



INTERNATIONAL EVIDENCE ON CORPORATE RISK-TAKING AND CASH HOLDINGS: ANALYSIS USING VARIOUS ESTIMATION PROCEDURES

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ABSTRACT

Effective management of cash holdings enhances financial sustainability; however, excessive cash holdings increase agency costs for shareholders. This study examines whether corporate risk-taking is associated with cash holdings by employing various estimation procedures to provide findings that are not an artefact of a particular statistical method. The analysis involves 176,663 observations from various industries in 60 countries. The estimation procedures employed are Ordinary Least Squares (OLS), Variance-covariance Matrix Estimator (VCE) (Robust), Huber M-Estimator (HUBER), High-dimensional Fixed Effects Regression (REGHDFE), and Weighted Least Squares (WLS). A positive link is observed between corporate risk-taking and cash holdings, confirming that high-risk-taking firms maintain high cash reserves. The results are consistent across different estimation procedures, supporting the robustness of the findings. This research offers a perspective on firms' cash-holding strategies across industries and countries. It provides insights into the importance of considering risk-taking aspects in corporate financial policy. For policymakers, the findings imply that regulatory improvements to corporate cash policies should take into account the various risk factors surrounding firms. For businesses, managers' strategic decisions on cash holdings are not universal but instead depend on their risk-taking environment. For researchers, utilising various estimation procedures ensures the robustness of analyses of corporate strategic choice.

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Introduction

Firms across industries rely on cash as their primary source of funding for operations and investments. As cash is an important corporate resource, effective cash management allows firms to maintain operational continuity and support long-term growth. From a capital market perspective, corporate cash holdings may indicate the financial resilience and sustainable performance of listed firms, as cash reserves signal performance to the market (Trinh *et al.*, 2021). Large cash holdings could reflect positive performance, indicating that the

firm has a high ability to generate income and pay dividends. However, large cash holdings could also reflect negative performance, as they may indicate the firm's inability to invest. Issues with cash holdings concern the management of critical yet limited corporate resources.

In fact, firms have significantly different cash levels, indicating that cash holdings depend on various factors. Dao and Maggi (2018), in discussing the prevalence of cash holdings across countries, indicated that the most important determinants of the increase in cash

holdings over the previous 15 years are lower effective tax rates, Research and Development (R&D) intensity, and the growth in assets of large firms. Govindarajan *et al.* (2024) noted that firms may maintain substantial cash reserves for several reasons, including tax advantages. Issues with corporate cash-holding strategies remain a key concern, particularly amid rising capital costs. A relevant scenario is the pressure from the COVID-19 pandemic, which pushed companies to plan their cash holdings to operate and survive.

The literature suggests that the cash-holding strategy is determined by factors that can be categorised into firm-level factors, such as capital expenditure (Kim *et al.*, 2011), country-level factors, such as Gross Domestic Product (GDP) (Alnori & Bugshan, 2023), and corporate governance quality (Eulaiwi *et al.*, 2020). A consistently highlighted aspect in prior studies is the managerial incentives associated with the cash-holding strategy. Given the significance of cash from a capital markets perspective, cash holdings involve managerial discretion and relate to agency costs between principals (shareholders) and agents (managers). Shareholders may prefer holding less cash because they view cash as not generating extra profit. In contrast, excess cash holdings may incentivise managers to entrench shareholders, thereby distorting the firm's optimal corporate policies (Zheng, 2022). Issues related to managerial incentives for cash holdings are critical in balancing the need to address immediate liquidity risks to maximise shareholder wealth (Raghibi *et al.*, 2021). This research examines how managerial incentives arise from corporate risk-taking in the context of cash-holding strategy.

Corporate risk-taking is an important source of managerial incentives, as managers make decisions based on expected returns and risk assessment, and potential deviations arising from uncertainty (Aren & Hamamci, 2021). Managers generally have an incentive to optimise risk-taking to elevate the firm's value (Aroui & Omri, 2008). Nevertheless, managers'

discretionary nature as corporate decision-makers can significantly influence corporate financial decisions (Aktas, 2019; Chen *et al.*, 2020). This is because managers face various incentives and pressures that shape their judgement and decision-making processes. In this study's context, the threshold of managerial discretion to pursue corporate risk-taking has a substantial influence on financial flexibility, including strategy involving cash holdings.

Prior studies have identified several determinants that influence cash holdings (Tran, 2020). However, theoretical predictions remain inconsistent, with different arguments used to substantiate them. Accordingly, it is inconclusive whether the Agency Theory or the Trade-Off Theory perspective of cash holdings succeeds in assessing the connection between risk-taking and cash holdings. Evidence on the linkage between risk-taking and cash holdings is limited, with different proxies of risk and risk-taking used in the literature. In this view, this study addresses the gap in the literature concerning corporate motives for cash holdings, which continue to demonstrate inconsistent empirical findings (Weidemann, 2018; Cruz *et al.*, 2019). Notably, prior studies have concentrated on applying OLS regression for the analysis (El-Halaby *et al.*, 2021; Haj-Salem & Hussainey, 2021). Given the known limitations and restrictions of various statistical procedures, applying multiple estimation methods, as done in this study, aims to ensure that the outcomes are robust and not limited to a single analysis. Further, the evidence is mostly derived from country-specific analysis (Manoel *et al.*, 2018) or based on firms from certain regions (Lozano & Yaman, 2020). The international perspective in this research is an effort to address the research gap, especially issues involving firms from various capital markets.

This study employs various estimation procedures to test whether corporate risk-taking is associated with cash holdings. The approach is selected to address concerns about relying on a single analysis and to ensure that the findings are not driven by a particular statistical method.

Given the importance of robust estimation techniques, we employ OLS, VCE (Robust), HUBER, REGHDFE, and WLS. OLS is the widely used classical regression method for estimating linear models, as it can provide estimators with acceptable characteristics under certain assumptions. The VCE robust estimation method provides heteroscedasticity-robust standard errors (Olaluwoye *et al.*, 2025), while the HUBER analysis effectively addresses heavy-tailed errors (Wang *et al.*, 2022). The REGHDFE analysis provides more reliable estimates by controlling for potential biases arising from omitted variables (Clarke & Schythe, 2020). WLS is employed to address substantial variation in observations across countries, particularly in samples where some countries were highly represented (Ismail *et al.*, 2022). The analysis is conducted on a global dataset involving 176,663 firm-year observations from various industries in 60 countries. The results consistently indicate positive associations between corporate risk-taking and cash holdings across all the estimation procedures. The consistency of the results supports our aim of testing the robustness of the findings on corporate risk-taking and cash holdings.

This study offers several contributions. First, it provides a methodological contribution by assessing the robustness of the findings by considering various estimation procedures: OLS, VCE (Robust), HUBER, REGHDFE, and WLS. This approach adds to the existing literature on determinants of cash holdings (i.e., Yun *et al.*, 2020; Garavito & Chion, 2021; Bagh *et al.*, 2021), which has yet to examine whether findings remain robust across different methodological approaches. Second, we provide evidence from an international setting and investigate corporate cash-holding behaviour across different environments that affect risk-taking, thereby extending prior studies of cash-holding that are mainly single-country-centric (Azis *et al.*, 2024). While the findings are important, a single-country analysis has not been able to demonstrate cash-holding determinants

across firms in various institutional contexts that impose different risk factors. By using an international setting and a large sample, the study extends the validity of the findings.

Materials and Methods

Theory, Literature Review and Hypothesis Development

The perspectives of cash holdings identify several factors that influence cash holdings (Tran, 2020), but their predictions remain inconsistent. In this study, aspects of managerial incentives related to corporate risk-taking are investigated to explain strategies for corporate cash holdings. Risk is the chance of loss, or an unfavourable outcome associated with an action (Azuma-Kotei & Ibrahim, 2024), while risk-taking is defined as a conscious process of making decisions among alternative outcomes under conditions of probabilistic uncertainty (Dan-Jumbo, 2016). Corporate risk-taking imposes greater motives and pressures on cash-holding strategies; hence, the current study addresses this issue by examining whether corporate risk-taking is associated with cash holdings.

Generally, in terms of risk and cash holdings, firms with large investment opportunities and high expenditure may face potential cash-holding problems and are prone to engage in risk-reducing activities. An important benefit of a high cash reserve is flexibility in funding future capital investments (Kusnadi & Wei, 2011), particularly when there is a significant gap between external and internal costs of finance. Palazzo (2012) and Simutin (2010) argue that riskier firms with high costs of acquiring external funds prefer to hold more cash to finance their growth. In this respect, cash holdings can be associated with both risk exposure and expected returns. Moreover, cash-holding benefits are clearly an optimal investment policy in a financially distressed environment (Afza & Adnan, 2007), as holding cash can minimise the propensity for financial distress (Ferreira & Vilela, 2004). Nonetheless, since risk fluctuates over time and a company's

investment opportunities continually evolve, cash-holding strategies may be associated with new investment opportunities.

Corporate risk-taking is a factor of the decision-making process that involves uncertainty regarding all outcomes and consequences (De-Juan-Ripoll *et al.*, 2021). Furthermore, the corporate risk-taking concept may be linked to managerial incentives related to cash holdings. According to Wang *et al.* (2025), risk-taking is essential in corporate decision-making and fundamental to corporate performance and long-term survival. Corporate risk-taking is closely tied to the uncertainty involved in pursuing risky yet potentially value-enhancing investments. For instance, firms with greater uncertainty or volatility may be more likely to experience operational cash shortages, requiring them to adopt strategies such as holding larger cash balances (Dittmar, 2008). Nevertheless, many businesses face the challenge of balancing corporate risk-taking with cash holdings, given the ambiguous relationship between the two. The theoretical frameworks that underpin the relationship between cash holdings and risk-taking are the Trade-off Theory and Agency Theory (Ki & Adhikari, 2022).

From the Trade-off Theory perspective, the precautionary motives of cash suggest that high-risk-taking firms would reserve more cash. In this perspective, greater cash reserves are prepared for two purposes: First, to finance potential investment opportunities, and second, to serve as a precaution in situations of significant liquidity problems. The Trade-off Theory posits that managers' risk-preference behaviours would cause them to meet shareholders' wealth maximisation goal. In this respect, reserving cash would minimise the impact of any mismatch between managers' and shareholders' risk preferences. From the Agency Theory perspective, the agency costs associated with holding cash suggest that high-risk-taking firms would have lower cash reserves. Cash is a corporate liquid asset that can easily be misappropriated, and holding

too much cash can encourage managerial entrenchment. According to O'Brien and Folta (2009), too much cash can lead to managerial complacency or overly optimistic decision-making. From this perspective, shareholders view high-risk-taking firms as having higher agency problems due to the greater potential for managerial entrenchment. To reduce agency costs in firms with high risk-taking behaviour, managers would employ a low cash-holding strategy, as they utilise cash in investments that provide better returns. In this respect, the greater risks and uncertainties associated with high-risk-taking firms will lead to a lower cash-holding approach.

There is limited literature that directly addresses the link between risk-taking and cash holdings. Nevertheless, the arguments and views for the hypothesis can be established from studies that use different proxies of risk and risk-taking. Thus, empirical findings that link various aspects of corporate risk factors and corporate liquidity become important sources of direction for this study. First, leverage is considered an aspect of risk-taking because greater leverage can bring firms into bankruptcy when commitment to liability is not fulfilled. Interestingly, evidence has been mixed, with studies proving a nonlinear relationship (Guney *et al.*, 2007) and a negative relationship (Xiong *et al.*, 2021; Alm Mustafa & Kalash, 2022) between leverage and cash holdings. In Friberg and Seiler (2017), risk and leverage are shown to have negative relationships with cash holdings, while ambiguity is positively associated with cash holdings.

Furthermore, risk-taking could relate to the uncertainty about future cash flow. Again, there is mixed evidence; Amini *et al.* (2024) documented that higher cash flow volatility, serving as a measure of corporate risk, is associated with increased cash holdings in Iranian companies. Nonetheless, Lozano and Yaman (2020) identified that cash flow volatility negatively affected cash holdings during prolonged crisis periods. As established by Wasiuzzaman (2014), the link between cash-flow volatility and the

amount of cash a firm holds is ambiguous, as it may be either negative or positive. Another perspective of risk-taking relates to conditions of financial constraints or distress. Weidemann (2018) reported that the level of cash holdings increases when the probability of financial distress rises. Nonetheless, Arslan *et al.* (2006) suggested that financially constrained firms tend to have lower cash holdings.

Further, industry-level risk can serve as a proxy for risk-taking. Lee (2024) indicated that higher industry risk exposure is linked to greater corporate cash holdings for a sample of US firms. Cash holdings are more strongly influenced by industry-specific risk than by macroeconomic or firm-specific risk. This effect is especially pronounced for companies operating in highly competitive industries and for highly leveraged firms that have limited tangible assets. Similarly, country-level risk, as measured by various indices, reflects the risk that may also impact corporate cash holdings. In Demir *et al.* (2019), the Geopolitical Risk (GPR) index negatively affects the cash holdings of firms from seven emerging economies. However, Behera and Mahakud (2025) documented a positive association between GPR and the cash reserves of Indian firms. In Tana and Aksoy-Hazır (2022), data utilising the World Uncertainty Spillover Index (United States) indicate a positive association between uncertainty spillovers and cash holdings. In sum, the literature on the association between risk and cash holdings offers various perspectives, but the results are conflicting and uncertain.

Relevant to this study is the prior evidence on corporate risk-taking and corporate performance, since cash holdings represent an important aspect of performance. Evidence also indicates that the association between risk-taking and corporate performance is not uniform across firms and has a different impact. For instance, some studies identified a positive influence of corporate risk-taking on corporate performance. Bagh *et al.* (2022) highlighted that corporate risk management has a positive

influence on sustainable growth rate and ROE, while Habib and Hasan (2015) indicated that risk-taking has a positive relationship with corporate performance, particularly in the introduction and decline phase of a firm's lifecycle. Employing the standard deviation of the Return on Assets (ROA) to proxy for risk-taking, Ahmad and Azhari (2022) revealed a negative relationship between corporate risk-taking and the performance of Malaysian agriculture firms.

Relying on theoretical arguments derived from the Trade-off Theory and Agency Theory, and exemplified by the mixed evidence of the abovementioned studies, it is indicative that corporate cash holdings are associated with various aspects of corporate risk. In sum, prior studies suggest two key relationships: (i) The link between various proxies of corporate risk and cash holdings, and (ii) the link between corporate risk-taking and numerous factors of corporate performance. However, the evidence is mixed and managerial incentives arise from corporate risk-taking; we posit that corporate risk-taking has significant implications for financial flexibility strategies related to cash holdings. On the one hand, firms with high risk-taking prefer holding more cash because uncertainty surrounding firms calls for greater precautionary reserves. Conversely, firms that engage in high-risk activities may maintain lower cash reserves to reduce agency costs linked to possible managerial entrenchment. In such firms, managers are more closely controlled in their potential misappropriation of liquid assets. Thus, we posit an association between corporate risk-taking and cash holdings. The expectation is that higher risk-taking would be linked to higher cash holdings if the Trade-off Theory prevails. In comparison, higher risk-taking would be connected to lower cash holdings if the Agency Theory prevails. The hypothesis set is as follows:

H1: There is an association between corporate risk-taking and cash holdings.

Sample

This study utilised a worldwide dataset spanning the period from 2011 to 2020. Years before 2011 were excluded due to (i) the missing data to calculate the required variables, and (ii) the need to avoid the effects of the 2007–2009 recession and the recovery year of 2010. Years after 2020 were excluded to minimise the effects of COVID-19, which could distort the analysis due to significant changes in data, especially on corporate cash holdings. Nevertheless, the 10-year data coverage is consistent with the approach of prior studies that utilise a worldwide dataset (Ismail *et al.*, 2022).

For the sample selection procedure, we first excluded financial firms (Standard Industrial Classification [SIC] code 6000 to 6999) because different legal requirements bind them and they are highly regulated (Ariff *et al.*, 2023), especially regarding cash holdings. For example, financial firms are required to maintain minimum cash reserves in accordance with regulatory requirements. Moreover, firms in the financial sector have varying cash needs. They are often subject to monitoring or oversight that is not typically applied to non-financial firms. Next, we excluded all firms and countries with incomplete datasets or missing data from the Thomson Reuters/Refinitiv database and the World Bank website, especially in the main variables of this study (i.e., data on cash and total assets). Accordingly, the dataset is restricted to observations with complete data required for analysis. Third, we winsorised all continuous variables by capping the top and bottom 1% to address potential outliers. The final sample includes 176,663 firm-year observations from various industries in 60 countries, due to the sample selection processes. The 60 countries in the sample include all countries with available data, ranging from emerging, transitional, and developed countries.

Data Sources and Variables

The data were obtained from two sources: The Thomson Reuters database for firm-level data and the World Bank website for country-

level data. The dependent variable is corporate cash holdings, and the independent variable is corporate risk-taking. Cash holdings are defined as the proportion of cash equivalent to total assets, consistent with prior studies (Ismail *et al.*, 2022). Corporate risk-taking is measured by the standard deviation of return on assets (ROA) over three years, as discussed by Panta (2020). The standard deviation of ROA is widely used as a proxy for corporate risk-taking in the risk-taking literature (e.g., Bhuiyan *et al.*, 2021) because it captures the variability in a firm's operating performance and reflects its operational risk-taking behaviour.

Firm-level control variables are selected based on prior studies on the determinants of cash holdings (Muhmad *et al.*, 2023). FSIZE is the natural logarithm of total assets. The pecking order and agency theories argue that large firms, which generally perform better and possess greater resources, tend to hold more cash than small firms (Jebran *et al.*, 2019). Nevertheless, the trade-off theory posits that small firms hold larger amounts of cash because they face difficulties in raising external funds due to their relatively young age, lower market recognition, and greater exposure to capital market imperfections (Almeida *et al.*, 2005). Due to these mixed arguments, we posit that firm size determines cash holdings. LEV is measured as total liabilities divided by total assets. According to El-Halaby *et al.* (2021), financial leverage determines corporate cash-holding strategies. Since leverage can reflect firms' financial risk based on external debt, it is one of the most common determinants of cash holdings. Following the literature (El-Halaby *et al.*, 2021; Azis *et al.*, 2024), we include leverage as a determinant of cash holdings. If high financial leverage is viewed as a potential risk of bankruptcy due to significant agency problems associated with debt, then financial leverage tends to increase cash holdings. Conversely, if financial leverage is seen as the firm's capacity to raise debt, it generally leads to a decrease in cash holdings. In line with these

mixed arguments, we posit that leverage is a determinant of cash holdings.

GROWTH measures a firm's growth based on changes in sales. Ferreira and Vilela (2004) demonstrated that a firm's growth opportunities significantly influence its cash holdings, since companies require higher cash reserves to prevent financial difficulties and capitalise on promising growth prospects. Thus, a positive association is predicted between GROWTH and cash holdings. LOSS is a dummy variable indicating loss-making firms. The trade-off theory presumes that more profitable companies tend to maintain lower cash reserves, as their profits provide an immediate source of liquidity. Consequently, a negative relationship is predicted between profitability and cash reserves (Al-Najjar, 2013). The Market-to-Book ratio (MKTBK) serves as a proxy for market valuation. The precautionary motive is particularly relevant for firms with greater growth prospects, especially those facing greater information asymmetry, where internal financing is more crucial. Hence, a positive association is predicted between MKTBK and cash holdings. QUICK is calculated by subtracting inventory from current assets and then dividing by total current liabilities. Companies with higher levels of liquid assets are expected to hold lower cash balances, as these assets can be readily converted into cash when required (Jebzan *et al.*, 2019).

LIT is an indicator variable representing industries with high litigation risk. Prior studies have indicated that litigation affects a firm's financial health and managerial decision-making, including cash management (Malm *et al.*, 2023). Consequently, firms with greater exposure to litigation risk have a stronger incentive to hold higher levels of cash to meet future obligations and any expected future settlement burden. Therefore, litigation risk is an important determinant of cash holdings and should be considered when making investment decisions (Liu, 2024). AGE is defined as the natural logarithm of the number of days since a firm's incorporation. Firms exhibit varying levels of cash holdings depending on their age

and stage of maturity due to the differences in their operational and investment opportunities (Ki & Adhikari, 2023). RETEQ, the ratio of retained earnings to total equity, serves as a measure of investment opportunities. Firms with significant investment prospects are likely to maintain higher cash reserves to avoid raising costly external capital; hence, a positive association is predicted between RETEQ and cash holdings.

Lifecycle is classified based on Dickinson's (2011) five-stage life cycle model derived from cash flow patterns, as follows: (i) Introduction: These firms have negative cash flow from operations and investments, but positive cash flow from financing; (ii) Growth: Firms exhibit positive cash flow from operations, negative cash flow from investments, and positive cash flow from financing; (iii) Maturity: Firms experience positive cash flow from operations, negative cash flow from investments, and negative cash flow from financing; (iv) Decline: Firms experience negative cash flow from operations but positive cash flow from investing activities; (v) Shake-out: Firms that do not fit any of the above categories are classified in the shake-out stage. In the analysis, the Introduction stage is used as the base category.

The country-level variables are included based on prior studies that employ international settings to evaluate determinants of cash holdings (Alves *et al.*, 2022). They are GDP, measured as the natural logarithm of gross domestic product per capita, and the country's inflation rate (INF). For GDP, prior studies include it in the model analysis to account for the possible impacts of economic cycle fluctuations on cash holdings (Magerakis *et al.*, 2020). As for INF, inflationary pressure will increase the liquidity value. Therefore, inflation can affect the balance between the costs and benefits of maintaining optimal cash holdings (Ghi, 2016). As this study employs a panel dataset, firms might possess time-invariant characteristics that could be associated with the independent variables. Accordingly, we control for the effects of years and industries, with FixedEffects being the

vector of industry and year fixed effects. More specifically, following the approach of Gotti *et al.* (2023), we include dummy variables for both industries and years to account for industry-specific and year-specific fixed effects.

Analysis

For the analysis, the data were coded in Stata, and several procedures were performed. First, diagnostic tests were used to ensure that the data had no issues. These tests included assessing outliers, normality, multicollinearity, and heteroscedasticity. Second, descriptive statistics for the variables, including the mean, standard deviation, and the highest and lowest values, were provided. The correlation matrix between variables then follows. Third, hypothesis testing was performed using regression analysis.

For regression analysis, various estimation procedures were employed to address methodological limitations in the analysis. These are OLS, VCE (Robust), HUBER, REGHDFE, and WLS. OLS requires a dataset that satisfies several assumptions, such as linearity and normality. Nonetheless, OLS is not robust to departures from its assumptions, and pooled OLS regression ignores the time-series and cross-sectional nature of the data. When observations are pooled together, the heterogeneity or individuality that exists between variables is obscured (Hill *et al.*, 2007). For VCE, Ford (2020) indicated that incorporating VCE (robust) at the end of the regression syntax produces robust standard errors. In this approach, the variance-covariance matrix of the parameter estimates is explicitly calculated, and a robust (or sandwich) variance estimator is used. This estimator remains reliable under certain types of model misspecifications, provided the observations are independent (McCullagh & Nelder, 1989).

Meanwhile, Huber (1964) extended median regression to a broader family of estimators known as M-estimators. These estimators are robust to vertical outliers but remain sensitive

to high-leverage points. This approach improves efficiency under a Gaussian assumption while maintaining robustness against vertical outliers. In practice, M-estimators are implemented using an iteratively reweighted OLS algorithm (Verardi & Croux, 2009). In the REGHDFE analysis, linear regression with multiple fixed effects is employed. Thus, this method is suitable for linear or instrumental-variable regressions that account for multiple categorical variables and their interactions. It can also optionally retain the estimated fixed effects (Correia, 2014). Finally, the WLS regression aims to mitigate the issue of biased results caused by overrepresented countries. Under the WLS regression, each country is assigned a weight equal to the inverse of its number of observations, ensuring that all countries contribute equally to the estimation (Jaggi & Low, 2011).

To empirically examine the determinants of cash holdings, this research builds a multiple regression analysis based on Kamarudin *et al.* (2020) and Hoang *et al.* (2022), with modifications tailored to the research objectives of this study. The hypothesis is tested using regression analysis based on the following equation:

$$\begin{aligned} CH = & \beta_0 + \beta_1 RT + \beta_2 FSIZE + \beta_3 LEV + \beta_4 GROWTH + \beta_5 LOSS + \beta_6 MKTBK + \beta_7 QUICK \\ & + \beta_8 LIT + \beta_9 AGE + \beta_{10} RETEQ + \beta_{11} GDP + \beta_{12} INF + \beta_{13} LcGROWTH + \beta_{14} LcMATURE \\ & + \beta_{15} LcDECLINE + \beta_{16} LcSHAKE-OUT + \theta_{1-} \\ & {}_{nn}FixedEffects_t + \varepsilon_{it}, \end{aligned} \quad (1)$$

where CH represents cash holdings; RT represents corporate risk-taking; FSIZE, LEV, GROWTH, LOSS, MKTBK, QUICK, LIT, AGE, and RETEQ are proxies for firm-level control variables; GDP and INF are proxies for country-level control variables; Lc variables (LcGROWTH, LcMATURE, LcDECLINE, and LcSHAKE-OUT) are the lifecycle variables; and FixedEffects is the vector of year and industry fixed effects. When testing the hypothesis about the relationship between corporate risk-taking and cash holdings, the coefficient of interest is β_1 .

Results

Descriptive Statistics

Table 1 presents descriptive statistics involving firm-level variables.

The average value of CH is 0.123, ranging from 0 to 0.994. The average value of RT is 0.055, spanning from 0.001 to 21.092. FSIZE has an average of 19.279, ranging from 10.125 to 24.323. The average values for LEV and GROWTH are 0.208 and 0.136, respectively. 20.9% of the firm-year observations represented loss-making firms, with a mean LOSS of 0.209. The average for MKTBK is 2.480. The average value of QUICK is 2.124, while the average value of LIT is 0.025. The mean logged AGE value is 9.064, while the average value of RETEQ is -0.120.

Correlation Analysis

Table 2 presents the results of the correlation analysis.

From Table 2, CH has a weak positive correlation with RT ($r = 0.068$). CH is positively linked with GROWTH (0.041), LOSS (0.020), MKTBK (0.154), QUICK (0.314), LIT (0.066), and GDP (0.244). CH has negative correlations with FSIZE, LEV, AGE, RETEQ, and INF, with correlation coefficients of -0.116, -0.322, -0.077, -0.117, and -0.130, respectively. There is no correlation greater than 0.80; hence, according to Kim (2019) and Senaviratna and

Cooray (2019), the model does not have issues with multicollinearity.

Regression Analysis

A panel data analysis was carried out. Several estimation approaches were used to test the hypothesis and address inconsistent results observed in prior studies, which may be due to the use of different estimation methods. The findings of the OLS regression are presented in Table 3. Meanwhile, Table 4 presents the VCE (Robust), HUBER, REGHDFE, and WLS analyses.

Table 3 displays the results of the hypothesis testing using OLS regression. OLS is a widely employed technique for estimating linear models (Ismail & Rasheed, 2021). The OLS regression results indicate a positive and significant association between RT and CH ($\beta = 0.018$, $t = 12.724$, $p < 0.01$). Thus, the findings concur with the expectation that firms engaging in high-risk-taking strategies have greater cash reserves, as predicted for H1. For the control variables, the findings report negative associations between FSIZE, LEV, LOSS, LIT, AGE, RETEQ, INF, and CH. However, the results demonstrate that GROWTH, MKTBK, QUICK, and GDP are positively associated with CH.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
CH	0.123	0.142	0.000	0.994
RT	0.055	0.283	0.001	21.092
FSIZE	19.279	1.977	10.125	24.323
LEV	0.208	0.179	0.000	2.922
GROWTH	0.136	0.798	-1.000	28.882
LOSS	0.209	0.407	0.000	1.000
MKTBK	2.480	3.931	0.093	49.096
QUICK	2.124	3.869	0.007	71.280
LIT	0.025	0.155	0.000	1.000
AGE	9.064	0.785	4.883	10.547
RETEQ	-0.120	3.482	-45.84	46.161

Table 2: Correlations

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) CH	1.000												
(2) RT	0.068***	1.000											
(3) FSIZE	-0.116***	-0.093***	1.000										
(4) LEV	-0.322***	-0.030***	0.216***	1.000									
(5) GROWTH	0.041***	0.077***	-0.032***	-0.021***	1.000								
(6) LOSS	0.020***	0.093***	-0.202***	0.109***	-0.026***	1.000							
(7) MKTBK	0.154***	0.087***	-0.006**	0.030**	0.060***	0.052***	1.000						
(8) QUICK	0.314***	0.045***	-0.168***	-0.298***	0.030***	0.035***	0.008***	1.000					
(9) LIT	0.066***	0.004	0.087***	-0.056***	-0.006	0.035***	0.090***	0.014***	1.000				
(10) AGE	-0.077***	-0.058***	0.159***	-0.005	-0.107***	-0.083***	-0.114***	-0.071***	-0.040***	1.000			
(11) RETEQ	-0.117***	-0.146***	0.222*	-0.048***	-0.035***	-0.272***	-0.369***	-0.014***	-0.059***	0.103***	1.000		
(12) GDP	0.244***	0.041***	0.246***	-0.121***	-0.008***	0.102***	0.029***	0.039***	0.161***	0.071***	-0.085***	1.000	
(13) INF	-0.130***	-0.009***	-0.121***	0.057***	0.040***	-0.037***	-0.016***	-0.023***	-0.037***	-0.090***	0.016***	-0.429***	1.000

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

The findings support our hypothesis that corporate risk-taking is linked to cash holdings. This finding confirms the trade-off theory, specifically the precautionary motive for holding cash, which suggests that companies prefer to reserve cash instead of making investments in situations of higher risk to hedge against potential risk. In support of the theory, firms consider the marginal benefits against the costs of holding cash to optimise shareholder wealth (Dittmar *et al.*, 2003).

In Table 4, our hypothesis is examined using alternative estimation procedures, with the results reported as follows: VCE (Robust) analysis in Column 1, the HUBER analysis in Column 2, the REGHDFE analysis in Column 3, and the WLS analysis in Column 4.

VCE stands for the variance-covariance matrix of the estimators. As highlighted in Column 1, the results of the analysis using VCE (Robust) suggest a significantly positive coefficient for RT ($\beta = 0.018$, $t = 4.284$, $p < 0.01$), indicating that higher risk-taking is associated with higher cash holdings. The finding aligns with the prediction set in hypothesis 1, on the association between corporate risk-taking and cash holdings. Meanwhile, Huber's M-estimator addresses robustness to outliers in a regression model. The findings of the HUBER analysis in Column 2 indicate a positive and significant association between RT and CH ($\beta = 0.014$, $t = 14.802$, $p < 0.01$), signifying that firms with a greater propensity for risk-taking tend to maintain greater cash reserves. This result likewise continues to be consistent with the hypothesis of this study.

In Column 3, the analysis employs REGHDFE, a linear regression that incorporates multiple fixed effects. The REGHDFE analysis in Column 3 indicates a positive and significant association between RT and CH ($\beta = 0.018$, $t = 12.724$, $p < 0.01$). In line with Hypothesis 1, the findings in Column 3 suggest that higher-risk-taking firms have greater cash holdings. In the WLS regression, the issue of biased results caused by over-represented countries is addressed. This is because the number of

Table 3: Regression analysis using OLS

	(1) OLS
<i>Intercept</i>	0.019 (1.596)
<i>RT</i>	0.018*** (12.724)
<i>FSIZE</i>	-0.004*** (-22.683)
<i>LEV</i>	-0.160*** (-86.801)
<i>GROWTH</i>	0.002*** (5.010)
<i>LOSS</i>	-0.014*** (-17.080)
<i>MKTBK</i>	0.004*** (51.784)
<i>QUICK</i>	0.008*** (99.131)
<i>LIT</i>	-0.014*** (-7.121)
<i>AGE</i>	-0.007*** (-17.160)
<i>RETEQ</i>	-0.002*** (-16.434)
<i>GDP</i>	0.022*** (75.997)
<i>INF</i>	-0.001*** (-15.930)
<i>Lc</i>	Included
Fixed Effects	Included
Adjusted R ²	0.26
N	176,663
F-stat	1,438.022

t-statistics in parentheses. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

observations in our sample substantially varied across countries. As demonstrated in Column 4, the coefficient of RT is significantly positive ($\beta = 0.018$, $t = 4.276$, $p < 0.01$). The findings support our hypothesis that corporate risk-taking is linked to cash holdings.

For the control variables, the tables indicate that FSIZE and AGE have a negative effect on CH in the VCE (Robust), REGHDFE, and WLS analyses. On the other hand, the HUBER analysis indicates a positive effect of FSIZE and AGE on CH. Therefore, investors should

Table 4: Regression analysis using Various Estimation Procedures

	(1) VCE(Robust)	(2) HUBER	(3) REGHDFE	(4) WLS
<i>Intercept</i>	0.019 (1.556)	-0.113*** (-13.925)	0.066*** (13.561)	0.038*** (3.204)
<i>RT</i>	0.018*** (4.284)	0.014*** (14.802)	0.018*** (12.724)	0.018*** (4.276)
<i>FSIZE</i>	-0.004*** (-22.001)	0.001*** (6.217)	-0.004*** (-22.683)	-0.004*** (-22.202)
<i>LEV</i>	-0.160*** (-80.743)	-0.070*** (-55.530)	-0.160*** (-86.801)	-0.160*** (-80.851)
<i>GROWTH</i>	0.002*** (3.410)	0.001*** (5.051)	0.002*** (5.010)	0.002*** (3.442)
<i>LOSS</i>	-0.014*** (-17.241)	-0.013*** (-24.207)	-0.014*** (-17.080)	-0.014*** (-17.082)
<i>MKTBK</i>	0.004*** (35.911)	0.002*** (41.479)	0.004*** (51.784)	0.004*** (35.935)
<i>QUICK</i>	0.008*** (34.672)	0.013*** (235.009)	0.008*** (99.131)	0.008*** (34.644)
<i>LIT</i>	-0.014*** (-6.337)	-0.007*** (-5.330)	-0.014*** (-7.121)	-0.014*** (-6.285)
<i>AGE</i>	-0.007*** (-17.300)	0.001*** (3.009)	-0.007*** (-17.160)	-0.007*** (-16.987)
<i>RETEQ</i>	-0.002*** (-9.566)	-0.000*** (-3.727)	-0.002*** (-16.434)	-0.002*** (-9.554)
<i>GDP</i>	0.022*** (78.619)	0.015*** (74.887)	0.022*** (75.997)	0.022*** (78.354)
<i>INF</i>	-0.001*** (-19.374)	-0.001*** (-17.419)	-0.001*** (-15.930)	-0.001*** (-17.920)
<i>Lc</i>	Included	Included	Included	Included
Fixed Effects	Included	Included	Included	Included
Adjusted R ²	0.26	0.37	0.26	0.26
N	176,663	176,663	176,663	176,663
F-stat	981.967	2452.153	2275.929	931.338

t-statistics in parentheses. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

consider firm size and age when evaluating cash-holding stability. The estimation approaches, VCE (Robust) analysis, HUBER analysis, REGHDFE analysis, and WLS analysis, all indicate negative associations between LEV,

LOSS, LIT, RETEQ, INF, and CH. Nevertheless, the results show that GROWTH, MKTBK, QUICK, and GDP are positively associated with CH in all estimation approaches: VCE (Robust), HUBER, REGHDFE, and WLS.

Discussion

In sum, the results support our hypothesis by demonstrating positive associations between RT and CH across all five estimation approaches, with statistical significance at $p < 0.01$. Firms that exhibit greater risk-taking behaviour generally maintain larger cash holdings, as indicated by the findings. Firms engaging in greater risk-taking may adopt a strategy of maintaining a higher cash reserve to prevent operational cash shortages. Overall, the findings suggest that corporate risk-taking is associated with the cash-holding strategies used by the firms, supporting our premise on the issue.

The consistent results across all analyses can be elucidated from the following viewpoint. First, our results are consistent with the findings of Lee (2024) and Behera and Mahakud (2025), who reported a significant positive relationship between risk proxies and cash holdings. Our findings contrast with those of Demir *et al.* (2019) and Lozano and Yaman (2020), who revealed a negative association between risk measures and corporate cash reserves. Overall, these findings support the Trade-off Theory, suggesting that firms with higher risk-taking tendencies tend to maintain larger cash reserves. In this view, greater cash reserves serve as a precaution in situations of significant liquidity problems, thereby minimising potential conflicts between managerial and shareholder risk preferences.

Second, we demonstrated the robustness of the analysed relationship between corporate risk-taking and cash holdings. This means that our findings provide robust evidence that higher corporate risk-taking is associated with higher cash holdings. The outcomes provide avenues for future research to apply a similar robust approach in testing the determinants of cash holdings.

Implications

Findings on the connection between risk-taking and corporate financial policies offer important practical implications for corporate decision-makers, policymakers, and investors. For investors, investment decisions should take into

consideration the firm's risk-taking, as it has implications for cash-related financial policies. Investors, especially those assessing firms based on cash-holding levels as an indicator of corporate performance, need to understand that variations in cash holdings may reflect corporate risk-taking strategies. For corporate decision-makers, i.e., managers in firms, insights from this study can help them make informed decisions regarding cash holdings and risk-taking based on the firm's attributes, its industry, as well as the regulatory environment. Demonstrating an integrated approach to responsible risk-taking would positively affect firms and reflect a good understanding of how strategic decisions and resource allocation are interconnected in addressing potential risks.

For policymakers and regulators, improving the regulatory framework on cash reserves should take into account the varying cash needs of firms operating under different levels of risk-taking. Moreover, when firms face high levels of corporate risk-taking, policymakers can introduce policies aimed at reducing uncertainty and encouraging productive investment rather than excessive cash accumulation. Examples include tax breaks for productive investments or targeted programmes to improve access to finance for productive ventures. These incentives and regulations can encourage efficient cash management and discourage excessive cash hoarding. In the aspect of risk-taking, the findings can inform policymakers in designing regulatory tools and risk-mitigation strategies. These strategies may include sector-specific regulations, capital adequacy requirements, or stress testing exercises to prevent excessive risk-taking and potential financial crises.

In terms of the societal implications of this finding, this study highlights attempts towards financial sustainability through efficient cash holdings. The findings suggest strengthening financial sustainability globally by creating strong policy frameworks that support sustainable corporate risk-taking and optimise cash management practices. One way

is to consider how contributions to society and the environment can lower financial constraints (Liem *et al.*, 2020). Taken together, the outcome of this study contributes to promoting financial stability and making a significant contribution to economic prosperity and financial well-being by reinforcing more effective regulations.

Limitations and Suggestions for Future Research

Although this research has certain limitations, it offers valuable opportunities for future study. The first limitation relates to the variables, as some relevant factors may not have been included as control variables, particularly in an international setting. For example, future research can consider controlling for corporate governance variables, including country-level institutional features and country-specific regulatory mechanisms, that may impact cash holdings. Moreover, the limitation is that the sample is restricted to only firms with available data. While this is a common approach in studies relying on publicly available datasets, future research may attempt to collect missing data by hand. Second, the analysis in this study used only samples from non-financial industries, making the findings limited to a selected sample. It is recommended that future research cover specific sectors, such as the financial sector, where the focus on cash-holding policies can be linked to country-level regulations in the finance and banking sectors.

Third, while an international analysis offers important implications, country-specific features may have been ignored. Future studies could reanalyse the results using regional datasets, such as those from the Association of Southeast Asian Nations (ASEAN) or the Gulf Cooperation Council, and consider regional policies to better understand corporate risk-taking and cash holdings. To contribute to sustainability and environmental policy, further research could explore how corporate sustainability influences risk-taking and, in turn, cash holdings. This is consistent with research suggesting that Environmental, Social, and Governance (ESG)

investments can reduce corporate risk by enhancing sustainability (Ilhan *et al.*, 2020). Finally, regarding methodological constraints, although this study employed various estimation procedures to ensure the validity and robustness of the results, an aspect to consider is the impact of the financial or COVID-19 crisis. Future research should employ a methodological approach that can address the “noisy” period.

Conclusions

Cash policy is among the crucial decisions in a firm because cash is a resource for operating, investment, and funding decisions. Nonetheless, the management of cash holdings presents a double-edged challenge that can both benefit and harm investors (Hsu & Liu, 2018), as there will be managerial discretion in determining the strategy. In this study, we employ various estimation procedures to examine whether corporate risk-taking is associated with cash holdings. In addition, we extend the literature on the determinants of cash holdings (i.e., Yun *et al.*, 2020; Garavito & Chion, 2021; Bagh *et al.*, 2021), which remains inconclusive, by exploring whether the results prevail across different estimation procedures. This study uses 176,663 firm-year observations from various industries in 60 countries to provide international evidence on cash-holding strategies as a key aspect of corporate financial management.

Through the various estimation procedures, the findings confirm the hypothesis on the association between corporate risk-taking and cash holdings. Significant and positive associations between cash holdings and corporate risk-taking are exemplified in the results of the OLS regression, the VCE (Robust) analysis, the HUBER analysis, the REGHDFE analysis, and the WLS analysis. The consistent evidence across all estimation procedures indicates that firms with a high propensity for risk tend to maintain larger cash reserves, in line with the precautionary view of cash holdings. More specifically, the findings provide robust evidence that firms with higher risk-taking have the propensity to hold more cash.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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