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Citation for published version:
Caglayan, M & Machokoto, M 2024, 'The sensitivity of investment to internal and external funds: New emerging market evidence', *Research in International Business and Finance*, vol. 67, no. Part B, 102099. https://doi.org/10.1016/j.ribaf.2023.102099

Digital Object Identifier (DOI):
10.1016/j.ribaf.2023.102099

Link:
Link to publication record in Heriot-Watt Research Portal

Document Version:
Publisher's PDF, also known as Version of record

Published In:
Research in International Business and Finance

Publisher Rights Statement:
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Download date: 16. Aug. 2024

Research in International Business and Finance 67 (2024) 102099



Contents lists available at ScienceDirect

Research in International Business and Finance

journal homepage: www.elsevier.com/locate/ribaf



Full length article



The sensitivity of investment to internal and external funds: New emerging market evidence

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ARTICLE INFO

Keywords:
Financial constraints
Internal and external capital
Emerging markets

ABSTRACT

Using a large panel of firm-level data from eight emerging African countries, we show that firms' fixed investment expenditures are more sensitive to external funds, particularly debt, relative to internal funds. We further show that the investment sensitivity to external funds is associated with over-investment rather than financial constraints. This nexus remains strong through the financial crisis and after addressing measurement errors. Our study shows that the investment behavior of emerging market firms is influenced by the availability of internal and external funds and that the latter, whose role has received limited attention, is playing an ever-increasing role.

1. Introduction

Since the seminal study of Fazzari et al. (1988), many researchers have continued to interpret the sensitivity of fixed investment expenditures to internally generated funds as an outcome of credit constraints (e.g., Biddle and Hilary, 2006; Almeida and Campello, 2007; Beatty et al., 2010); however, several studies have argued that this interpretation might be problematic as evidence consistently indicates that the investment-cash flow sensitivity has declined over time (see Chen and Chen, 2012; Moshirian et al., 2017; Machokoto et al., 2019). Researchers have also shown that firms have been leveraging extensively over the last three decades. For instance, Graham et al. (2015) report a three-fold rise in leverage ratios for non-utility and non-financial firms in the United States (US) from 1920 to 2010. Similar observations have been reported for firms in other parts of the world, including Africa (see Alfaro et al., 2019; Edjigu and Sim, 2019; Machokoto et al., 2020). This study focuses on a large panel of listed firms from eight emerging African countries and reexamines the sensitivity of fixed investment expenditures on internally generated funds. In doing so, we specifically scrutinize the role of external sources of funds on investment expenditures, including debt and equity financing. Our investigation is motivated by the observation that African firms with good investment prospects have increasingly attracted external funds despite the traditionally highlighted limited access to external finance (e.g., Gwatidzo and Ojah, 2014; Machokoto et al., 2020).[1]

In particular, over the last three decades, firms with better prospects for growth in Africa have raised substantial amounts of external funds to finance their large fixed investment projects, although they generated limited internal funds.[2] Hence, as African firms' capital structures change, it is essential to reevaluate the sensitivity of the firms' investment expenditures to the availability

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[1] Also see Gwatidzo and Ojah (2014), Beck et al. (2009), and Edjigu and Sim (2019).

[2] For instance, see, among others, Mu et al. (2013), Garay et al. (2019) and Machokoto et al. (2020).

https://doi.org/10.1016/j.ribaf.2023.102099
Received 23 August 2022; Received in revised form 5 September 2023; Accepted 8 September 2023
Available online 13 September 2023
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of internal and external funds. This is an open question that has not been scrutinized earlier, while the literature primarily focused on the role of internal funds for firms in developed economies. We investigate the fixed investment sensitivity of firms to the available sources of funds by employing a large unbalanced firm-level panel dataset comprised of 799 manufacturing firms from eight emerging African countries.[3] We initially examine the sensitivity of fixed investment expenditures to sources of finance by implementing two-stage least squares (2SLS) instrumental variables (IV-2SLS) (Baum et al., 2008), GMM (IV-GMM) (Baum et al., 2003a) and GMM5 higher-order moments estimator of Erickson and Whited (2000, 2002). We then split the firms into constrained versus non-constrained groups based on a set of widely used proxies to evaluate the role of financial constraints on firms' investment expenditures, including size, age, HP (Hadlock and Pierce, 2010) and WW (Whited, 2006) indices and reexamine the model for each sub-group.[4] We establish whether the investment sensitivity of firms to sources of funds is affected as a consequence of firms' investment expenditures exceeding (or falling short of) the industry average. This thorough investigation can, therefore, help us (1) to reconcile the mixed findings due to specific proxies and (2) uncover consistent evidence from African countries central to the literature.

Our initial examination provides evidence that firms' fixed investment expenditures react positively to internal and external funds; however, our empirical results show a significant difference in the order of importance of the sources of funds on investment expenditures. Based on the calculated elasticities, borrowing is the most important source, followed by cash flow, and equity financing; a one standard deviation increase in debt, cash flow, and equity increases fixed investment expenditures by 1.79, 1.44, and 0.20 percentage points, respectively. A similar order occurs when we examine the relationship between constrained versus unconstrained firms. Furthermore, constrained firms' investment expenditures are more sensitive to debt and internal financing than unconstrained firms. Additionally, equity financing has a more prominent role for unconstrained firms.

Our investigation further provides evidence that the impact of debt financing is most important for those firms that invest more than the industry average. We also find that equity financing has no significant role when firms invest above the industry average. This pattern repeats when we spit the data for constrained versus unconstrained firms; debt financing is paramount for constrained firms to carry out investment expenditures. Our investigation suggests that the sensitivity of investment to external funds is essential for firms that expand their investment activities above the industry average. The results are robust to using alternative measures of financial constraints.

Using data from emerging African countries, we contribute to the literature by providing new empirical insights on the nexus between investment and cash flow (internal funds). By considering the role of internal and external funds together, we show that firms' fixed investment expenditures are more sensitive to debt financing than internally generated funds. Access to external capital, especially corporate debt, has been improving in emerging markets (see Mu et al., 2013; Garay et al., 2019; Machokoto et al., 2020); thus, our study shows the vital role that debt financing can play in the African firms with higher than average investment expenditures.

The rest of our paper is organized as follows. Section 2 describes the methodology and data. Section 3 presents and discusses the empirical results. Section 4 presents the robustness tests, and Section 5 concludes.

2. Methodology and data

We use a variant of the Fazzari et al. (1988) model to investigate the sensitivity of investment to internal and external sources of funds for a large panel of firms collected from eight emerging African countries.[5] While this study implemented a static model, we also provide evidence that dynamic models would yield similar results for the whole dataset. We proceeded with static models so as not to sacrifice data, as the permissible instruments require different lags of the variables when using dynamic models.[6] Our baseline model takes the following form:

$$I_{ijt} = \alpha_0 + \beta_1 CF_{ijt} + \beta_2 \Delta D_{ijt} + \beta_3 \Delta E_{ijt} + \theta \boldsymbol{X}_{ijt-1} + \mu_i + \mu_t + e_{ijt} \quad (1)$$

where I_{ijt} is the investment for firm i in industry j at time t. We are specifically interested in the sensitivity of investment to internal (CF_{ijt}) and external sources of funds (ΔD_{ijt} and ΔE_{ijt}) captured by the coefficients β_1—β_3, respectively. We expect each of these coefficients to take a positive sign, as firms' investment expenditures should depend on the availability of all sources of funds. Nonetheless, in the context of emerging African country firms, we expect the debt sensitivity to investment to be higher than that of internal funds and cash flow because debt financing should be of paramount importance, especially for firms with profitable investment opportunities, low debt overhang, and low levels of internally generated funds. Otherwise, these firms could not pursue their investments as planned (Machokoto et al., 2020; Dodd et al., 2021). Furthermore, firms would not often resort to new equity issuance because equity financing is the most expensive means to raise funds; hence, the coefficient associated with debt financing,

[3] The data is collected for manufacturing firms from Egypt, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, South Africa, and Tunisia.

[4] A wide variety of credit constraint measures are used to provide broader consensus on the investment sensitivity link. Also, see Hadlock and Pierce (2010).

[5] For other studies using similar models, see, Guariglia (2008), Chen and Chen (2012), Moshirian et al. (2017), Drobetz et al. (2018) and Drobetz et al. (2019).

[6] This requirement becomes especially binding for subsample investigations.

β_2, is expected to be greater than that of cash flows, β_1. In contrast, the coefficient on equity financing, β_3, to be the smallest: $\beta_2 > \beta_1 > \beta_3$.[7]

The model controls for several additional variables depicted by vector $\boldsymbol{X}$. The vector contains Tobin's q to capture the firm's investment opportunities. At the beginning of the period, the average Tobin's q is defined as the firm's market value (shares plus debt) net of current assets (inventories and financial assets) divided by the book value of the firm's total assets.[8] The model also contains total aggregate debt (D) to control for debt overhang, as highly indebted firms might choose not to expand more on investment (see Lang et al., 1996; Lyandres and Zhdanov, 2005). We include cash holdings of the firm, *Cash*, as a control variable for emerging market firms that have limited access to external finance and may significantly depend on internal financing sources, which include retained earnings, loans from related parties, and cash reserves (Guariglia and Yang, 2018). Our empirical model also controls for sales growth (*SG*), the logarithm of total assets (*Size*), and property, plant, and equipment (*PPE*). The inclusion of *PPE* in the model is motivated by Moshirian et al. (2017), who showed that asset tangibility significantly impacts the investment-cash flow sensitivity.[9] We control for country-specific effects by introducing the GDP growth rate, inflation rate, and interest rate spread for each country, as introducing country-specific dummies renders an irreversible variance–covariance matrix. For robustness, we also present results based on alternative estimation techniques and variants of Eq. (1) to account for the dynamic nature of corporate investment decisions.

We next conjecture that the investment sensitivity of firms to internal and external funds would be affected by the extent that firms' fixed investment expenditures exceed (or fall short of) their industrial peers. Moreover, we argue that firms that invest more than their peers would display higher sensitivity levels for all sources of funds. To examine these claims, we generate a dummy variable, *DO*, that takes the value of 1 when the firm invests more than the industry median by year and country and otherwise zero.[10] Consequently, we modify Eq. (1) as follows:

$$\begin{aligned} I_{ijt} =& \alpha_0 + \beta_1 CF_{ijt} + \beta_2 \Delta D_{ijt} + \beta_3 \Delta E_{ijt} + \alpha_2 DO_{ijt-1} \\ &+ \gamma_4 CF_{ijt} \times DO_{ijt-1} + \gamma_5 \Delta D_{ijt} \times DO_{ijt-1} \\ &+ \gamma_6 \Delta E_{ijt} \times DO_{ijt-1} + \theta \boldsymbol{X}_{ijt-1} + \eta_i + \eta_t + \epsilon_{ijt} \end{aligned} \tag{2}$$

The main difference between Eq. (2) and the earlier models is the introduction of interaction terms. The parameters on the interaction terms, α_4—α_6, capture the incremental sensitivity difference of investment on the sources of funds when the firm invests over the industry average. We expect these interaction terms to take positive significant coefficients as firms would require further internal and external funds to support over and above industry average investment expenditures. We also expect the sensitivity of investment to internal funds to be more pronounced for firms subjected to binding credit constraints. To test these predictions, we sub-divided the sample in each year and country into constrained versus unconstrained categories if the firm is in the upper (lower) tercile concerning the WW Index (Whited and Wu, 2006), HP Index (Hadlock and Pierce, 2010), firm-size, and firm age.[11]

We estimate Eqs. (1) and (2) using fixed effect (FE), instrumental variables 2SLS (IV-2SLS) (Baum et al., 2008), instrumental variables generalized method of moments (IV-GMM) (Baum et al., 2003b) and the GMM5 higher-order moments estimator of Erickson and Whited (2000, 2002) to address the biases that might be introduced due to the measurement error problem associated with the use of Tobin's q (Erickson and Whited, 2000, 2002). We used twice and thrice lagged peer average market-to-book ratio where the peer average is calculated at the four-digit SIC Code level when we implemented IV-2SLS.[12] We used twice and thrice lagged market-to-book ratio as instruments while implementing IV-GMM and higher-order moments GMM5 estimators. Estimates obtained from various methodologies ensure the robustness of our results and facilitate comparison with prior studies.

2.1. Data

Our data are drawn from the Datastream database, covering from 1997 to 2015.[13] We apply several filters similar to the practice observed in the extant literature to remove the outliers (Almeida et al., 2004; Guariglia, 2008; Bao et al., 2012; Chen et al., 2012; Chang et al., 2014). We exclude firms in the utility and financial sectors and those with missing observations on key variables. We also drop firms that exhibit more than 100% growth in sales or total assets annually. To reduce the compounding effect of outliers, we winsorize all variables used at the upper and lower one percentile. Our final sample comprises 799 firms (8136 firm-year observations) from eight emerging African economies, including Egypt, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, South Africa, and Tunisia.

[7] Sony and Bhaduri (2018) find fewer equity issues relative to debt issues in India, while only firms with low information asymmetry problems can raise a limited amount of funds through the issuance of new equity as capital markets are still in their infancy.

[8] Among others, see Baum et al. (2010), Doidge et al. (2004), Chen and Chen (2012) and Grullon et al. (2018) who employed the same definition to proxy for Tobin's q.

[9] See Almeida et al. (2004), Chen et al. (2012), Chang et al. (2014) and Lewellen and Lewellen (2016) for our choice of control variables.

[10] We also experimented with using mean industry-level investment or the firm's expected investment level driven from Eq. (1) as a target.

[11] Our choice of proxies for financial constraints and categorization schemes is in line with the extant literature (see Almeida et al., 2004; Almeida and Campello, 2007; Francis et al., 2016; Gyimah et al., 2020).

[12] For a similar approach, see Krammer and Jiménez (2020) and Nason and Patel (2016), who used the industrial peer political connectedness and cash holdings to instrument the individual firm's political connectedness and cash holdings, respectively. Therefore, the peer average Tobin's q is less noisy and significantly correlated with GDP growth, a good proxy of firms' long-term growth prospects.

[13] African country firm-level data, especially for the key variables used in this study, are only available from 1997 onwards.

Table 1
Basic statistics.
The table presents variable definitions and summary statistics for all variables. I is capital expenditure-to-lagged total assets. CF is net cash flow from operating activities-to-lagged total assets. ΔD is the change in total debt-to-lagged total assets. ΔE are net proceeds from the sale/issue of common and preferred shares for the current year-to-lagged total assets. D is total debt-to-total assets. $Cash$ is cash and cash equivalent-to-total assets. DO is a dummy variable that takes the value of one for firms with above-target investment and otherwise zero. q is market value-to-total assets. SG is the growth in sales. $Size$ is the logarithm of total assets. PPE is property, plant, and equipment-to-total assets. $WW\,Index = -0.091\times\frac{Cash\ \ Flow}{Total\ \ Assets} - 0.062\times DivDummy + 0.021\times\frac{Total\ \ debt}{Total\ \ Assets} - 0.044\times Size + 0.102\times ISG - 0.035\times SG$. ISG is the industrial sales growth. The *WW Index* is based on Whited and Wu (2006). $HP\,Index = -0.737\times Size + 0.043\times Size^2 - 0.040 * Age$. The *HP Index* is based on Hadlock and Pierce (2010). $LogAge$ is the logarithm of firm age. $GDPGrowth$ is GDP growth (annual %). *Inflation* is the change in the consumer price index (annual %). Interest rate spread ($IRSpread$) is the lending rate minus the deposit rate (%). The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. Macroeconomic variables are from The World Bank. All variables are winsorized at the lower and upper one percentile.

Panel A: All sample firms

Variables	N	Mean	Std.Dev	Min	p25	Median	p75	Max
I	8,136	0.074	0.064	0.000	0.030	0.058	0.102	0.627
CF	8,136	0.129	0.114	−0.557	0.060	0.117	0.185	0.703
ΔD	8,136	0.022	0.088	−0.441	−0.017	0.001	0.051	0.957
ΔE	8,136	0.010	0.042	0.000	0.000	0.000	0.002	0.735
DO	8,136	0.445	0.497	0.000	0.000	0.000	1.000	1.000
D	8,136	0.131	0.117	0.000	0.047	0.099	0.179	0.758
Cash	8,136	0.156	0.139	0.000	0.038	0.129	0.234	0.741
q	8,136	1.599	0.899	0.284	1.012	1.341	1.930	9.732
SG	8,136	0.121	0.192	−0.496	0.023	0.107	0.202	0.976
Size	8,136	15.054	2.068	8.141	13.516	15.292	16.588	19.880
PPE	8,136	0.352	0.222	0.004	0.161	0.315	0.535	0.977
WW	8,136	−0.721	0.103	−0.991	−0.792	−0.736	−0.652	−0.352
HP	8,136	−11.381	1.040	−12.369	−12.135	−12.009	−10.804	−6.880
LogAge	8,136	2.372	0.524	1.099	2.079	2.398	2.773	3.258
GDPGrowth	7,337	0.033	0.019	−0.044	0.025	0.032	0.046	0.140
Inflation	7,337	0.063	0.031	0.004	0.046	0.057	0.071	0.262
IRSpread	6,796	0.044	0.013	0.032	0.033	0.040	0.050	0.130
CF *vs* ΔD		0.107***	0.025***			0.116***		
CF *vs* ΔE		0.119***	0.072***			0.117***		
ΔD *vs* ΔE		0.012***	0.046***			0.001		

Panel B: Differences between below and above-target firms

Variables	Below-target firms (DO=0)				Above-target firms (DO=1)			
	N	Mean	Median	Std.Dev	N	Mean	Median	Std.Dev
I	4,514	0.052	0.039	0.047	3,622	0.103***	0.089***	0.070***
CF	4,514	0.117	0.105	0.110	3,622	0.144***	0.136***	0.116***
ΔD	4,514	0.019	0.000	0.091	3,622	0.025***	0.006***	0.084***
ΔE	4,514	0.009	0.000	0.044	3,622	0.011*	0.000***	0.038***
D	4,514	0.136	0.100	0.125	3,622	0.124***	0.096*	0.106***
Cash	4,514	0.152	0.124	0.140	3,622	0.160***	0.133**	0.139
q	4,514	1.546	1.265	0.895	3,622	1.666***	1.419***	0.900
SG	4,514	0.105	0.103	0.186	3,622	0.142***	0.114***	0.196***
Size	4,514	14.907	15.186	2.119	3,622	15.236***	15.421***	1.989***
PPE	4,514	0.302	0.239	0.225	3,622	0.414***	0.388***	0.201***
WW	4,514	−0.714	−0.731	0.106	3,622	−0.731***	−0.743***	0.099***
HP	4,514	−11.306	−11.902	1.105	3,622	−11.475***	−12.068***	0.946***
LogAge	4,514	2.334	2.398	0.530	3,622	2.420***	2.485***	0.512**
CF *vs* ΔD		0.098***	0.105***	0.019***		0.119***	0.131***	0.032***
CF *vs* ΔE		0.108***	0.105***	0.066***		0.133***	0.136***	0.078***
ΔD *vs* ΔE		0.010***	0.000	0.047***		0.014***	0.006*	0.046***

(*continued on next page*)

Table 1 provides the summary statistics of all variables and their full definition. Panel A shows that the mean (median) investment (I) is 7.4% (5.8%). Panel B of the table shows that target firms above (below) have higher (lower) investments and higher (lower) internal (CF) and external funds (ΔD and ΔE). Panel C, conditional on four commonly used proxies of financial constraints (WW Index, HP Index, size, and firm age), provides evidence of significant differences between firms. In particular, we find that unconstrained firms have a higher investment (I), cash flow (CF), and new loans (ΔD), while they have a lower equity issuance (ΔE) relative to unconstrained firms.

Fig. 1 displays the evolution of investment rates and sources of funds for the full data. Fig. 1(a) shows that the investment expenditures in African economies increased until 2007; however, as the financial crisis in the USA turned into a global crisis, debt financing dropped in 2009 and 2010, but started to increase again as of 2011 (Fig. 1(c)). When we examine firms' cash flow

Table 1 (*continued*).

Panel C: Differences between unconstrained and constrained firms									
Variables		Unconstrained				Constrained			
		N	Mean	Median	Std.Dev	N	Mean	Median	Std.Dev
WW Index	I	2,134	0.087	0.079	0.061	1,953	0.062***	0.043***	0.066***
	CF	2,134	0.139	0.117	0.104	1,953	0.102***	0.099***	0.122***
	ΔD	2,134	0.020	0.006	0.078	1,953	0.013**	0.000***	0.094***
	ΔE	2,134	0.010	0.000	0.039	1,953	0.013**	0.000***	0.051***
	DO	2,134	0.475	0.000	0.499	1,953	0.397***	0.000***	0.489
	D	2,134	0.112	0.088	0.089	1,953	0.151***	0.102***	0.152***
	Cash	2,134	0.181	0.170	0.133	1,953	0.147***	0.115***	0.142***
	q	2,134	1.736	1.499	0.897	1,953	1.282***	1.094***	0.664***
	SG	2,134	0.117	0.101	0.192	1,953	0.123	0.103	0.215***
	Size	2,134	16.997	17.339	1.465	1,953	12.808***	12.914***	1.314***
	PPE	2,134	0.459	0.471	0.202	1,953	0.282***	0.230***	0.211*
HP Index	I	3,959	0.082	0.071	0.060	1,946	0.060***	0.041***	0.065***
	CF	3,959	0.132	0.115	0.103	1,946	0.116***	0.111	0.121***
	ΔD	3,959	0.029	0.007	0.091	1,946	0.008***	0.000***	0.086***
	ΔE	3,959	0.009	0.000	0.036	1,946	0.010	0.000***	0.047***
	DO	3,959	0.472	0.000	0.499	1,946	0.394***	0.000***	0.489
	D	3,959	0.112	0.091	0.089	1,946	0.165***	0.119***	0.155***
	Cash	3,959	0.181	0.156	0.142	1,946	0.130***	0.092***	0.137**
	q	3,959	1.731	1.470	0.956	1,946	1.324***	1.110***	0.749***
	SG	3,959	0.120	0.105	0.183	1,946	0.120	0.104	0.210***
	Size	3,959	16.683	16.606	1.183	1,946	12.625***	12.862***	1.185
	PPE	3,959	0.401	0.375	0.216	1,946	0.277***	0.219***	0.217
Size	I	2,132	0.089	0.082	0.062	1,969	0.060***	0.041***	0.065**
	CF	2,132	0.133	0.111	0.103	1,969	0.116***	0.112	0.121***
	ΔD	2,132	0.028	0.007	0.087	1,969	0.008***	0.000***	0.086
	ΔE	2,132	0.010	0.000	0.042	1,969	0.010	0.000***	0.048***
	DO	2,132	0.487	0.000	0.500	1,969	0.392***	0.000***	0.488
	D	2,132	0.104	0.083	0.081	1,969	0.165***	0.119***	0.155***
	Cash	2,132	0.199	0.183	0.139	1,969	0.129***	0.092***	0.136
	q	2,132	1.660	1.450	0.850	1,969	1.328***	1.112***	0.751***
	SG	2,132	0.129	0.103	0.192	1,969	0.120	0.104	0.211***
	Size	2,132	17.154	17.447	1.344	1,969	12.663***	12.874***	1.231***
	PPE	2,132	0.472	0.487	0.204	1,969	0.275***	0.217***	0.217***
LogAge	I	3,351	0.080	0.068	0.060	1,406	0.071***	0.053***	0.072***
	CF	3,351	0.128	0.113	0.106	1,406	0.124	0.118	0.118***
	ΔD	3,351	0.023	0.005	0.083	1,406	0.018*	0.000***	0.086
	ΔE	3,351	0.008	0.000	0.034	1,406	0.011***	0.000***	0.047***
	DO	3,351	0.439	0.000	0.496	1,406	0.410*	0.000*	0.492
	D	3,351	0.111	0.082	0.095	1,406	0.125***	0.090***	0.122***
	Cash	3,351	0.168	0.142	0.138	1,406	0.144***	0.111***	0.136
	q	3,351	1.688	1.425	0.935	1,406	1.425***	1.259***	0.667***
	SG	3,351	0.102	0.092	0.179	1,406	0.146***	0.116***	0.219***
	Size	3,351	15.916	16.195	2.024	1,406	14.468***	14.441***	2.003
	PPE	3,351	0.428	0.435	0.208	1,406	0.310***	0.235***	0.235***

*** Indicate significance at the one percent level.

** Indicate significance at the five percent level.

* Indicate significance at the ten percent level.

patterns, we see that it has been on an upward trajectory until 2007; however, with the financial crisis and the subsequent decline in world merchandize trade, firms' CF began to exhibit a falling trend. Consequently, after attaining its peak in 2007 at around 9.20%, firms' investment rate followed a declining path, eventually settling at approximately 5.8% in 2015.[14] The figure provides prima facia evidence that debt financing and CFs are essential for firms' fixed investment expenditures. Indeed, Machokoto et al. (2020) report that South African corporate debt has increased by 89% over the past three decades.[15] Only 13.1% of the assets of the firms in our data are financed by debt, which is comparatively lower than what we observe in developed economies (see Oztekin and Flannery, 2012; Sorge et al., 2017); therefore, we expect debt financing would continue to increase for as long as it is effectively used to support firms' fixed investment expenditures.

[14] Between 2009 and 2011, firms were decommissioning their earlier investments, as there was a continuous flow of funds from the African Countries to the rest of the world.

[15] These observations are in line with the literature (see Khémiri and Noubbigh, 2019; Machokoto et al., 2020; Machokoto and Areneke, 2020).

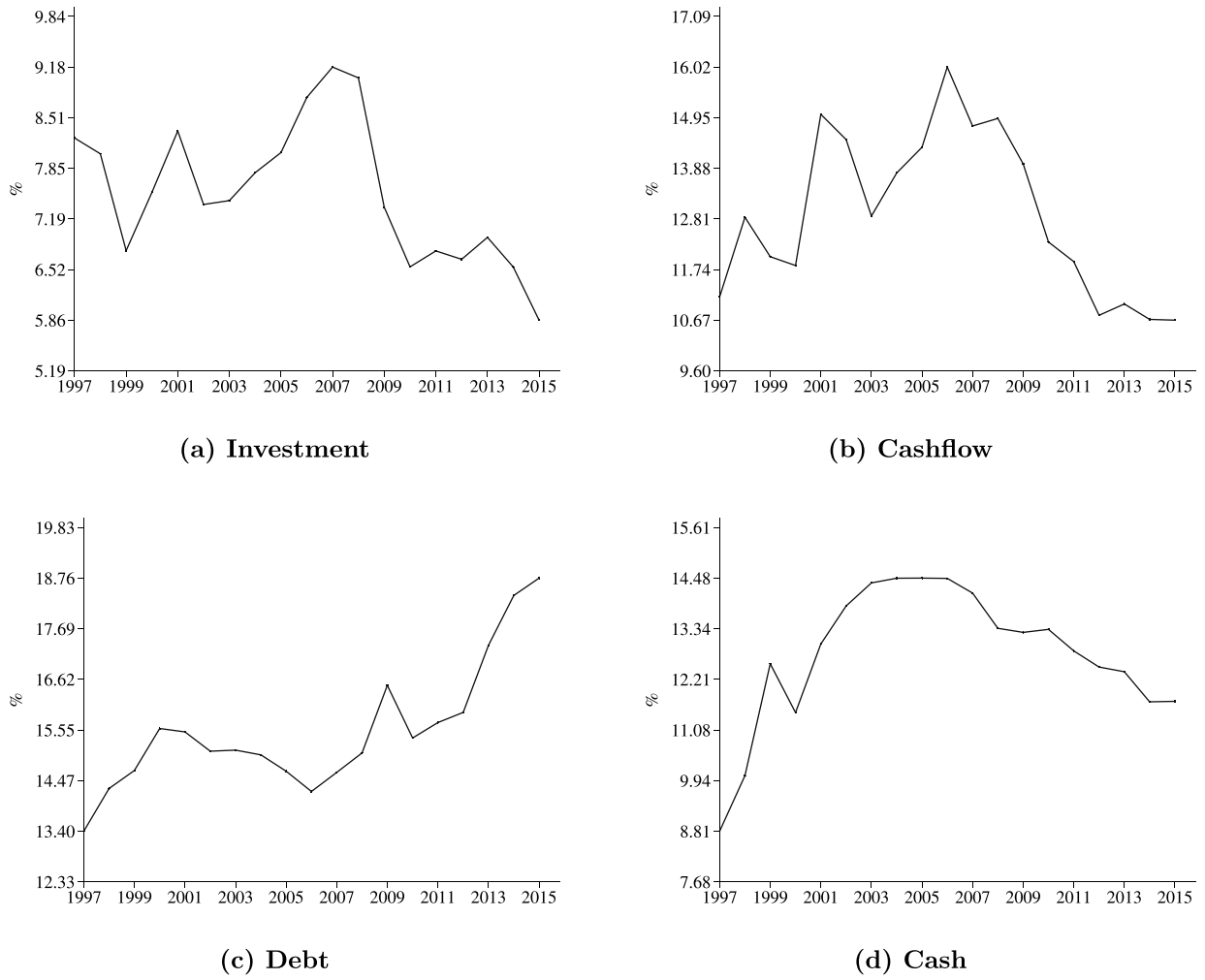


Fig. 1. Investment, internal, and external funds.
The figure plots the mean of investment, internal, and external funds over time. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables used are defined in Table 1 and are winsorized at the lower and upper one percentile.

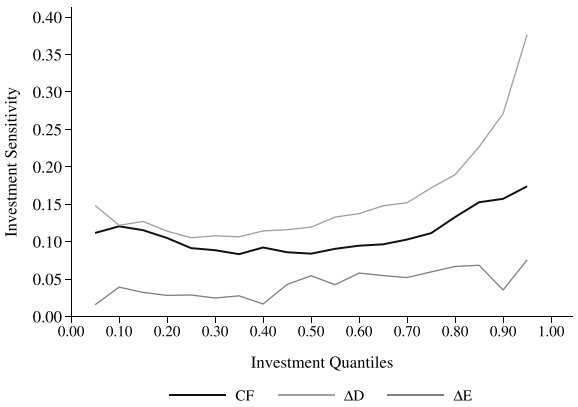


Fig. 2. The sensitivity of investments.
The figure plots the coefficients of internal and external sources of funds at different quantiles of investments. Investment sensitivities are estimated using quantile regressions based on Eq. (1). The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables used are defined in Table 1 and are winsorized at the lower and upper one percentile.

Table 2
Correlations.
The table presents the pairwise correlations. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

#	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	I	1								
(2)	CF	0.285***	1							
(3)	ΔD	0.270***	−0.108***	1						
(4)	ΔE	0.079***	−0.115***	0.050***	1					
(5)	D	0.421***	0.144***	0.028**	0.013	1				
(6)	Cash	−0.101***	0.184***	−0.048***	−0.026**	−0.049***	1			
(7)	DO	0.069***	−0.206***	−0.012	0.099***	0.018	−0.362***	1		
(8)	q	0.189***	0.413***	0.131***	0.139***	0.089***	0.158***	−0.109***	1	
(9)	SG	0.093***	0.177***	0.081***	0.000	0.081***	0.020*	−0.007	0.133***	1
(10)	Size	0.147***	0.007	0.064***	−0.015	0.049***	−0.253***	0.211***	0.163***	0.002
(11)	PPE	0.407***	0.094***	0.010	0.060***	0.275***	−0.332***	0.254***	−0.018	−0.040***
(12)	WW	−0.150***	−0.104***	−0.055***	0.029**	−0.061***	0.182***	−0.119***	−0.233***	−0.002
(13)	HP	−0.115***	−0.050***	−0.091***	0.018	−0.040***	0.240***	−0.154***	−0.190***	−0.014
(14)	LogAge	−0.003	−0.062***	0.026**	−0.032***	0.060***	−0.105***	0.099***	0.106***	−0.098***
(15)	GDPGrowth	0.149***	0.104***	0.105***	0.020*	−0.014	0.069***	−0.048***	0.152***	0.084***
(16)	Inflation	−0.032***	0.012	−0.023*	−0.029**	−0.006	0.002	0.007	0.018	0.119***
(17)	IRSpread	0.080***	0.071***	0.031**	−0.015	−0.047***	0.009	−0.027**	0.020*	0.034***

#	Variables	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(10)	Size	1							
(11)	PPE	0.315***	1						
(12)	WW	−0.935***	−0.289***	1					
(13)	HP	−0.893***	−0.225***	0.853***	1				
(14)	LogAge	0.431***	0.101***	−0.411***	−0.439***	1			
(15)	GDPGrowth	−0.045***	0.015	0.040***	0.063***	−0.253***	1		
(16)	Inflation	−0.019	0.074***	0.013	0.031**	−0.202***	−0.040***	1	
(17)	IRSpread	0.004	0.103***	−0.030**	0.025**	−0.518***	0.425***	0.273***	1

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

Table 2 shows that pairwise correlation coefficients compare favorably with the earlier research regarding sign and magnitude. Consistent with our central hypothesis, we observe that firms' investment expenditures correlate positively with internal and external funds. The table also shows that CF correlates negatively with debt and equity funds, suggesting that internal and external sources of funds can be substitutes in emerging markets. Observing the evolution of debt from Fig. 1, we argue that firms strive to borrow to substitute for declining internal funds. Similar conclusions are more difficult to draw for equity financing as changes in equity financing do not yield comparable observations. Consistent with our expectations and the literature, the table further shows that investment is negatively correlated with measures of financial constraints (WW Index and HP Index) and positively correlated with size ($Size$) and firm age ($LogAge$).

3. Empirical results

We begin by examining the role of internal and external funds on African firms' investment behavior. Table 3 presents the results for Eq. (1) obtained from the standard fixed effects and several instrumental variable approaches, including IV-2SLS, IV-GMM, and GMM5.

The results in the first four columns were obtained when we implemented the fixed effects method. Columns (1)—(3) introduce firms' sources of funds, CF, debt, and equity financing, separately, while Column 4 estimates the full model. All three columns show that the sensitivity of investment to sources of funds is positive while the coefficient sizes vary substantially. To highlight the economic impact of each source of finance, we calculate the effect of a one standard deviation increase in CF, debt, and equity financing on firms' fixed investment expenditures. The average firm increases its investment expenditures by 0.90 percentage points in response to a one standard deviation change in CF (Column 1). Similarly, Columns (2) and (3) show that the average sample firm increases investment by 1.53 and 0.05 percentage points for one standard deviation increase in debt and equity funds, respectively. These results quantify the significant positive impact of internal (CF) and external (debt) funds on investment expenditures; investment is most sensitive to debt financing, followed by internal funds, and the least on equity financing.[16]

[16] Mu et al. (2013) argue that firms in less-developed capital markets are equity-dependent. We show that equity financing is important but has the least impact, which is not surprising considering that equity financing is considered the most expensive means of raising funds (see Bayless and Chaplinsky, 1996; Bessler et al., 2011; Brav, 2009; Dittmar and Thakor, 2007).

Table 3
Investment, internal, and external funds.
The table presents the estimation results of Eq. (2) that relate investment to firm-specific variables. The models are estimated using fixed effect (FE), instrumental variables 2SLS (IV-2SLS) (Baum et al., 2008), instrumental variables GMM (IV-GMM) (Baum et al., 2003b), and the GMM5 higher-order moments estimator of Erickson and Whited (2000, 2002). The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Estimation	FE				IV-2SLS	IV-GMM	GMM5
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CF_{ijt}	0.079***			0.126***	0.119***	0.120***	0.124***
	(0.008)			(0.008)	(0.010)	(0.010)	(0.025)
ΔD_{ijt}		0.174***		0.203***	0.190***	0.192***	0.200***
		(0.011)		(0.011)	(0.016)	(0.016)	(0.021)
ΔE_{ijt}			0.012	0.048***	0.071***	0.071***	0.059**
			(0.017)	(0.016)	(0.021)	(0.021)	(0.025)
$Cash_{ijt-1}$	0.022**	0.031***	0.023**	0.032***	0.031**	0.031***	−0.013
	(0.009)	(0.009)	(0.009)	(0.009)	(0.012)	(0.012)	(0.010)
D_{ijt-1}	−0.035***	0.023***	−0.038***	0.034***	0.051***	0.052***	0.024**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)	(0.010)
q_{ijt-1}	0.010***	0.009***	0.012***	0.005***	0.010***	0.010***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.005)
SG_{ijt-1}	0.009***	0.015***	0.014***	0.007**	0.001	0.001	0.010**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
$Size_{ijt-1}$	−0.010***	−0.012***	−0.013***	−0.006***	−0.007**	−0.007**	−0.001*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)
PPE_{ijt-1}	−0.001	−0.005	0.001	−0.009	−0.013	−0.013	0.104***
	(0.010)	(0.010)	(0.010)	(0.009)	(0.013)	(0.013)	(0.006)
CF *vs* ΔD				38.83	18.38	19.56	15.36
CF *vs* ΔE				23.34	5.00	5.10	10.09
ΔD *vs* ΔE				77.94	31.41	33.10	43.40
N	8,136	8,136	8,136	8,136	6,538	6,538	8,136
R^2	0.546	0.579	0.536	0.602	0.213	0.212	
τ							0.432
J					0.492	0.492	
J $p-value$					[0.483]	[0.483]	

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

We next estimate the model, including all sources of funds as depicted in Eq. (1), to evaluate the effect of each source in the presence of the other sources. The results show that investment is more sensitive to debt financing than CF and equity financing. More specifically, on average, a firm would increase investment by 1.79, 1.44, and 0.20 percentage points in response to a one standard deviation increase in debt, CF, and equity funds, respectively. Furthermore, the R^2 more than doubles when internal and external funds are included in the model compared to the simpler models with a single funding source. The increase in the explanatory power of the entire model signals the importance of incorporating debt finance in investment models, although emerging market firms have been thought to depend heavily on internal rather than external funds. Overall, these findings contrast with the literature, which mainly focused on internal sources (mostly CF) while overlooking the role of external financing sources (see Fazzari et al., 1988, 2000; Chen et al., 2012; Moshirian et al., 2017).

The concern arises whether the results presented so far could be due to measurement errors associated with Tobin's q, a proxy for future growth opportunities. To address this concern, we re-estimate Equation (1) using IV-2SLS (Baum et al., 2008), IV-GMM (Baum et al., 2003b), and GMM5, the higher-order moment estimator of Erickson and Whited (2000, 2002). Columns (5)–(7) show that our main conclusions are not affected by whether we implement IV or GMM approaches. Parameter estimates are similar to those given in Column (4), which we obtained using the fixed effects approach. Specifically, the estimates based on IV-2SLS, IV-GMM, and GMM5 consistently show that investment is more sensitive to debt, followed by cash flow, and equity capital. Therefore, we argue that access to debt financing significantly impacts firms' fixed investment expenditures, especially when internally generated funds and equity financing (an expensive means to raise capital) fall behind the firms' investment plans.

Examining the control variables, we find their associated coefficient estimates are as expected. Cash holdings, Tobin's q, and SG positively impact firms' fixed investment expenditures, which aligns with the extant literature. Debt has a negative and significant effect in the case of fixed effects methods, as expected; however, this effect becomes positive and significant when we implement the IV methods. We observe a positive effect for this variable because when IV methodologies are implemented, which is related to the African firms' low debt-to-total assets ratio (capital structure). Indeed, only over the last two decades has the debt-to-equity ratio increased for African firms. As Fig. 1(d) shows, a debt-to-total assets ratio for firms is less than 20% even by the end of 2015. Examining size and PPE, similar to findings reported in the literature (e.g., Calvino et al., 2018; Ding et al., 2012; Hart and Oulton,

Table 4
Investment, financial constraints, internal, and external funds.
The table presents the estimation results of Eq. (2) that relate investment to firm-specific variables. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Constraints	WW Index			HP Index			Size			LogAge		
	U	C	Diff	U	C	Diff	U	C	Diff	U	C	Diff
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF_{ijt}	0.120***	0.114***	0.30	0.134***	0.100***	12.24***	0.139***	0.101***	9.93***	0.136***	0.101***	9.13***
	(0.009)	(0.008)		(0.007)	(0.007)		(0.009)	(0.008)		(0.007)	(0.008)	
ΔD_{ijt}	0.254***	0.219***	8.47***	0.208***	0.206***	0.06	0.261***	0.204***	21.52***	0.231***	0.204***	6.40**
	(0.008)	(0.009)		(0.006)	(0.008)		(0.008)	(0.009)		(0.008)	(0.009)	
ΔE_{ijt}	0.095***	0.035**	7.32***	0.099***	0.054***	5.39**	0.104***	0.045***	6.89***	0.123***	0.045***	5.50**
	(0.016)	(0.016)		(0.014)	(0.014)		(0.015)	(0.016)		(0.017)	(0.016)	
$Cash_{ijt-1}$	−0.030***	0.050***	31.66***	0.025***	0.042***	2.23	0.008	0.044***	5.88**	0.031***	0.044***	20.37***
	(0.011)	(0.009)		(0.009)	(0.007)		(0.012)	(0.008)		(0.010)	(0.008)	
D_{ijt-1}	0.030***	0.047***	1.52	0.041***	0.028***	1.40	0.059***	0.030***	4.52**	0.027***	0.030***	51.01***
	(0.009)	(0.010)		(0.007)	(0.008)		(0.010)	(0.010)		(0.008)	(0.010)	
q_{ijt-1}	0.012***	0.008***	3.98**	0.006***	0.007***	0.09	0.013***	0.007***	10.11***	0.011***	0.007***	90.20***
	(0.001)	(0.002)		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
SG_{ijt-1}	0.015***	0.006	2.74*	0.009***	0.006**	0.34	0.013***	0.007*	1.61	−0.000	0.007*	0.02
	(0.003)	(0.004)		(0.003)	(0.003)		(0.004)	(0.004)		(0.003)	(0.004)	
$Size_{ijt-1}$	0.004**	−0.011***	25.13***	0.003*	−0.016***	51.98***	0.012***	−0.016***	73.86***	0.004**	−0.016***	47.02***
	(0.002)	(0.002)		(0.002)	(0.002)		(0.002)	(0.002)		(0.002)	(0.002)	
PPE_{ijt-1}	−0.019*	−0.034***	0.96	−0.009	−0.042***	7.23***	−0.007	−0.042***	5.67**	−0.024***	−0.042***	1.62
	(0.010)	(0.011)		(0.008)	(0.009)		(0.010)	(0.011)		(0.008)	(0.011)	
CF *vs* ΔD	154.50***	101.50***		78.78***	137.20***		120.70***	92.06***		103.90***	92.06***	
CF *vs* ΔE	2.14	23.41***		5.14**	10.10***		4.37**	10.55***		0.51	10.55***	
ΔD *vs* ΔE	81.38***	109.40***		50.53***	96.97***		83.85***	75.95***		34.98***	75.95***	
N	2,134	2,134		3,959	3,959		2,132	2,132		3,351	2,132	
R^2	0.266	0.194		0.223	0.171		0.287	0.172		0.252	0.172	

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

1996; Soderbom and Teal, 2004), we find that these two variables negatively affect investment expenditures. This result is expected as mature and large firms tend to invest less relative to young and small firms that aggressively seek growth opportunities.[17]

In summary, our findings suggest that access to debt finance (ΔD) increases investment significantly more than other sources, such as operating CF, equity issues, and cash reserves ($Cash$). This finding is surprising as access to external finance is limited in emerging markets. We attribute this insight to two reasons. (1) Access to debt, which has been improving in emerging markets, enables firms to undertake additional projects that would not have been possible otherwise. (2) Debt serves a dual purpose as a disciplinary device that prevents management from slacking (under-investing) and diverting free-CF to finance private benefits (Berger et al., 1997; Jensen, 1986).

3.1. Financial constraints and sensitivity of investment to internal and external funds

Having shown the importance of debt financing on investment expenditures, we examine whether our findings hold for financially constrained *versus* unconstrained firms by using the WW Index, HP Index, size, and age to differentiate between the two firms. Table 4 presents the coefficient estimates.

Observing the coefficient estimates, we find that all coefficients assume the expected signs, as in Table 3. Second, and more importantly, we find that the coefficient estimates associated with sources of funds are greater for unconstrained firms than constrained ones. This result holds for any method we used to construct our sample splits with minor differences.[18] The findings reported in this table further highlight the need for caution when interpreting the correlation between investment and CF (investment-CF sensitivity).

The second interesting observation we can drive from Table 4 is that the sensitivity of investment to debt financing is higher for all sub-samples than its responsiveness to CF and equity funds. Thus, both constrained and unconstrained firms depend heavily on debt financing rather than their internal sources or equity financing. This result confirms our earlier findings in Table 3 and indicates the importance of borrowing for emerging market firms to continue their planned investment expenditures.

[17] This finding is in line with Ding et al. (2018), who find that most private firms, which are mostly young and small, assume more investment opportunities in China.

[18] Cash flow sensitivity is significantly higher for HP index, size, and age-based unconstrained firms. The role of debt financing is significantly higher for WW index, size, and age-based unconstrained firms. The impact of equity financing is significantly higher for the WW index, HP index, and size-based unconstrained firms.

Table 5
The effect of over (under) investment on investment sensitivity to internal and external funds.
The table presents the estimation results of Eq. (2) that relate investment to firm-specific variables. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Constraints	WW Index			HP Index			Size			LogAge		
	U	C	Diff	U	C	Diff	U	C	Diff	U	C	Diff
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CF_{ijt}	0.129***	0.090***	5.90**	0.116***	0.053***	21.99***	0.101***	0.054***	8.18***	0.129***	0.061***	25.55***
	(0.013)	(0.010)		(0.010)	(0.009)		(0.013)	(0.010)		(0.010)	(0.009)	
ΔD_{ijt}	0.215***	0.139***	24.32***	0.154***	0.135***	2.36	0.213***	0.134***	27.61***	0.177***	0.161***	1.43
	(0.011)	(0.011)		(0.008)	(0.009)		(0.010)	(0.011)		(0.009)	(0.009)	
ΔE_{ijt}	0.106***	0.025	8.88***	0.118***	0.043***	10.02***	0.094***	0.043**	3.88**	0.114***	0.069***	2.81*
	(0.019)	(0.019)		(0.018)	(0.015)		(0.018)	(0.018)		(0.021)	(0.017)	
DO_{ijt-1}	0.007***	0.003**	8.89***	0.010***	0.004***	24.12***	0.010***	0.004***	13.42***	0.012***	0.006***	17.40***
	(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
$CF_{ijt} \times DO_{ijt-1}$	−0.006	0.066***	10.56***	0.036***	0.118***	19.69***	0.078***	0.119***	3.28*	0.012	0.116***	29.90***
	(0.016)	(0.015)		(0.013)	(0.013)		(0.017)	(0.015)		(0.013)	(0.014)	
$\Delta D_{ijt} \times DO_{ijt-1}$	0.086***	0.196***	24.57***	0.120***	0.178***	10.03***	0.121***	0.181***	7.15***	0.125***	0.261***	45.12***
	(0.016)	(0.016)		(0.012)	(0.014)		(0.015)	(0.017)		(0.014)	(0.015)	
$\Delta E_{ijt} \times DO_{ijt-1}$	−0.021	0.032	1.32	−0.007	0.016	0.30	0.082**	−0.004	3.24*	0.050	0.043	0.02
	(0.032)	(0.032)		(0.029)	(0.031)		(0.032)	(0.035)		(0.034)	(0.030)	
$Cash_{ijt-1}$	−0.026**	0.048***	27.23***	0.032***	0.039***	0.38	0.017	0.040***	2.53	0.041***	0.100***	21.50***
	(0.011)	(0.008)		(0.009)	(0.007)		(0.012)	(0.008)		(0.010)	(0.008)	
D_{ijt-1}	0.030***	0.041***	0.64	0.036***	0.024***	1.14	0.057***	0.026***	4.83**	0.025***	0.114***	55.45***
	(0.009)	(0.010)		(0.007)	(0.008)		(0.010)	(0.010)		(0.008)	(0.009)	
q_{ijt-1}	0.010***	0.009***	1.01	0.005***	0.007***	3.29*	0.011***	0.008***	3.08*	0.010***	−0.004***	71.72***
	(0.001)	(0.002)		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
SG_{ijt-1}	0.012***	0.006*	1.41	0.006**	0.006**	0.01	0.011***	0.006*	0.92	−0.003	0.003	1.47
	(0.003)	(0.004)		(0.003)	(0.003)		(0.004)	(0.004)		(0.003)	(0.003)	
$Size_{ijt-1}$	0.002	−0.010***	16.78***	0.003*	−0.014***	44.91***	0.010***	−0.015***	58.71***	0.003	−0.011***	23.48***
	(0.002)	(0.002)		(0.002)	(0.002)		(0.002)	(0.002)		(0.002)	(0.002)	
PPE_{ijt-1}	−0.022**	−0.045***	2.43	−0.013	−0.049***	8.55***	−0.002	−0.049***	10.28***	−0.027***	−0.060***	6.52**
	(0.010)	(0.011)		(0.008)	(0.009)		(0.009)	(0.011)		(0.008)	(0.010)	
CF *vs* ΔD	29.34***	13.96***		10.19***	50.86***		49.21***	34.19***		15.48***	64.40***	
CF *vs* ΔE	1.10	10.87***		0.01	0.37		0.12	0.33		0.41	0.19	
ΔD *vs* ΔE	23.38***	29.56***		3.36*	27.83***		31.16***	18.97***		7.28***	23.60***	
CF + CF × DO *vs* ΔD + ΔD × DO	156.50***	137.70***		119.60***	113.90***		114.40***	78.76***		147.20***	298.40***	
CF + CF × DO *vs* ΔE + ΔE × DO	2.04	13.26***		3.39*	16.31***		0.01	18.42***		0.73	6.26**	
ΔD + ΔD × DO *vs* ΔE + ΔE × DO	61.67***	94.97***		50.68***	75.73***		32.98***	70.20***		25.23***	129.50***	
N	2,134	2,134		3,959	3,959		2,132	2,132		3,351	3,351	
R^2	0.281	0.225		0.254	0.201		0.317	0.204		0.288	0.285	

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

3.2. Financial constraints, deviation from target investment and sensitivity of investment to internal and external funds

Overall, our results provide evidence that the sensitivity of investment to external sources of funds, particularly debt financing, is important for all firms regardless of whether they are constrained. We have also shown that this sensitivity is much stronger for unconstrained firms; therefore, we further scrutinize whether the investment sensitivity to the availability of funds depends on the size of the investment and estimate Eq. (2). Table 5 presents the results for constrained and unconstrained firms.

The coefficients associated with CF, debt, and equity financing display a similar pattern as we observed in Table 4. The novelty in Table 5 is the significance of the interaction terms between the sources of funds and the dummy variable, which captures firms that invest over the target. The results show that the interaction coefficient between debt financing and the over-investment dummy is always significant regardless of whether firms are constrained. Furthermore, the incremental difference of the interaction coefficient for constrained firms is significantly higher than for their unconstrained counterparts. These observations are sensible and imply that firms that invest above the industry average depend heavily on debt financing; however, constrained firms rely on more debt financing than unconstrained firms. When we examine the interaction coefficient between the over-investment dummy and CF, although the effect is not as strong, we see a similar pattern. Cash flow becomes vital as firms expand faster than the average firm; for financially constrained firms, CFs have a positive and significant effect if they invest over and above the industry level.

Our analysis provides evidence that investment is sensitive to the availability of debt financing among emerging market firms in Africa. We further show that exceptionally constrained firms that invest over and above the industry average heavily depend on debt financing. Based on our empirical findings, we conclude that (under-) over-investment problems rather than financial constraints drive investment sensitivities. This finding is crucial as it helps reconcile the mixed conclusions in the literature. Furthermore, our results are consistent and robust to using alternative measures of financial constraints. Our findings highlight the limitations of investment sensitivities as proxies of financial constraints and complement Dudley (2012) and Elsas et al. (2013) that significant or lumpy investments are primarily financed externally.

Table 6
Alternative sub-periods and sub-sample analyses.
The table presents the estimation results of Eq. (2) that relate investment to firm-specific variables. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from Datastream from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Sub-period/Sub-sample	1997–2007	2008–2015	Diff	Non-IND	IND	Diff	Non-SA	SA	Diff
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CF_{ijt}	0.069***	0.112***	15.19***	0.089***	0.091***	0.04	0.149***	0.081***	38.70***
	(0.008)	(0.008)		(0.007)	(0.010)		(0.008)	(0.008)	
ΔD_{ijt}	0.131***	0.158***	6.66***	0.145***	0.133***	1.24	0.332***	0.088***	490.60***
	(0.008)	(0.008)		(0.007)	(0.009)		(0.008)	(0.007)	
ΔE_{ijt}	0.012	0.103***	16.47***	0.045***	0.038*	0.07	0.255***	0.016	86.63***
	(0.013)	(0.018)		(0.013)	(0.023)		(0.022)	(0.013)	
DO_{ijt-1}	0.013***	0.005***	48.61***	0.009***	0.009***	0.12	0.006***	0.011***	15.02***
	(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
$CF_{ijt} \times DO_{ijt-1}$	0.102***	0.045***	14.32***	0.055***	0.130***	21.06***	0.103***	0.069***	4.21**
	(0.011)	(0.011)		(0.010)	(0.013)		(0.013)	(0.010)	
$\Delta D_{ijt} \times DO_{ijt-1}$	0.157***	0.122***	4.75**	0.123***	0.179***	12.01***	0.080***	0.168***	27.58***
	(0.011)	(0.011)		(0.011)	(0.012)		(0.013)	(0.010)	
$\Delta E_{ijt} \times DO_{ijt-1}$	0.164***	−0.059**	35.59***	0.030	0.043	0.11	−0.127***	0.046**	17.96***
	(0.028)	(0.025)		(0.022)	(0.032)		(0.035)	(0.022)	
$Cash_{ijt-1}$	0.033***	0.037***	0.22	0.056***	−0.040***	84.83***	0.140***	0.020***	117.90***
	(0.007)	(0.007)		(0.006)	(0.008)		(0.009)	(0.006)	
D_{ijt-1}	0.008	0.051***	22.46***	0.028***	0.029***	0.03	0.081***	0.028***	26.74***
	(0.007)	(0.006)		(0.006)	(0.007)		(0.008)	(0.006)	
q_{ijt-1}	0.009***	0.002**	28.90***	0.004***	0.007***	4.40**	0.004***	0.007***	5.06**
	(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
SG_{ijt-1}	−0.004	0.010***	13.44***	0.001	0.015***	14.12***	0.012***	0.002	6.38**
	(0.003)	(0.003)		(0.003)	(0.003)		(0.003)	(0.002)	
$Size_{ijt-1}$	−0.005***	−0.005***	0.01	−0.004**	−0.010***	6.28**	−0.014***	−0.005***	9.50***
	(0.002)	(0.002)		(0.001)	(0.002)		(0.003)	(0.001)	
PPE_{ijt-1}	0.003	−0.031***	10.50***	−0.005	−0.074***	32.45***	−0.019**	−0.006	1.46
	(0.007)	(0.007)		(0.007)	(0.010)		(0.008)	(0.007)	
CF *vs* ΔD	39.33***	22.07***		39.16***	12.52***		377.40***	0.58	
CF *vs* ΔE	17.00***	0.24		9.75***	4.89**		21.34***	20.51***	
ΔD *vs* ΔE	62.86***	7.76***		44.89***	15.72***		10.94***	22.82***	
CF + CF × DO *vs* ΔD + ΔD × DO	112.40***	141.40***		143.90***	63.94***		169.00***	116.10***	
CF + CF × DO *vs* ΔE + ΔE × DO	0.02	43.78***		13.72***	35.83***		19.64***	24.36***	
ΔD + ΔD × DO *vs* ΔE + ΔE × DO	18.24***	163.20***		93.64***	90.76***		103.80***	102.60***	
N	3,520	3,520		5,836	5,836		1,655	1,655	
R^2	0.233	0.202		0.212	0.23		0.306	0.211	

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

4. Robustness

We re-estimate our models following several alternatives to examine the sensitivity of our results, presented in Tables 6–8. Table 6 summarizes the estimation results of Eq. (2) for the following cases. The first two columns of the table focus on the sensitivity of investment to sources of funds over time between the pre- and the post-financial crisis periods;1997–2007 and 2008–2015. Columns 4 and 5 provide coefficient estimates when considering the role of cross-industrial differences for industrial (IND) and non-industrial (Non-IND) firms. Columns 7 and 8 investigate the differences between South African (SA) and non-South African (Non-SA) firms.

Column (1) shows that firms are generally more sensitive to both internal and external funds in the post-crisis period (2008–2015) relative to the pre-crisis (1997–2007); however, when we examine the interaction terms, we realize that external financing had an extra positive effect on firms that overinvested in the pre-crisis period rather than the post-crisis period. This result is possibly due to adopting a more cautious investment approach in the aftermath of the financial crisis. Additionally, the variations in the investment sensitivity around the financial crisis suggest an increased reliance on internal funds and that access to external funds is crucial for survival. Columns 4–6 compare Non-IND and ND firms, indicating that industrial firms depend much more heavily on internal and external funds than non-industrials. We find that debt financing is crucial for industrial firms that invest over the target. Columns (7)—(9) show that the investment sensitivity of the Non-SA firms to sources of funds is relatively higher than that for the SA firms, which could be due to differences in the levels of capital market development, with SA firms having better access to external finance, resulting in lower investment sensitivity.

In Table 7, Columns (1)–(6), we experiment with the use of different tiers of fixed effects in estimating Eq. (1). Our experiments consistently show that firms are more sensitive to debt, followed by CF, and equity funds. In Column (7), we account for changes in macroeconomic conditions by including GDP growth ($GDPGrowth$), inflation, and interest rate spread ($IRSpread$) as additional control variables in the models. Results based on the inclusion of macroeconomic variables provide similar sensitivity orderings.

Table 7
Alternative models of investment, internal and external funds.
The table presents the estimation results of Eq. (1) that relate investment to firm-specific variables. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. Macroeconomic variables are from The World Bank. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CF_{ijt}	0.089***	0.078***	0.077***	0.078***	0.078***	0.062***	0.068***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
ΔD_{ijt}	0.133***	0.132***	0.135***	0.131***	0.134***	0.097***	0.122***
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.010)	(0.013)
ΔE_{ijt}	0.099***	0.081***	0.083***	0.081***	0.083***	0.048***	0.045**
	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.017)	(0.018)
DO_{ijt-1}	0.018***	0.018***	0.020***	0.018***	0.020***	0.003	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\Delta CF_{ijt} \times DO_{ijt-1}$	0.128***	0.127***	0.125***	0.126***	0.123***	0.123***	0.116***
	(0.014)	(0.014)	(0.013)	(0.014)	(0.013)	(0.014)	(0.013)
$\Delta D_{ijt} \times DO_{ijt-1}$	0.186***	0.186***	0.184***	0.185***	0.182***	0.205***	0.181***
	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)	(0.018)	(0.020)
$\Delta E_{ijt} \times DO_{ijt-1}$	0.043	0.039	0.038	0.030	0.028	0.036	0.034
	(0.049)	(0.048)	(0.047)	(0.047)	(0.046)	(0.039)	(0.039)
$Cash_{ijt-1}$	−0.005	−0.006	−0.001	0.003	0.007	0.042***	0.037***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.009)	(0.008)
D_{ijt-1}	0.017***	0.019***	0.019***	0.019***	0.019***	0.025***	0.028***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.007)
q_{ijt-1}	0.002***	0.003***	0.004***	0.002**	0.002**	0.002	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
SG_{ijt-1}	0.005	0.001	0.003	0.001	0.002	−0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$Size_{ijt-1}$	0.000	0.000	−0.001**	−0.000	−0.001**	−0.008***	−0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)
PPE_{ijt-1}	0.074***	0.076***	0.068***	0.078***	0.070***	−0.018**	−0.026***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.009)	(0.009)
$GDPGrowth_{ijt-1}$							0.226***
							(0.046)
$Inflation_{ijt-1}$							0.004
							(0.038)
$IRSpread_{ijt-1}$							−0.077
							(0.080)
CF *vs* ΔD	6.99***	10.24***	12.32***	10.74***	12.82***	9.27***	12.55***
CF *vs* ΔE	0.32	0.03	0.12	0.02	0.09	0.63	1.54
ΔD *vs* ΔE	2.50	5.31**	6.03**	5.23**	5.80**	7.64***	14.95***
$CF + CF \times DO$ *vs* $\Delta D + \Delta D \times DO$	26.79***	33.28***	36.92***	32.26***	35.90***	38.97***	43.51***
$CF + CF \times DO$ *vs* $\Delta E + \Delta E \times DO$	2.64	3.56*	3.38*	4.57**	4.30**	7.85***	8.77***
$\Delta D + \Delta D \times DO$ *vs* $\Delta E + \Delta E \times DO$	17.07***	22.14***	23.06***	25.06***	25.87***	39.34***	41.76***
Firm FE	No	No	No	No	No	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes	No	No
Industry FE	No	No	Yes	No	No	No	No
Country FE	No	No	No	Yes	Yes	No	No
Year#Industry#Country FE	No	No	No	No	No	Yes	No
N	8,136	8,136	8,136	8,136	8,136	8,023	8,136
R^2	0.431	0.444	0.459	0.460	0.475	0.633	0.599

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

Finally, Table 8 provides results for a dynamic version of Eq. (1) which we estimate with the difference generalized method of moments (DIFF-GMM) (Arellano and Bond, 1991) and system generalized method of moments (SYS-GMM) (Blundell and Bond, 1998). We restrict our instruments to the second-to-third lags in both cases to reduce instrument proliferation (too many instruments) (Roodman, 2009). The Hansen (J) and second-order autocorrelation ($m2$) tests are both insignificant, which indicate no evidence of serial correlation, and confirm the validity of our instruments. Table 8 shows that investment is persistent, as evidenced by the relatively high and significant lagged investment coefficient. The lagged investment coefficient is much higher than that reported in the literature, for instance, by Moshirian et al. (2017) for the US and other developed economies (excluding the US) (0.42—0.49), which suggests that African firms may strive to invest in physical or tangible fixed assets. This finding contrasts with the reported transition to intangible or knowledge-based capital in developed economies (see Barth et al., 2009; Brown and Petersen, 2015; He and Wintoki, 2016; Qiu and Wan, 2015) More importantly, Columns (1)—(8) show that investment sensitivities to internal and external capital are in line with our main results even after accounting for potential endogeneity concerns (using instrumental

Table 8
Dynamic models of investment, internal and external funds.
The table presents the estimation results of Eq. (1) that relate investment to firm-specific variables. The sample consists of 799 listed non-financial and non-utility firms (8136 firm-year observations) from eight countries drawn from *Datastream* from 1997 to 2015. All variables are defined in Table 1 and are winsorized at the lower and upper one percentile.

Variables	DIFF-GMM				SYS-GMM			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I_{ijt-1}	0.542***	0.531***	0.529***	0.538***	0.510***	0.505***	0.525***	0.477***
	(0.102)	(0.099)	(0.103)	(0.095)	(0.073)	(0.073)	(0.074)	(0.071)
CF_{ijt}	0.076***			0.105***	0.073***			0.113***
	(0.012)			(0.012)	(0.009)			(0.009)
ΔD_{ijt}		0.125***		0.148***		0.140***		0.168***
		(0.014)		(0.014)		(0.012)		(0.013)
ΔE_{ijt}			0.028	0.051*			0.011	0.046**
			(0.028)	(0.027)			(0.025)	(0.022)
$Cash_{ijt-1}$	0.111***	0.092***	0.086***	0.129***	0.033***	0.048***	0.035***	0.049***
	(0.022)	(0.020)	(0.020)	(0.021)	(0.010)	(0.010)	(0.010)	(0.010)
D_{ijt-1}	−0.128***	0.032*	−0.110***	0.025	−0.026***	0.003	−0.033***	0.018**
	(0.017)	(0.018)	(0.016)	(0.017)	(0.007)	(0.007)	(0.007)	(0.007)
q_{ijt-1}	0.001	0.001	0.002	−0.001	0.004***	0.006***	0.007***	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
SG_{ijt-1}	−0.019***	−0.014***	−0.017***	−0.016***	−0.019***	−0.015***	−0.017***	−0.017***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
$Size_{ijt-1}$	−0.077***	−0.076***	−0.085***	−0.059***	0.001**	0.000	0.001*	0.000
	(0.007)	(0.007)	(0.008)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)
PPE_{ijt-1}	−0.229***	−0.253***	−0.243***	−0.239***	0.035***	0.039***	0.038***	0.033***
	(0.030)	(0.031)	(0.031)	(0.029)	(0.009)	(0.010)	(0.010)	(0.009)
$CF vs \Delta D$				7.09***				18.99***
$CF vs \Delta E$				3.50*				9.61***
$\Delta D vs \Delta E$				14.27***				30.03***
N	7337	7337	7337	7337	8136	8136	8136	8136
m	0.708	0.735	0.862	0.522	0.465	0.611	0.663	0.377
$m\ p-value$	[0.479]	[0.462]	[0.389]	[0.602]	[0.642]	[0.541]	[0.507]	[0.706]
J	1.147	1.122	1.192	0.916	1.223	2.102	2.132	1.149
$J\ p-value$	[0.284]	[0.289]	[0.275]	[0.339]	[0.543]	[0.350]	[0.344]	[0.563]

*** Indicate significance at the one percent level.
** Indicate significance at the five percent level.
* Indicate significance at the ten percent level.

variables) and the dynamic nature of investment decisions (*via* dynamic models with the lagged investment variable). Our results consistently suggest that emerging market firms can be more sensitive to debt, followed by CF, and equity funds.[19]

Based on the above additional experiments, we conclude that our findings are robust to using alternative sub-samples, sub-periods, estimation techniques, and models, accounting for endogeneity and the dynamic nature of corporate investments.

5. Conclusions

Motivated by the recent literature, which documented a decline in investment-CF sensitivity, we examine the sensitivity of investment to both internal and external sources of funds for a large panel of firm-level data drawn from eight emerging African countries from 1997 to 2015. Our examination contrasts with the extant literature that has focused primarily on developed economies and examined the role of CF on investment expenditures while overlooking the role of external sources of funds. We argue that the role of external sources of funds on investment expenditures needs to be considered, especially for emerging markets where several pro-capital market development policies have been implemented. Our results show that internal and external funds significantly influence fixed investment expenditures, with the investment sensitivity being more pronounced for external funds than internally generated funds. This finding highlights the importance of external funds and contrasts with the extant literature that has focused mainly on the role of internal funds.

Our investigation can be developed in several dimensions. For instance, one may use firm-level surveys over several African countries while covering private and public firms, which can help generalize our findings. Second, although we account for institutional differences across countries, future studies can examine how institutions affect the financing of fixed investment expenditures, primarily focusing on internal and external capital, which can better inform public policy.

[19] Fig. 2, plotting the estimates of investment sensitivities based on quantile regressions, shows qualitatively similar results, with investment increasing with debt more than the other sources of financing (equity and internally-generate cash flow).

Disclosure and disclaimer statement

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any organization with which the authors are affiliated. The usual disclaimer applies: any remaining errors are the sole responsibility of the authors.

CRediT authorship contribution statement

Mustafa Caglayan: Conceptualisation, Writing – original draft, Writing – review & editing, Visualisation, Supervision, Project administration. **Michael Machokoto:** Conceptualisation, Methodology, Software programming, Formal analysis, Data curation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

We certify that there are no potential conflicts of interest relating to the subject matter discussed in this manuscript.

Data availability

The authors do not have permission to share data.

Acknowledgments

This paper has benefited greatly from comments and suggestions by two anonymous reviewers, The Editor (John W. Goodell), Daniel Gymiah, Abongeh Tunyi, Anothny Kyiu and seminar participants at the University of the Witwatersrand.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.ribaf.2023.102099.

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