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Cash holding models in nonprofit organizations: an integrative approach

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Abstract
This paper presents a novel empirical test of an integrative model of cash holdings in nonprofit organizations (NPOs), using a large, detailed dataset of 9,185 charities in England and Wales from 2015 to 2022 (51,685 annual observations). We adapt the corporate finance model of Opler et al. (1999), incorporating nonprofit-specific variables drawn from Fisman and Hubbard (2003), along with additional factors relevant to charitable organizations. Our results show that most of the explanatory power comes from the adapted variables of the corporate finance model, although nonprofit-specific factors are also significant. Among competing explanations, pecking order theory best explains NPO cash-holding behavior. The findings highlight consistent and rational financial decisions by NPOs, with implications for funders, regulators, and future research.

Keywords: cash holdings, nonprofit, trade-off theory, pecking order theory, agency theory
JEL Classification Codes: G32

1. Introduction

Cash management is a critical decision in any organizational context, as it directly affects financial stability and long-term viability. In the nonprofit sector, this decision becomes even more consequential due to heightened environmental uncertainty, complex funding structures (Johnson *et al.*, 2021), and limited access to external funding sources (Calabrese, 2011). Consequently, nonprofit organizations (NPOs) are generally more vulnerable to financial shocks and tend to hold larger cash reserves to cope with them (Hansmann, 1990; Core *et al.*, 2006).

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While cash reserves may serve as a financial buffer, they also present potential drawbacks. Large cash reserves may be discouraging for managers, as they can be perceived as signs of inefficiency or poor financial management (Calabrese, 2011; Johnson *et al.,* 2021; Pizzini & Sterin, 2025), and may also raise concerns related to agency problems (Core *et al*., 2006). Balancing the need for financial stability to support operational continuity with the risk of inefficient capital accumulation creates a challenging tension for NPOs, which remains underexplored in the existing literature.

Previous studies on NPO cash holding decisions have largely relied on the precautionary framework developed by Hansmann (1990), and later expanded by Fisman and Hubbard (2003) and Core *et al.* (2006), with a focus on organizational risk and governance concerns. However, few studies have empirically questioned the adequacy of these models, and only Ramirez (2011) has attempted to adapt the more general and widely used corporate financial model of Opler *et al.* (1999) to the nonprofit context.

The objective of this paper is to fill this gap by proposing and testing an integrative model of NPO cash holdings. We integrate corporate variables from Opler *et al.* (1999) with nonprofit-specific factors from both the nonprofit literatures, to develop a more comprehensive and adaptable framework. We test this model on a comprehensive dataset of 9,185 charities in England and Wales over the period 2015-2022, comprising 51,685 observations.

This approach allows us to make three key contributions. First, we show that, despite the specific characteristics of the sector, traditional corporate finance variables—when properly adjusted to NPOs—maintain strong explanatory power, and that pecking order theory best fits the cash management behavior. These findings suggest that NPOs make cash holding decisions based on a financial logic similar to that of for-profit firms, but shaped by the distinct features of the nonprofit environment. Second, we present a novel large-scale empirical application of an integrated cash holding model adapted to the NPOs. Third, the diversity in financial behaviors exhibited among NPOs—driven by factors analyzed such as size, cash flow generation, leverage, revenue concentration, or public funding—supports the development of a typology of liquidity profiles. This typology provides both theoretical and practical value for researchers, funders, and policymakers interested in nonprofit financial strategies.

1.1 Traditional theories tailored to explain NPOs' cash holdings

Three different theories have traditionally been used to explain for-profit firms' cash holdings: trade-off theory, pecking order theory, and agency theory. The arguments of each theory are based on a combination of precautionary and transactional motives, along with the costs of information asymmetries and agency problems. These theories apply to NPOs with certain nuances, considering their specificities. First, NPOs aim to maximize programs and services, not profits (Charles *et al.*, 2021). Second, NPOs operate in contexts of high uncertainty and face greater obstacles to accessing external funding (Calabrese, 2011). Finally, NPOs are subject to the "non-distribution constraint," which determines that their profits must remain within the organization (Hansmann, 2003).

Trade-off theory postulates the existence of an optimal level of cash when there is a trade-off between the marginal costs and benefits of holding cash (Miller and Or, 1966; Myers, 1984). The benefits of holding cash include reducing the likelihood of financial problems and reducing transaction costs (Miller and Orr, 1966; Ferreira and Vilela, 2004; Ozkan and Ozkan, 2004; Bates *et al.*, 2009). In the nonprofit sector, the benefits of holding cash and avoiding external funding are accentuated (Fisman and Hubbard, 2003; Calabrese, 2011), but there are opportunity costs associated not only with the low profitability derived from holding cash

(Ozkan and Ozkan, 2004), but also with the fact that cash could be used to provide more services to beneficiaries (Calabrese, 2013; Calabrese and Gupta, 2019).

Pecking order theory suggests that there is no optimal level of cash holdings. This theory is related to the precautionary motive to hold cash, as well as the speculative motive, meaning organizations accumulate cash to have funds available when investment opportunities arise (Ramirez, 2011). This perspective leads organizations to prioritize internal funding for their projects, aiming to mitigate the cost of information asymmetries associated with external financing and to prevent underinvestment issues (Myers, 1984; Myers and Majluf, 1984; Ferreira and Vilela, 2004). This argument holds particularly true for NPOs, as their operations are susceptible to significant information asymmetries, face challenges in accessing external financing (Calabrese, 2011), and, due to their reputation, are reluctant to use debt (García-Rodríguez *et al.*, 2022). Additionally, the process of raising equity capital for NPOs requires significantly greater effort compared to traditional fundraising activities (Calabrese, 2011). Consequently, it is imperative for NPOs to hold cash reserves to support their activities.

Finally, agency theory suggests that managers may prefer to accumulate cash to increase their discretionary power over the organization's investment decisions (Jensen, 1986). While debt provides a monitoring mechanism, cash allows managers to develop projects without having to provide information about them (Ferreira and Vilela, 2004). Thus, the main threat of holding cash would be the manager's risk of opportunistic use of these resources for personal gain (Weidemann, 2018). In NPOs, the non-distribution constraint exacerbates the potential problem of self-serving resource use by managers, for example, by increasing their compensation or investing in projects that are not aligned with the organization's mission (Calabrese, 2012; Calabrese and Gupta, 2019; Lee and Woronkowicz, 2019). Moreover, in these NPOs, the role of donors as monitors of potentially inappropriate management behavior is much weaker than that of shareholders (Andres-Alonso *et al.*, 2006; Calabrese, 2012; Calabrese and Gupta, 2019).

1.2. Determinants of NPOs' cash holdings

The corporate literature has typically used the Opler *et al.* (1999) model to determine firms' cash holdings, which considers issues such as organizational size, leverage, liquidity substitution, investment (capital expenditures), growth opportunities, cash flow generated, and cash flow volatility.

In the NPO sector, however, cash holdings have been determined using models such as Fisman and Hubbard (2003) and Core *et al.* (2006), which define cash holdings based on access to alternative funding sources or the level of fixed costs. Besides these issues, previous literature suggests that revenue concentration and public funding are also relevant determinants of NPO cash holdings (Calabrese, 2013; Lee and Woronkowicz, 2019; Ramirez, 2011).

Table 1 shows all these determinants and their expected signs, according to the three traditional theories of cash holdings described in the previous section.

Table 1. Expected effect of variables on cash holdings depending on the theoretical approach

Variables	*Trade-off*	*Pecking order*	*Agency theory*
SIZE	negative	negative	positive
LEVERAGE	positive/negative	negative	negative
LIQUID_ASSETS_SUBSTITUTES	negative	negative	--
INVESTMENT	positive	negative	--
GROWTH_OPPORTUNITIES	positive	positive	negative
CASH_FLOW	negative	positive	positive
CASH_FLOW_VOLATILITY	positive	positive	--
ACCESS_DEBT	negative	negative	negative
FIXED_COSTS	positive	positive	--
REVENUE_CONCENTRATION	positive	positive	negative
GOVERNMENT_FUNDING	negative	negative	negative

Source: own elaboration

2. Methods

Based on the previous arguments, we propose three models to be tested (see Table 2).

Table 2. Model definition

Model 1 (following Opler *et al*., 1999)	
$CASH\_HOLDINGS_{it}$ =	$\beta_0 + \beta_1 SIZE_{it} + \beta_2 LEVERAGE_{it} + \beta_3 LIQUID\_ASSETS\_SUBSTITUTES_{it} + \beta_4 INVESTMENTS_{it} + \beta_5 GROWTH\_OPPORTUNITIES_{it} + \beta_6 CASH\_FLOW_{it} + \beta_7 CASH\_FLOW\_VOLATILITY_{it} +$ industry $dummy_{it}$ + region $dummy_{it}$ + $d_t + \varepsilon_{it}$
Model 2 (following Fisman and Hubbard (2003) and Core *et al*. (2006))	
$CASH\_HOLDINGS_{it}$ =	$\beta_0 + \beta_1 CASH\_FLOW\_VOLATILITY_{it} + \beta_2 ACCESS\_DEBT_{it} + \beta_3$ CASH_FLOW_VOLATILITY x $ACCESS\_DEBT_{it} + \beta_4 FIXED\_COSTS_{it} + \beta_5 SIZE_{it}$ + industry $dummy_{it}$ + region $dummy_{it}$ + $d_t + \varepsilon_{it}$
Model 3 (integrative model including Models 1 and 2 and other variables specific to NPOs)	
$CASH\_HOLDINGS_{it}$ =	$\beta_0 + \beta_1 SIZE_{it} + \beta_2 LEVERAGE_{it} + \beta_3 LIQUID\_ASSETS\_SUBSTITUTES_{it} + \beta_4 INVESTMENTS_{it} + \beta_5 GROWTH\_OPPORTUNITIES_{it} + \beta_6 CASH\_FLOW_{it} + \beta_7 CASH\_FLOW\_VOLATILITY_{it} + \beta_8 ACCESS\_DEBT_{it} + \beta_9$ CASH_FLOW_VOLATILITY x $ACCESS\_DEBT_{it} + \beta_{10} FIXED\_COSTS_{it} + \beta_{11} REVENUE\_CONCENTRATION_{it} + \beta_{12} GOVERNMENT\_FUNDING_{it}$ + industry $dummy_{it}$ + region $dummy_{it}$ + $d_t + \varepsilon_{it}$

Note: In these three models, subindex i identifies the organization, t indicates the year, d_t represents annual dummy variables, and ε_{it} represents the random disturbance term
Source: own elaboration

The variables proposed by Opler *et al.* (1999) have been adapted to the reality of the nonprofit sector (see Table 3). Thus, the size of the NPO is determined by its revenues and not

by its assets (Core *et al*., 2006; Calabrese, 2011; Lee and Woronkowicz, 2019; Pizzini and Sterin, 2025). Likewise, as a measure of cash holdings, cash and cash equivalents are divided by total expenses, as opposed to size (Fisman and Hubbard, 2003; Core *et al*., 2006; Lee and Woronkowicz, 2019). This measure is interpreted as the length of time the NPO can continue to operate at its current level of services without receiving additional revenue or liquidating assets (Pizzini and Sterin, 2025).

Table 3. Definition of variables

Variable	*Role in the models*	*Definition*
CASH_HOLDINGS	Dependent	Cash, savings, and temporary cash investments / Total expenses
CASH_HOLDINGS_2	Dependent	Cash / Total expenses
SIZE	Independent (Model 1, 2 & 3)	Logarithm of total income
LEVERAGE	Independent (Model 1 & 3)	Total liabilities / Total assets
LIQUID_ASSETS_ SUBSTITUTES	Independent (Model 1 & 3)	Net working capital (current assets minus cash and equivalents minus current creditors) / Total assets
INVESTMENT	Independent (Model 1 & 3)	Capital expenditures measured as increase (decrease) in fixed assets including depreciations / Total assets
GROWTH_ OPPORTUNITIES	Independent (Model 1 & 3)	(Total $income_t$ – Total $income_{t-1}$) / Total $income_{t-1}$
CASH_FLOW	Independent (Model 1 & 3)	Net income before depreciation and amortization / Total income
CASH_FLOW_ VOLATILITY	Independent (Models 1, 2 & 3)	Standard deviation of the variable CASH_FLOW
ACCESS_DEBT	Independent (Models 2 & 3)	Dummy variable: 1 if the NPO has long-term debt outstanding; 0 otherwise.
ACCESS_DEBT x CASH_FLOW_ VOLATILITY	Independent (Models 2 & 3)	Interaction effect of ACCESS_DEBT and CASH_FLOW_VOLATILITY
FIXED_COSTS	Independent (Models 2 & 3)	Support costs (related to the general running of the organization, i.e. overheads, central support and governance costs) / Total expenses
REVENUE_ CONCENTRATION	Independent (Model 3)	Hirschman-Herfindahl index (HHI) using five revenue sources (donations and legacies, charitable activities, trading activities, investments, other)
GOVERNMENT_ FUNDING	Independent (Model 3)	Income from government contracts and grants / Total income

Source: own elaboration

We have estimated the models using an OLS regression with clustered robust errors (see Core *et al.*, 2006; Ramirez, 2011). To avoid outlier bias, we have winsorized continuous variables at 1% and we have calculated variance inflation factors (VIF) to test for multicollinearity problems.

3. Data

The sample used in the study includes charities in England and Wales registered at the Charity Commission. After filtering the database to remove organizations that did not provide complete financial, the final sample includes 51,685 year-observations from 9,185 charities during 2015 to 2022.

4. Results

The descriptive statistics of the variables and the results of the model estimations are presented in Tables 4 and 5, respectively.

Table 4. Descriptive statistics

Variable	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
CASH_HOLDINGS	0.5513	0.3499	0.7080	0.0003	4.8737
CASH_HOLDINGS_2	0.4997	0.3295	0.6069	0.0003	3.9641
SIZE	14.7186	14.4345	1,1720	13.1632	18.3712
LEVERAGE	0.2293	0.1517	0.2352	0.0007	1.1407
LIQUID_ASSETS_SUBSTITUTES	-0.0430	-0.0182	0.1850	-0.7733	0.5618
INVESTMENT	0.0305	0.0188	0.0868	-0.3257	0.4765
GROWTH_OPPORTUNITIES	0.0740	0.0307	0.3325	-0.6490	1.8705
CASH_FLOW	0.0466	0.0530	0.2554	-1.3273	0.7488
CASH_FLOW_VOLATILITY	0.1737	0.1004	0.2688	0.0126	2.0554
ACCESS_DEBT	0.5430	1.0000	0.4982	0.0000	1.0000
FIXED_COSTS	0.1927	0.1396	0.1995	0.0000	1.0000
REVENUE_CONCENTRATION	0.7487	0.7965	0.2129	0.3198	1.0000
GOVERNMENT_FUNDING	0.1837	0.0067	0.2875	0.0000	0.9915

Source: own elaboration

All the variables in the Opler *et al.* (1999) model (see Column 1 of Table 5) have a significant impact on NPO cash holdings, explaining 21.4% of their variance. Except for GROWTH_OPPORTUNITIES, which has a negative relationship with cash holdings (in line with agency theory), the rest of the variables follow the direction predicted by the pecking order theory. These results suggest that this approach best explains this financial decision in the nonprofit sector. The results show that larger organizations (SIZE) hold less cash because they have less precautionary need and information asymmetries. The NPO's leverage (LEVERAGE) and the presence of liquid substitutes (LIQUID_ASSETS_SUBSTITUTES) are negatively related to the organization's cash holdings, as they represent substitute sources of financing. Similarly, the negative sign of the variable INVESTMENT indicates that NPOs finance their investments in fixed assets with cash. Also, we see that NPOs use cash to finance growth opportunities, as the variable GROWTH_OPPORTUNITIES is also negatively related to cash holdings. Finally, those NPOs that generate more cash flow (CASH_FLOW) are able to save more since they accumulate more cash (internal financing) and the standard deviation of this variable (CASH_FLOW_VOLATILITY) is also significant and positively related to NPO cash holdings, which can be explained by precautionary reasons.

Column 2 of Table 5 shows the estimates of Model 2, which includes all the variables outlined by Fisman and Hubbard (2003) and Core *et al.* (2006). This model explains only 6.6% of the variance in cash holdings. The effects of NPO size (SIZE) and cash flow volatility (CASH_FLOW_VOLATILITY) are similar to those described in the previous model (see Column 1). Access to long-term debt (ACCESS_DEBT) is negatively related to NPO cash

holdings because the availability of another source of financing reduces the need for precautionary savings. The interactive variable is not significant. Finally, the fixed costs necessarily incurred by the NPO (FIXED_COSTS) are positively related to cash holdings. When these costs increase, the NPO expands the buffer to avoid entering into insolvency or bankruptcy situations when revenues are reduced (precautionary savings).

Table 5. Results of estimations

Variable	CASH_HOLDINGS		
	Model 1	*Model 2*	*Model 3*
SIZE	-0.042***	-0.031***	-0.036***
	(0.002)	(0.003)	(0.003)
LEVERAGE	-0.734***		-0.704***
	(0.015)		(0.015)
LIQUID_ASSETS_SUBSTITUTES	-0.670***		-0.634***
	(0.017)		(0.017)
INVESTMENT	-0.682***		-0.676***
	(0.046)		(0.046)
GROWTH_OPPORTUNITIES	-0.135***		-0.138***
	(0.015)		(0.015)
CASH_FLOW	1.001***		0.992***
	(0.025)		(0.025)
CASH_FLOW_VOLATILITY	0.725***	0.533***	0.675***
	(0.023)	(0.033)	(0.032)
ACCESS_DEBT		-0.070***	-0.042***
		(0.008)	(0.00754)
ACCESS_DEBT x CASH_FLOW_VOLATILITY		-0.052	0.050
		(0.042)	(0.040)
FIXED_COSTS		0.113***	0.049***
		(0.017)	(0.016)
REVENUE_CONCENTRATION			0.094***
			(0.014)
GOVERNMENT_FUNDING			-0.188***
			(0.008)
Constant	1.299***	1.038***	1.153***
	(0.039)	(0.044)	(0.042)
Industry	*Included*	*Included*	*Included*
Year	*Included*	*Included*	*Included*
Region	*Included*	*Included*	*Included*
Number of observations	51,685	51,685	51,685
Model significance	226.99***	96.81***	209.16***
R^2	0.214	0.066	0.220
VIF	1.61	1.77	1.68
R^2 change			0.0059
F (df) change			126.61***

Note: Standard errors in parentheses; ***p<0.01.
Source: own elaboration

Finally, Column 3 of Table 5 shows the results of estimating the integrative model (Model 3). All of the previous variables maintain the sign already described and the two new variables are also significant. Thus, NPOs with a higher concentration of revenues (REVENUE_CONCENTRATION) accumulate more cash for precautionary reasons (if their only source of income fails they run out of resources), and those NPOs that are more dependent

on government funding (GOVERNMENT_FUNDING) tend to keep more cash to cope with the usual payment delays of this funder. The explanatory power of this integrative model rises to 22%, and this increase is significant.

In order to know the percentage change in the dependent variable for one standard deviation change in the independent variables, we have calculated the standardized coefficients (beta coefficients) (see Appendix Table A1). The determinant with the strongest effect is the volume of cash flow generated by the NPO (CASH_FLOW). This is followed by the volatility of cash flow (CASH_FLOW_VOLATILITY) and the existence of substitute financing (LEVERAGE and volume of LIQUID_ASSETS_SUBSTITUTES). These results reinforce that precautionary motives (pecking order theory) best explain the NPO's cash holding decision.

We conducted several robustness checks to validate our findings. First, we re-estimated Models 1-3 using only *cash* as the dependent variable (CASH_HOLDINGS_2 in Appendix Table A2). Next, we employed lagged independent variables (with one- and two-years lags) as shown in Appendix Table A3). The results remain consistent across all variables except for *fixed costs,* which lose their explanatory power. We then split the sample by sector (see Appendix Table A4) and observed broadly similar results across sectors, though some variables also lose significance in specific cases. Finally, we divided the sample into pre-COVID crisis (2015-2019) and post-COVID (2020-2022) (see Appendix Table A5). Consistent with the results in Table A3, the FIXED_COSTS variable is only significant in the post-COVID period[1].

5. Concluding remarks

Although traditional corporate finance theories have often been considered inadequate for explaining the financial decision-making of NPOs, this study revisits and adapts key models to analyze a specific and critical financial decision: cash holdings. We empirically test an integrated model that unifies the traditional framework of Opler *et al.* (1999) -adapted to the nonprofit context- with nonprofit-specific variables, applying it to a large dataset of 9,185 charities in England and Wales over the period 2015-2022.

Our findings provide robust support for the pecking order theory in the nonprofit sector. The traditional Opler *et al.* model adapted to NPOs explains 21.4% of the variance in their cash holdings, and the inclusion of sector-specific variables is significant and increases the explanatory power of the model to 22%, highlighting the value of an integrative approach. This demonstrates that NPOs cash management, although shaped by mission-driven constraints, follows rational financial patterns that can be effectively modeled using adapted corporate finance tools.

Among the determinants analyzed, we find that the most influential factors driving cash accumulation are the organization’s ability to generate cash flow and the volatility of those cash flow—underscoring the central role of precautionary motives. Conversely, access to substitute sources of liquidity, such as debt or other liquid assets, reduces the need to hold cash. In addition, organizational characteristics such as size, investment opportunities and access to long-term financing, are associated with lower cash holdings, while higher revenue concentration, higher fixed costs, and reduced dependence on public funding tend to increase cash reserves.

[1] Although not included in this paper, results comparing the Opler *et al.* (1999) and Core *et al.* (2006) models for each of these robustness checks are available on request from the authors. The Opler *et al.* (1999) model remains the most appropriate for explaining NPO cash holdings, but including specific NPO sector variables leads to statistically significant improvements in explanatory power.

We also observe changes in financial behavior following the COVID-19 crisis. Notably, fixed cost coverage, which was not a significant determinant before the pandemic, emerges as an important factor in the post-crisis period. This suggests an increased focus on operational security in response to heightened uncertainty.

This paper offers several theoretical and practical contributions. From a theoretical perspective, we show that NPOs, despite their mission-driven nature, exhibit financial behaviors that align with rational economic theories when properly contextualized. Specifically, our results support the idea that the pecking order theory best fits NPOs cash-holding decision. Though originally developed for for-profit firms, this theory suggests a hierarchy of financing preferences: organizations prioritize internal funds, then debt, and finally external equity, to mitigate issues related to information asymmetry and financing costs. Moving away from the idea of finding an optimal balance in cash accumulation (which would be expected from the trade-off approach), these organizations seem to make their cash management decisions based on precautionary motives, avoiding the costs of information asymmetries arising from external financing (the fundamental basis of the pecking order theory). This idea is confirmed by the finding that the more resources the nonprofit generates (cash flow), the more cash it holds, regardless of the opportunity costs incurred. Also, by adapting a well-established corporate model and integrating nonprofit-specific variables, we propose an integrated framework for analyzing liquidity decisions in NPOs. This approach lays the groundwork for future research into topics such as excess cash accumulation (e.g., Gupta, 2024; Pizzini and Sterin, 2025) and financial resilience in the nonprofit sector. We provide in this paper a large-scale empirical application of this integrated cash holding model adapted to NPOs, allowing us to identify the main determinants of this decision.

In addition to these theoretical contributions, this paper offers practical insights by implicitly identifying distinct liquidity behavior patterns among nonprofit organizations. Based on the observed variation in key determinants—such as cash flow generation capacity, cash flow volatility, reliance on public funding, revenue concentration, or access to long-term debt—we can distinguish emerging profiles of financial management within the sector. For example, organizations with strong internal cash generation and low dependence on government funding tend to adopt precautionary savings strategies, while larger NPOs with access to external financing hold relatively less cash. These findings suggest the possibility of creating a typology of nonprofit liquidity profiles, which could serve as a useful diagnostic framework for managers, funders, and policymakers seeking to evaluate financial strategies and assess organizational risk based on the structural characteristics of NPOs.

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Appendix

Table A1. Standardized coefficients of estimations

Variable	*Standardized coefficient*
SIZE	-0.059***
LEVERAGE	-0.234***
LIQUID_ASSETS_SUBSTITUTES	-0.166***
INVESTMENT	-0.083***
GROWTH_OPPORTUNITIES	-0.065***
CASH_FLOW	0.358***
CASH_FLOW_VOLATILITY	0.256***
ACCESS_DEBT	-0.029***
ACCESS_DEBT x CASH_FLOW_VOLATILITY	0.016
FIXED_COSTS	0.014***
REVENUE_CONCENTRATION	0.028***
GOVERNMENT_FUNDING	-0.076***

Note: Standardized coefficients are calculated without considering clusters by NPOs and years; p<0.01.
Source: own elaboration

Table A2. Results of estimations with CASH_HOLDINGS_2

Variable	CASH_HOLDINGS_2		
	Model 1	*Model 2*	*Model 3*
SIZE	-0.051***	-0.040***	-0.045***
	(0.002)	(0.002)	(0.002)
LEVERAGE	-0.636***		-0.612***
	(0.012)		(0.013)
LIQUID_ASSETS_SUBSTITUTES	-0.579***		-0.551***
	(0.014)		(0.014)
INVESTMENT	-0.539***		-0.531***
	(0.038)		(0.038)
GROWTH_OPPORTUNITIES	-0.110***		-0.113***
	(0.013)		(0.013)
CASH_FLOW	0.884***		0.877***
	(0.021)		(0.020)
CASH_FLOW_VOLATILITY	0.570***	0.428***	0.558***
	(0.019)	(0.028)	(0.027)
ACCESS_DEBT		-0.059***	-0.034***
		(0.007)	(0.006)
ACCESS_DEBT x		-0.092***	-0.003
CASH_FLOW_VOLATILITY		(0.034)	(0.033)
FIXED_COSTS		0.092***	0.037***
		(0.014)	(0.013)
REVENUE_CONCENTRATION			0.096***
			(0.012)
GOVERNMENT_FUNDING			-0.143***
			(0.007)
Constant	1.368***	1.123***	1.219***
	(0.032)	(0.037)	(0.035)
Industry	*Included*	*Included*	*Included*
Year	*Included*	*Included*	*Included*
Region	*Included*	*Included*	*Included*
Number of observations	51,685	51,685	51,685
Model significance	259.03***	109.54***	230.01***
R^2	0.219	0.064	0.224
VIF	1.61	1.77	1.68
R^2 change			0.0053
F (df) change			100.57***

Note: Standard errors in parentheses; ***p<0.01.
Source: own elaboration

Table A3. Results of estimations including one- and two-year lags

Variable	CASH_HOLDINGS	
	One-year lag	Two-year lags
SIZE	-0.040***	-0.047***
	(0.003)	(0.003)
LEVERAGE	-0.595***	-0.524***
	(0.017)	(0.019)
LIQUID_ASSETS_SUBSTITUTES	-0.407***	-0.347***
	(0.020)	(0.022)
INVESTMENT	-0.336***	-0.338***
	(0.050)	(0.057)
GROWTH_OPPORTUNITIES	-0.099***	-0.094***
	(0.018)	(0.021)
CASH_FLOW	0.691***	0.672***
	(0.028)	(0.033)
CASH_FLOW_VOLATILITY	0.564***	0.533***
	(0.036)	(0.041)
ACCESS_DEBT	-0.046***	-0.047***
	(0.009)	(0.010)
ACCESS_DEBT x CASH_FLOW_VOLATILITY	0.042	0.033
	(0.046)	(0.052)
FIXED_COSTS	-0.003	-0.015
	(0.017)	(0.020)
REVENUE_CONCENTRATION	0.060***	0.037**
	(0.016)	(0.018)
GOVERNMENT_FUNDING	-0.208***	-0.204***
	(0.009)	(0.010)
Constant	1.224***	1.339***
	(0.047)	(0.053)
Industry	*Included*	*Included*
Year	*Included*	*Included*
Region	*Included*	*Included*
Number of observations	31,348	33,315
Model significance	142.70***	109.98***
R^2	0.153	0.140
VIF	1.60	1.52

Note: Standard errors in parentheses; ***p<0.01.
Source: own elaboration

Table A4. Results of estimations by sector

Variable	CASH_HOLDINGS				
	ARTS	*EDUCATION*	*HEALTH*	*HUMAN SERVICES*	*OTHER*
SIZE	-0.017	-0.048***	-0.038***	-0.020	-0.024***
	(0.012)	(0.003)	(0.007)	(0.016)	(0.004)
LEVERAGE	-0.548***	-0.566***	-0.480***	-0.817***	-0.829***
	(0.063)	(0.020)	(0.067)	(0.102)	(0.023)
LIQUID_ASSETS_ SUBSTITUTES	-0.646***	-0.491***	-0.566***	-0.680***	-0.731***
	(0.079)	(0.024)	(0.089)	(0.089)	(0.024)
INVESTMENT	-0.487**	-0.648***	-0.463***	-0.814***	-0.691***
	(0.197)	(0.065)	(0.130)	(0.251)	(0.067)
GROWTH_OPPORTUNITIES	-0.128***	-0.090***	-0.184***	-0.224**	-0.154***
	(0.049)	(0.027)	(0.071)	(0.094)	(0.020)
CASH_FLOW	0.392***	0.805***	1.049***	1.245***	1.058***
	(0.085)	(0.039)	(0.092)	(0.137)	(0.034)
CASH_FLOW_VOLATILITY	0.317	0.674***	0.744***	0.524***	0.667***
	(0.254)	(0.057)	(0.131)	(0.131)	(0.042)
ACCESS_DEBT	-0.245***	-0.049***	-0.099***	-0.013	-0.015
	(0.056)	(0.011)	(0.028)	(0.049)	(0.011)
ACCESS_DEBT x CASH_ FLOW_VOLATILITY	0.368	-0.122*	0.160	0.392**	0.078
	(0.316)	(0.071)	(0.171)	(0.173)	(0.052)
FIXED_COSTS	0.079	-0.003	0.049	0.004	0.094***
	(0.075)	(0.018)	(0.052)	(0.074)	(0.026)
REVENUE_ CONCENTRATION	0.140*	0.015	0.260***	-0.072	0.155***
	(0.075)	(0.019)	(0.043)	(0.106)	(0.022)
GOVERNMENT_FUNDING	-0.232***	-0.091***	-0.339***	-0.352***	-0.212***
	(0.058)	(0.010)	(0.025)	(0.059)	(0.012)
Constant	1.026***	1.277***	1.020***	1.297***	0.923***
	(0.222)	(0.056)	(0.121)	(0.287)	(0.070)
Year	*Included*	*Included*	*Included*	*Included*	*Included*
Region	*Included*	*Included*	*Included*	*Included*	*Included*
Number of observations	981	18,716	4,111	2,046	25,831
Model significance	9.81***	86.69***	28.76***	17.64***	129.84***
R^2	0.239	0.212	0.292	0.219	0.216
VIF	2.31	1.63	2.34	2.04	1.83

Note: Standard errors in parentheses; **p< 0.05, ***p<0.01.
Source: own elaboration

Table A5. Results of estimations pre-crisis and post-crisis COVID

Variable	CASH_HOLDINGS	
	Pre-crisis (2015-19)	Post-crisis (2020-2022)
SIZE	-0.031***	-0.042***
	(0.003)	(0.004)
LEVERAGE	-0.687***	-0.734***
	(0.019)	(0.026)
LIQUID_ASSETS_SUBSTITUTES	-0.612***	-0.672***
	(0.021)	(0.028)
INVESTMENT	-0.675***	-0.690***
	(0.062)	(0.068)
GROWTH_OPPORTUNITIES	-0.147***	-0.126***
	(0.021)	(0.022)
CASH_FLOW	1.035***	0.943***
	(0.034)	(0.036)
CASH_FLOW_VOLATILITY	0.658***	0.697***
	(0.041)	(0.052)
ACCESS_DEBT	-0.049***	-0.033***
	(0.010)	(0.012)
ACCESS_DEBT x CASH_FLOW_VOLATILITY	0.059	0.034
	(0.053)	(0.063)
FIXED_COSTS	0.006	0.109***
	(0.020)	(0.025)
REVENUE_CONCENTRATION	0.108***	0.072***
	(0.017)	(0.023)
GOVERNMENT_FUNDING	-0.174***	-0.211***
	(0.009)	(0.013)
Constant	1.022***	1.244***
	(0.051)	(0.066)
Industry	*Included*	*Included*
Year	*Included*	*Included*
Region	*Included*	*Included*
Number of observations	31,348	20,337
Model significance	130.29***	93.51***
R^2	0.223	0.208
VIF	1.33	1.41

Note: Standard errors in parentheses; ***p<0.01.
Source: own elaboration