Equations. *The Review of Financial Studies*, 23(9):3279–3328.

Almeida, H., Campello, M., and Weisbach, M. S. (2004). The Cash Flow Sensitivity of Cash. *The Journal of Finance*, 59(4):1777–1804.

Amaeshi, K., Adegbite, E., and Rajwani, T. (2016). Corporate Social Responsibility in Challenging and Non-enabling Institutional Contexts: Do Institutional Voids matter? *Journal of Business Ethics*, 134(1):135–153.

Bae, K.-H. and Goyal, V. K. (2009). Creditor Rights, Enforcement, and Bank Loans. *The Journal of Finance*, 64(2):823–860.

Bao, D., Chan, K. C., and Zhang, W. (2012). Asymmetric cash flow sensitivity of cash holdings. *Journal of Corporate Finance*, 18(4):690–700.

Bates, T. W., Kahle, K. M., and Stulz, R. M. (2009). Why Do U.S. Firms Hold So Much More Cash than They Used To? *The Journal of Finance*, 64(5):1985–2021.

Brown, J. R. and Petersen, B. C. (2011). Cash holdings and R&D smoothing. *Journal of Corporate Finance*, 17(3):694–709.

Campello, M. and Giambona, E. (2013). Real Assets and Capital Structure. *The Journal of Financial and Quantitative Analysis*, 48(5):1333–1370.

Chang, X., Dasgupta, S., Wong, G., and Yao, J. (2014). Cash-Flow Sensitivities and the Allocation of Internal Cash Flow. *The Review of Financial Studies*, 27(12):3628–3657.

Dittmar, A. and Thakor, A. (2007). Why Do Firms Issue Equity? *The Journal of Finance*, 62(1):1–54.

Erickson, T. and Whited, T. M. (2000). Measurement Error and the Relationship between Investment and q. *Journal of Political Economy*, 108(5):1027–1057.

Erickson, T. and Whited, T. M. (2002). Two-Step GMM Estimation of the Errors-in-Variables Model Using High-Order Moments. *Econometric Theory*, 18(3):776–799.

Erickson, T. and Whited, T. M. (2012). Treating Measurement Error in Tobin's q. *Review of Financial Studies*, 25(4):1286–1329.

Flannery, M. J. and Lockhart, G. B. (2009). Credit Lines and the Substitutability of Cash and Debt. SSRN Scholarly Paper ID 1422867, Social Science Research Network, Rochester, NY, USA.

Flor, C. R. and Hirth, S. (2013). Asset Liquidity, Corporate Investment, and Endogenous Financing Costs. *Journal of Banking & Finance*, 37(2):474–489.

Foley, C. F., Hartzell, J. C., Titman, S., and Twite, G. (2007). Why Do Firms Hold So Much Cash? A Tax-Based Explanation. *Journal of Financial Economics*, 86(3):579–607.

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Gamba, A. and Triantis, A. (2008). The Value of Financial Flexibility. *The Journal of Finance*, 63(5):2263–2296.

Grullon, G., Hund, J., and Weston, J. P. (2018). Concentrating on q and cash flow. *Journal of Financial Intermediation*, 33:1–15.

Guariglia, A. and Yang, J. (2018). Adjustment behavior of corporate cash holdings: the China experience. *The European Journal of Finance*, 24(16):1428–1452.

Gwatidzo, T. and Ojah, K. (2014). Firms Debt Choice in Africa: Are Institutional Infrastructure and Non-Traditional Determinants Important? *International Review of Financial Analysis*, 31:152–166.

Hennessy, C. A. and Whited, T. M. (2007). How Costly Is External Financing? Evidence from a Structural Estimation. *The Journal of Finance*, 62(4):1705–1745.

Khurana, I. K., Martin, X., and Pereira, R. (2006). Financial Development and the Cash Flow Sensitivity of Cash. *Journal of Financial and Quantitative Analysis*, 41(04):787–808.

Kling, G., Paul, S. Y., and Gonis, E. (2014). Cash Holding, Trade Credit and Access to Short-Term Bank Finance. *International Review of Financial Analysis*, 32:123–131.

Lei, J., Qiu, J., and Wan, C. (2018). Asset tangibility, cash holdings, and financial development. *Journal of Corporate Finance*, 50:223–242.

McLean, R. D. and Zhao, M. (2018). Cash savings and capital markets. *Journal of Empirical Finance*, 47:49–64.

Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R. (1999). The Determinants and Implications of Corporate Cash Holdings. *Journal of Financial Economics*, 52(1):3–46.

Riddick, L. A. and Whited, T. M. (2009). The Corporate Propensity to Save. *The Journal of Finance*, 64(4):1729–1766.

Whited, T. M. (2006). External Finance Constraints and the Intertemporal Pattern of Intermittent Investment. *Journal of Financial Economics*, 81(3):467–502.

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Table 1 Basic statistics and correlations

Panel A presents the basic statistics, and Panel B presents the pairwise Spearman (Pearson) correlations in the upper (lower) diagonal for all variables used. The sample consists of 745 listed non-financial firms from Ivory Coast, Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa and Tunisia drawn from *Datastream* over the period from 2000 to 2015. All variables used are defined in Appendix A and are winsorised at the lower and upper one percentiles. ***, **, * indicate the significance of the difference between positive cash flow firms (CF>0) and negative cash flow firms (CF≤0) at the one, five, and ten percent levels, respectively.

Panel A: Basic statistics

	All firms			CF>0			CF≤0		
Variables	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
ΔCash	0.013	0.006	0.073	0.017	0.008	0.071	-0.029***	-0.019***	0.079***
CF	0.153	0.143	0.124	0.174	0.154	0.107	-0.074***	-0.053***	0.061***
Q	1.600	1.345	0.860	1.628	1.376	0.868	1.275***	1.088***	0.683***
$Size$	15.080	15.202	2.019	15.099	15.224	1.996	14.856***	14.951**	2.249***
$\Delta Debt$	0.021	0.001	0.084	0.022	0.001	0.082	0.015**	0.004	0.102***
ΔPPE	0.036	0.019	0.084	0.040	0.022	0.082	-0.012***	-0.007***	0.091***
$R\&D$	0.001	0.000	0.003	0.001	0.000	0.003	0.001	0.000***	0.003***
N	7,280			6,689			591		

Panel B: Correlations

Variables	$\Delta Cash$	CF	Q	$Size$	$\Delta Debt$	ΔPPE	$R\&D$
$\Delta Cash$	1	0.340***	0.035***	-0.028**	0.028**	-0.021*	-0.017
CF	0.359***	1	0.418***	-0.005	0.108***	0.310***	-0.001
Q	0.013	0.388***	1	0.182***	0.072***	0.231***	0.060***
$Size$	-0.028**	0.004	0.127***	1	0.116***	0.144***	0.237***
$\Delta Debt$	0.058***	0.153***	0.060***	0.098***	1	0.401***	0.032***
ΔPPE	-0.019	0.285***	0.138***	0.076***	0.413***	1	0.020*
$R\&D$	-0.036***	0.021*	0.025**	0.097***	0.056***	-0.002	1

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Table 2 Asymmetry in the cash flow sensitivity of cash

The table presents the estimation results of Equations (1) and (2) that relate investment to cash flow and Tobin's q. τ is the coefficient of determination of Equation (2) in Erickson and Whited (2000) and is an index that varies between zero and one of measurement quality for the Tobin's q. The sample consists of 745 listed non-financial firms from Ivory Coast, Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa and Tunisia drawn from *Datastream* over the period from 2000 to 2015. All variables used are defined in Appendix A and are winsorised at the lower and upper one percentiles. ***, **, * indicate significance at the one, five, and ten percent levels, respectively.

Estimation	OLS	FE	IV	GMM3	GMM4	GMM5	OLS	FE	IV	GMM3	GMM4	GMM5
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF	0.265***	0.309***	0.315***	0.449***	0.331***	0.351***	0.299***	0.356***	0.353***	0.458***	0.351***	0.388***
	(0.010)	(0.014)	(0.011)	(0.046)	(0.021)	(0.019)	(0.012)	(0.016)	(0.014)	(0.052)	(0.026)	(0.020)
$DNeg$							-0.020***	-0.018***	-0.020***	-0.018***	-0.019***	-0.018***
							(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
$CF\times$DNeg							-0.478***	-0.542***	-0.476***	-0.784***	-0.578***	-0.650***
							(0.061)	(0.063)	(0.063)	(0.115)	(0.069)	(0.062)
Q	-0.012***	-0.010***	0.009	-0.090***	-0.041***	-0.049***	-0.014***	-0.012***	0.006	-0.067***	-0.032***	-0.044***
	(0.001)	(0.002)	(0.007)	(0.020)	(0.008)	(0.006)	(0.001)	(0.002)	(0.007)	(0.017)	(0.008)	(0.006)
$Size$	-0.001**	-0.024***	-0.032***	0.004**	0.001	0.001*	-0.001*	-0.024***	-0.032***	0.003**	0.001	0.001*
	(0.000)	(0.003)	(0.004)	(0.002)	(0.001)	(0.001)	(0.000)	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)
$\Delta Debt$	0.059***	0.047***	0.056***	0.080***	0.069***	0.071***	0.047***	0.032**	0.039***	0.052***	0.051***	0.052***
	(0.014)	(0.013)	(0.014)	(0.017)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.012)	(0.013)
ΔPPE	-0.131***	-0.179***	-0.206***	-0.082***	-0.112***	-0.107***	-0.130***	-0.172***	-0.190***	-0.094***	-0.117***	-0.109***
	(0.013)	(0.013)	(0.016)	(0.021)	(0.013)	(0.013)	(0.014)	(0.013)	(0.017)	(0.019)	(0.014)	(0.013)
N	7,280	7,280	5,045	7,280	7,280	7,280	7,280	7,280	5,045	7,280	7,280	7,280
R^2	0.173	0.208	0.213				0.186	0.224	0.228			
τ				0.276	0.406	0.366				0.359	0.540	0.443
ρ		0.387		0.267	0.205	0.215		0.391		0.257	0.207	0.224

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Table 3 The effect of financial constraints on the cash flow sensitivity of cash

The table presents estimation results of Equation (2) that relate investment to cash flow and Tobin's q. τ is the coefficient of determination of Equation (2) in Erickson and Whited (2000) and is an index that varies between zero and one of measurement quality for the Tobin's q. The sample consists of 745 listed non-financial firms from Ivory Coast, Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa and Tunisia drawn from *Datastream* over the period from 2000 to 2015. All variables used are defined in Appendix A and are winsorised at the lower and upper one percentiles. ***, **, * indicate significance at the one, five, and ten percent levels, respectively.

Period	2000-2015				2000-2007				2008-2015			
Constraint	WW	MktCap	Firm-Age	Tangibility	WW	MktCap	Firm-Age	Tangibility	WW	MktCap	Firm-Age	Tangibility
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF	0.308***	0.306***	0.303***	0.347***	0.374***	0.388***	0.324***	0.399***	0.260***	0.251***	0.294***	0.307***
	(0.028)	(0.030)	(0.024)	(0.026)	(0.034)	(0.033)	(0.030)	(0.030)	(0.042)	(0.041)	(0.033)	(0.037)
$DNeg$	-0.011*	-0.008	-0.017**	0.002	0.009	0.005	-0.002	0.009	-0.021***	-0.015**	-0.033***	-0.004
	(0.007)	(0.006)	(0.008)	(0.007)	(0.014)	(0.011)	(0.011)	(0.013)	(0.007)	(0.007)	(0.011)	(0.008)
$CF \times DNeg$	-0.470***	-0.456***	-0.483***	-0.501***	-0.517***	-0.633***	-0.593***	-0.623***	-0.426***	-0.379***	-0.505***	-0.461***
	(0.065)	(0.068)	(0.062)	(0.066)	(0.134)	(0.114)	(0.110)	(0.125)	(0.088)	(0.089)	(0.082)	(0.090)
DFC	-0.026***	-0.028***	-0.027***	-0.007	-0.016**	-0.014**	-0.027***	-0.001	-0.030***	-0.033***	-0.025***	-0.011**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.005)	(0.005)
$CF \times DFC$	0.143***	0.145***	0.152***	0.121***	0.087**	0.064*	0.151***	0.097***	0.182***	0.193***	0.140***	0.127***
	(0.023)	(0.024)	(0.022)	(0.025)	(0.040)	(0.038)	(0.034)	(0.037)	(0.029)	(0.029)	(0.031)	(0.033)
$DNeg \times DFC$	-0.018*	-0.027***	-0.002	-0.035***	-0.049***	-0.052***	-0.042**	-0.032*	-0.008	-0.018	0.014	-0.034***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.017)	(0.017)	(0.017)	(0.019)	(0.012)	(0.012)	(0.014)	(0.013)
$CF \times DNeg \times DFC$	-0.332***	-0.376***	-0.282***	-0.303**	-0.206	-0.052	-0.123	0.224	-0.496***	-0.579***	-0.395***	-0.505***
	(0.100)	(0.105)	(0.100)	(0.130)	(0.155)	(0.144)	(0.150)	(0.195)	(0.143)	(0.142)	(0.146)	(0.164)
Q	-0.037***	-0.037***	-0.044***	-0.044***	-0.059***	-0.062***	-0.054***	-0.065***	-0.026***	-0.024**	-0.038***	-0.032***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.010)	(0.010)	(0.007)	(0.007)
$Size$	-0.000	-0.001	0.000	0.001*	0.002*	0.002	0.002	0.004***	-0.000	-0.001	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\Delta Debt$	0.040***	0.043***	0.040***	0.033**	0.017	0.025	0.020	0.009	0.051***	0.050***	0.053***	0.044***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.024)	(0.024)	(0.022)	(0.024)	(0.016)	(0.017)	(0.017)	(0.017)
ΔPPE	-0.115***	-0.116***	-0.108***	-0.085***	-0.089***	-0.088***	-0.088***	-0.064***	-0.130***	-0.133***	-0.124***	-0.102***
	(0.013)	(0.014)	(0.013)	(0.014)	(0.020)	(0.021)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)	(0.020)
N	7,280	7,280	7,280	7,280	2,945	2,945	2,945	2,945	4,335	4,335	4,335	4,335
τ	0.526	0.529	0.497	0.495	0.492	0.489	0.508	0.478	0.601	0.633	0.499	0.545
ρ	0.234	0.235	0.239	0.244	0.263	0.265	0.270	0.278	0.211	0.212	0.220	0.216

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Appendix A Variable definitions

The table lists the definitions of all variables used and the account items obtained from Datastream databases.

Variable	Definition
ΔCash	Change in cash holdings to total assets.
cash flow	Earnings before interest and tax plus depreciation plus the change in non-cash working capital to total assets.
DNeg	A dummy variable that takes the value of one if a firm has negative cash flow and otherwise zero.
Q	Market-to-book ratio (Tobin's q).
Size	Log of total assets.
ΔDebt	Change in total debt to total assets.
ΔPPE	Change in property, plant and equipment to total assets.
DFC	A dummy variable that takes the value of one if a firm is constrained and otherwise zero.
WW Index	$-0.091 \times \frac{Cash\ Flow}{Assets} - 0.062 \times Dividend\ Dummy + 0.021 \times \frac{Total\ Debt}{Assets}$ $-0.044 \times Size + 0.102 \times Industry\ Sales\ Growth - 0.035 \times Sales\ Growth$ The WW Index (WW) is based on (Whited, 2006).
MktCap	Log of market capitalisation.
LogAge	The logarithm of the difference between the current year and the first year that the firm appears in the database.
Tangibility	Tangible fixed assets to total assets.

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Appendix B Alternative estimates of the cash flow sensitivity of cash

The table presents the estimation results of Equations (1) and (2) that relate investment to cash flow and Tobin's q. τ is the coefficient of determination of Equation (2) in Erickson and Whited (2000) and is an index that varies between zero and one of measurement quality for the Tobin's q. Panel A and B present the results for the firms in South Africa and other countries (excluding South Africa), respectively. The sample consists of 745 listed non-financial firms from Ivory Coast, Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa and Tunisia drawn from *Datastream* over the period from 2000 to 2015. All variables used are defined in Appendix A and are winsorised at the lower and upper one percentiles. ***, **, * indicate significance at the one, five, and ten percent levels, respectively.

Pane A: South Africa

Estimation	OLS	FE	IV	GMM3	GMM4	GMM5	OLS	FE	IV	GMM3	GMM4	GMM5
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF	0.249***	0.282***	0.294***	0.528***	0.328***	0.337***	0.292***	0.331***	0.335***	0.558***	0.370***	0.394***
	(0.011)	(0.015)	(0.012)	(0.070)	(0.022)	(0.022)	(0.014)	(0.017)	(0.016)	(0.077)	(0.026)	(0.024)
$Dneg$							-0.016***	-0.015**	-0.021***	-0.018***	-0.016***	-0.016***
							(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)
$CF \times DNeg$							-0.466***	-0.508***	-0.481***	-1.038***	-0.635***	-0.687***
							(0.066)	(0.068)	(0.068)	(0.186)	(0.074)	(0.071)
Q	-0.010***	-0.010***	0.005	-0.140***	-0.048***	-0.052***	-0.012***	-0.012***	0.002	-0.107***	-0.041***	-0.049***
	(0.002)	(0.003)	(0.007)	(0.035)	(0.008)	(0.007)	(0.002)	(0.003)	(0.007)	(0.028)	(0.008)	(0.007)
$Size$	-0.001*	-0.023***	-0.030***	0.010***	0.002**	0.003***	-0.000	-0.022***	-0.031***	0.008***	0.002**	0.003***
	(0.001)	(0.003)	(0.005)	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)	(0.005)	(0.003)	(0.001)	(0.001)
$\Delta Debt$	0.050***	0.037**	0.065***	0.100***	0.070***	0.071***	0.036**	0.020	0.046***	0.051**	0.046***	0.046***
	(0.016)	(0.015)	(0.015)	(0.029)	(0.015)	(0.015)	(0.016)	(0.016)	(0.015)	(0.021)	(0.015)	(0.015)
ΔPPE	-0.124***	-0.164***	-0.193***	-0.023	-0.092***	-0.089***	-0.120***	-0.154***	-0.174***	-0.042	-0.095***	-0.088***
	(0.015)	(0.013)	(0.018)	(0.037)	(0.014)	(0.014)	(0.015)	(0.013)	(0.019)	(0.031)	(0.015)	(0.015)
N	5,906	5,906	4,217	5,906	5,906	5,906	5,906	5,906	4,217	5,906	5,906	5,906
R^2	0.158	0.181	0.195				0.172	0.196	0.209			
τ				0.232	0.332	0.321				0.296	0.431	0.393
ρ		0.329		0.259	0.184	0.187		0.336		0.261	0.195	0.204

Pane B: Other countries

Estimation	OLS	FE	IV	GMM3	GMM4	GMM5	OLS	FE	IV	GMM3	GMM4	GMM5
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF	0.345***	0.439***	0.455***	0.323***	0.390***	0.395***	0.352***	0.472***	0.471***	0.175	0.317***	0.376***
	(0.022)	(0.037)	(0.027)	(0.097)	(0.068)	(0.037)	(0.024)	(0.039)	(0.031)	(0.174)	(0.102)	(0.042)
$Dneg$							-0.033**	-0.032**	-0.011	-0.045**	-0.036**	-0.032**
							(0.014)	(0.016)	(0.017)	(0.020)	(0.017)	(0.015)
$CF \times DNeg$							-0.476***	-0.709***	-0.316	-0.276	-0.442**	-0.512***
							(0.145)	(0.179)	(0.207)	(0.259)	(0.183)	(0.152)
Q	-0.018***	-0.010**	0.030	-0.012	-0.030	-0.031***	-0.018***	-0.011***	0.032	0.023	-0.010	-0.024***
	(0.002)	(0.004)	(0.050)	(0.025)	(0.019)	(0.007)	(0.002)	(0.004)	(0.050)	(0.037)	(0.023)	(0.007)
$Size$	-0.003***	-0.051***	-0.063**	-0.004***	-0.004***	-0.004***	-0.004***	-0.051***	-0.065**	-0.004***	-0.004***	-0.004***
	(0.001)	(0.011)	(0.026)	(0.001)	(0.001)	(0.001)	(0.001)	(0.011)	(0.026)	(0.001)	(0.001)	(0.001)
$\Delta Debt$	0.095***	0.091***	0.008	0.090***	0.090***	0.090***	0.095***	0.088***	0.001	0.093***	0.091***	0.090***
	(0.028)	(0.029)	(0.039)	(0.027)	(0.027)	(0.027)	(0.028)	(0.030)	(0.039)	(0.030)	(0.027)	(0.027)
ΔPPE	-0.174***	-0.254***	-0.276***	-0.175***	-0.176***	-0.177***	-0.180***	-0.262***	-0.278***	-0.175***	-0.181***	-0.184***
	(0.034)	(0.044)	(0.038)	(0.035)	(0.034)	(0.034)	(0.034)	(0.044)	(0.038)	(0.041)	(0.035)	(0.035)
N	1,374	1,374	828	1,374	1,374	1,374	1,374	1,374	828	1,374	1,374	1,374
R^2	0.277	0.372	0.345				0.285	0.387	0.343			
τ				1.453	0.677	0.658				-0.423	1.665	0.822
ρ		0.780		0.246	0.301	0.305		0.779		0.151	0.249	0.290