

# Strengthening Corporate Cash Holdings and Investment Efficiency in the COVID-19 Pandemic: Some Empirical Evidence from Indonesia Emerging Markets

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## ABSTRACT

This study explores the connection between the amount of cash a company holds and its effectiveness in making investments, as well as the effect of the COVID-19 pandemic. The researchers analyzed a dataset consisting of 2721 observations from Indonesian publicly listed firms between 2013 and 2020, excluding the financial industry (SIC 6). They utilized multiple linear regression analysis to investigate how cash holding influences investment efficiency and how the COVID-19 pandemic affects this relationship. The research approach employed was quantitative. The results indicate that a higher cash holding has a negative impact on investment efficiency. The uncertainty caused by the COVID-19 outbreak has significantly affected corporate cash flows, impeding business activities. Additionally, robustness tests were conducted to address concerns regarding potential bias, and the results consistently aligned with the ordinary least squares (OLS) estimation. These findings are significant for investors, potential investors, and management, providing insights into the interplay among cash holding, investment efficiency, and the COVID-19 Pandemic.

**Keywords:** Cash holding; investment efficiency; covid-19; sustainability reporting disclosure; governance.

## INTRODUCTION

This research paper examines the intricate relationship between cash holdings, the COVID-19 pandemic, and the efficiency of investments in companies. The effectiveness of investments is a crucial factor for business growth and has garnered significant attention from researchers. Critical is the efficiency of firms' investments, as it directly impacts their ability to achieve objectives and maximize shareholder wealth [1]. To undertake investments, companies require a substantial amount of available cash flow, which serves as an essential measure of liquidity and facilitates various activities, including investments [2, 3]. The level of cash reserves held by firms significantly influences their investment decisions. Maintaining an optimal cash holding level helps mitigate agency problems and information asymmetry, thereby promoting investment efficiency [4, 9, 10, 46, 47]. By having an optimal cash position, firms are better prepared to navigate economic uncertainties like the COVID-19 pandemic. The Pandemic has presented unprecedented challenges globally, causing disruptions in supply chains, reduced consumer demand, and increased market volatility. In this context, companies with

adequate cash reserves can capitalize on investment opportunities during market downturns and pursue strategic acquisitions or expansions [5, 39, 40]. However, it is important to note that excessive cash holdings can hinder investment efficiency. Companies that hoard cash beyond their optimal level may face criticism from shareholders seeking higher returns on their investments. Furthermore, excessive cash reserves can create complacency, discouraging firms from actively seeking profitable investment opportunities [6, 41, 42, 43].

Investment distortion, which can lead to both over-investment and under-investment, is influenced by two key factors: moral hazard and adverse selection. These factors arise from conflicting interests between managers and shareholders, as well as the presence of agency problems [5, 6]. Over-investment can occur when managers are motivated by personal incentives such as the prospect of promotion or receiving compensation tied to successful investments [7, 8, 44, 45]. Conversely, under-investment may result from managers seeking a more relaxed lifestyle [8, 9, 48, 49]. These conflicting motivations can lead to suboptimal investment decisions, undermining investment efficiency. Besides agency issues and cash-related concerns, firms

facing financial difficulties find themselves unstable, making it challenging to improve investment efficiency. Therefore, addressing and predicting financial problems during the COVID-19 pandemic should encompass all affected sectors rather than focusing solely on healthcare [10, 50, 51]. Researchers consider this matter crucial and intriguing for further exploration. Understanding the complex dynamics of investment distortion and its impact on firm performance is essential for policymakers and practitioners [32, 33, 38]. By identifying the root causes of investment distortion, steps can be taken to mitigate moral hazard, address adverse selection, and enhance investment efficiency. Future research should delve deeper into these factors, considering the unique challenges posed by the COVID-19 pandemic and its implications across various sectors of the economy. Such research can provide valuable insights into practical strategies for promoting sound investment decisions and facilitating economic recovery in the post-pandemic era [51, 52, 55].

The onset of the COVID-19 pandemic in March 2020 marked an unparalleled global crisis, with Indonesia reporting its first case. In response, the government implemented various preventive measures across sectors. One significant consequence of the Pandemic has been the increased uncertainty surrounding economic policies, prompting firms to adopt a more cautious approach to managing their cash holdings [11, 53, 54]. Given the prevailing uncertain economic conditions, it is likely that firms will choose to bolster their cash reserves as a precautionary measure [11]. In the past, firms with excess cash holdings have demonstrated a greater inclination to increase their investments [12]. However, the dynamics surrounding cash holdings have potentially shifted during the COVID-19 pandemic as firms further augment their cash reserves [13, 55]. This increase is motivated by the need to ensure adequate liquidity for operational activities and safeguard against uncertainties from the Pandemic. The present study anticipates that the growing emphasis on cash holdings may affect firms' investment efficiency, as management may prioritize accumulating cash over making new investments. This shift in priorities, as suggested by [14, 15, 18, 34], is likely to influence firms' decisions to delay investments, consequently impacting the overall efficiency of their investment strategies. Acknowledging the intricate and evolving nature of the relationship between cash holdings, the COVID-19 pandemic, and investment efficiency is crucial. The unprecedented circumstances triggered by the Pandemic have compelled firms to reevaluate their financial strategies, emphasizing liquidity and risk management [34, 35, 36]. Future research should continue to explore how

these evolving dynamics affect investment decision-making and investigate potential strategies for optimizing investment efficiency in uncertain economic conditions.

This paper aims to tackle the issue of endogeneity that arises in empirical analyses of cash holdings. Endogeneity problems pose significant challenges due to various factors. One key concern is that observable and unobservable factors that influence a firm's cash holdings may also impact specific firm characteristics. This inter-relationship between cash holdings and firm-specific variables raises endogeneity concerns. The paper adopts the Coarsened Exact Matching (CEM) approach to address these concerns, which helps mitigate potential endogeneity problems.

Additionally, CEM serves as an alternative method to address self-selection bias. CEM focuses on observed potential variables that may influence the results in a standard regression model. According to [15], Coarsened Exact Matching (CEM) is considered a superior approach compared to Propensity Score Matching (PSM) when examining the influence of observed variables on regression results. Acknowledging the importance of addressing endogeneity in empirical research is crucial to avoid biased or spurious results. The adoption of the CEM approach in this paper enhances the validity of the analysis. It contributes to a more comprehensive understanding of the relationship between cash holdings and firm-specific variables. Further research can build upon this methodological approach and explore other innovative techniques to address endogeneity and advance our understanding of the impact of cash holdings on firm behaviour and performance [34, 36, 38].

Moreover, this study is expected to make significant scientific and practical contributions in the following ways. Firstly, the findings will serve as valuable additions to the existing literature on firms' disclosure of their COVID-19 exposure. With limited studies conducted on this topic, both in Indonesia and globally, the results will enrich the body of knowledge and deepen our understanding of how firms manage and communicate the risks and impacts related to COVID-19. Secondly, the study will contribute to the literature on the preference factors that influence appropriate investment activities during the Pandemic. By examining and analyzing these factors, the study will provide insights into the decision-making process behind investment choices in the challenging environment. This understanding will empower stakeholders, including firms and policymakers, to make informed investment decisions and develop strategies that align with the evolving market dynamics.

Lastly, the study will benefit investors by offering valuable insights into firms' efficient investment preferences. By identifying and analyzing the factors that drive investment efficiency during the Pandemic, the study will guide investors in making informed decisions regarding capital allocation. Understanding firms' efficient investment preferences can help investors identify companies likely to generate higher returns in the future and allocate their resources accordingly. Overall, this study's contributions lie in its capacity to expand the literature on COVID-19 disclosure, provide insights into preference factors shaping investment decisions, and offer guidance for investors. The findings will contribute to a comprehensive understanding of firms' behaviour and investment strategies during challenging times, facilitating informed decision-making across various stakeholders.

## Hypothesis Development

### *Cash Holding and Investment Efficiency*

The concept of investment efficiency has been defined in multiple ways. According to [16, 18, 23, 24], investment efficiency depends on the risks and overall costs associated with the investment management structure. This definition emphasizes the importance of considering detailed information about risks, returns, and total costs when evaluating investment efficiency [34, 35, 36]. Therefore, managers must carefully evaluate these three factors for optimal investment efficiency. Additionally, a related concept in the field of investment is investment distortion or inefficient investment. Information asymmetry between internal and external parties can contribute to investment inefficiency [34, 35, 36]. Managers, who typically possess more information about the company's operations and prospects, may make investment decisions influenced by various motivations. For example, they may be driven by the prospect of advancing to higher management positions or receiving compensation tied to the success of their investments [15, 17, 18].

To tackle investment inefficiency, it is necessary to implement measures that mitigate information asymmetry and foster transparent decision-making processes. Measures such as enhancing information disclosure, improving communication channels among stakeholders, and implementing effective governance mechanisms can reduce investment distortion and facilitate efficient allocation of investments [23, 25, 45]. Managers and decision-makers must acknowledge the complexities associated with investment efficiency and investment distortion. By recognizing the importance of conducting comprehensive risk assessments, considering costs,

and addressing information asymmetry, companies can strive for improved investment efficiency and align their investment decisions with long-term organizational objectives [43, 46, 49]. Ongoing research in this field is crucial to enhance our understanding of investment efficiency further and develop strategies to effectively overcome investment distortions in practical settings [56, 58].

The Cost of Delay Theory states that having excessive cash in a company or individual means sacrificing the opportunity to invest that money in projects or assets that could generate higher returns (Branzei et al., 2002). In the context of investment efficiency, it shows that a company's higher cash holdings will decrease investment value because delays in cash flow to investments hampered opportunities for increasing returns.

Conversely, managers may prioritize a more relaxed lifestyle, resulting in under-investment [19]. Additionally, shareholders may need a more comprehensive understanding of the firm's investment size, leading to suboptimal investment decisions. Firms' investment decisions are only sometimes optimal, leading to inefficiencies [20, 24, 28]. Managers require assets that can be easily converted into cash when making investment choices, as highlighted by [20, 24, 28]. Cash, a highly liquid asset, is often preferred for its convertibility and immediate usability. It gives managers flexibility and agility in responding to investment opportunities or fulfilling financial obligations.

Similarly, [21, 23, 29, 31] emphasize the crucial role of cash as an asset in assessing a firm's liquidity level. Cash holdings are a key indicator of a company's ability to meet short-term obligations and maintain financial stability. Cash acts as a safety net during economic uncertainty, enabling firms to navigate unforeseen challenges and seize potential investment opportunities as they arise [32, 36, 39].

Companies that maintain significant cash reserves often need help effectively deploying their cash, resulting in challenges such as excessive investment and diminished investment efficiency [22, 23, 24]. Moreover, this situation can give rise to agency issues, as managers may exploit the abundance of cash for personal gain, perceiving it as a more easily manipulable asset than others [25, 26]. As emphasized by [27], managers might prioritize investment opportunities that serve their interests rather than those aligned with shareholders' interests. Such behaviour can contribute to investment inefficiency and exacerbate agency problems [28, 29]. The temptation to misuse available cash resources can lead to inappropriate investments and suboptimal allocation of funds. Based on the insights gained from this analysis, we put forward the following hypothesis:

H<sub>1</sub>: Firms' cash holdings are negatively associated with investment efficiency, as excessive cash reserves can create agency problems and encourage managerial biases in investment decision-making.

The ability to forecast and anticipate financial difficulties in a company is crucial because of its profound influence on investments and capacity to meet its obligations [29]. Financial distress disrupts companies' internal and external financing channels and impacts the associated financial risks related to accounts payable and the turnover period of payables [30]. Additionally, it affects the recovery rate of accounts receivable, leading to payment defaults and long-term losses [31, 32]. The uncertainties stemming from the COVID-19 pandemic have further intensified the challenges companies face, affecting their cash flow, hindering business operations, and limiting short-term capacity expansion. The global stock market is experiencing volatility due to investors' lack of confidence [32]. Within this context, the researchers anticipate that increasing cash reserves can significantly influence the investment efficiency of companies.

Due to the uncertain business environment, management often prioritizes accumulating cash over making investments. Moreover, research conducted by [33, 34, 36, 39, 42] suggests that the increase in cash holdings can influence firms to delay their investment decisions, leading to a potential decrease in investment efficiency. As firms allocate a larger portion of their resources to cash reserves, the availability of funds for productive investments may diminish, hindering the firm's ability to maximize investment returns [43, 44, 46, 49]. Understanding the consequences of increased cash holdings on firms' investment efficiency becomes crucial, especially in the face of financial uncertainty and the uncertainties stemming from the COVID-19 Pandemic. By investigating the relationship between cash holdings, investment decisions, and their impact on investment efficiency, this study aims to contribute to comprehending the challenges firms face in effectively managing their resources [23, 26, 29, 32].

Financial distress affects the payment processes within and outside the firm and has implications for firms' investment decisions, financing choices, and dividend distributions [34, 35, 47]. The allocation of cash by firms to long-term assets (such as fixed assets) and short-term assets reflects their investment choices, which play a crucial role in stimulating firm growth. As highlighted by [36] and [37], investments are essential for improving future cash flows, enhancing profitability, mitigating operational risks, and fostering development opportunities.

However, the unprecedented challenges posed by the COVID-19 pandemic have led to constrained cash flows, significantly impacting firms' investment behaviour [38, 32, 44, 45]. Firms have had to reassess their investment strategies and prioritize cash preservation in response to the uncertainties and disruptions caused by the Pandemic. We put forward the hypotheses as follows:

H<sub>2</sub>: The COVID-19 pandemic has had a negative impact on firms' investment efficiency and cash allocation, leading to reduced investment in long-term assets and increased emphasis on cash preservation.

## RESEARCH METHOD

### Samples and Data Sources

This study's research sample consists of companies listed on the Indonesian Stock Exchange from 2013 to 2020. The data is gathered from the firms' annual reports. To ensure the quality of the sample, specific selection criteria are applied. Initially, firms with incomplete data on investment efficiency are excluded. Additionally, any missing control variables are also eliminated from the analysis. After applying these criteria, the final sample consists of 2,721 firms with observations from each year of the study period. To minimize the impact of outliers and unusual values, all continuous variables in the dataset are adjusted using win-sorization, which restricts extreme values to the 1st and 99th percentiles. This adjustment helps to reduce potential distortions in the data caused by extreme observations.

Table 3 presents the sample distribution based on overinvestment and underinvestment. Panel A displays the sample distribution by year of observation. On the other hand, Panel B presents the sample distribution based on industry classification. The highest observation year was in 2017, with 323 sample observations. The highest sample is in the construction industry classification, with 423 samples. Thus, our sample distribution is relatively large and dominant.

### Operational Definition and Variable Measurement

Financial cash utilization refers to a firm's ability to effectively manage and allocate internal and external funds through appropriate financial policies [13, 14]. The primary variable examined in this study is cash holdings, which is measured by dividing the sum of cash and cash equivalents by the total assets of the firm [16, 17]. To capture the impact of the COVID-19 pandemic, a moderating

variable labelled as COVID-19 (COV) is introduced. It takes a value of 1 if the firm's fiscal year falls within 2019 and 2020, representing the years directly affected by the pandemic [18]. The study focuses on investment efficiency as the dependent variable, representing the firm's investment decisions aimed at achieving an optimal balance without exhibiting either over-investment or under-investment [19, 56]. The measurement of investment efficiency in this study is based on a model developed by [20], with the residual derived from the corresponding equation.

$$INVEST(CAPX,R\&D) = \beta_0 + \beta_1 MTBi,t-1 + \beta_2 SGi,t-1 + \beta_3 OCFi,t + \beta_4 LEVi,t-1 + \beta_5 LOGSALEi,t-1 + ei,t \quad (1)$$

The residual value obtained is transformed into an absolute value and then multiplied by -1 to ensure that the *absminINVEFF* variable reflects the firms' investment efficiency in a negative direction. This adjustment is necessary to align the variable value with the investment efficiency concept, where higher *absminINVEFF* values indicate greater investment efficiency. The study includes several control variables based on previous literature [21, 22]. These control variables consist of the board size (BSIZE), the natural logarithm of the company's age (lnAGE), the size of the firms measured by the natural logarithm of total assets (FIRMSIZE), return on equity (ROE), market-to-book ratio (MTB), property, plant, and equipment divided by total assets (PPE), and leverage measured by liabilities divided by assets (LEV). A summary of all variables used in this paper can be found in Table 1, Table 2 provides the definitions of each variable, and Table 3 presents the distribution of the samples.

**Table 1.** Derivation of Samples

Description	Source
Firms-Year Observations	2895
Missing Data	(174)
Firm-Year Observations for Final Sample	2721

**Research Methods**

The study employs ordinary least squares regression to examine the hypotheses [45, 47, 53], incorporating fixed effects from industrial years and combined standard error [23]. Two different research models are utilized to test the hypotheses. The first research model (Model 1) is employed to test Hypothesis 1, while the second (Model 2) is used to test Hypothesis 2. Based on the study's argument in Hypotheses 1 and 2, it is anticipated that cash holdings will have a negative impact on investment efficiency, and COVID-19 will influence the relationship between cash holdings and investment efficiency.

$$absminINVEFF,t = \beta_0 + \beta_1 CASH\ HOLDINGi,t + \beta_2 COVi,t + \beta_3 BSIZEi,t + \beta_4 INDCOMSIZEi,t + \beta_5 lnAGE,t + \beta_6 FIRMSIZEi,t + \beta_7 ROEi,t + \beta_8 MTBi,t + \beta_9 PPEi,t + \beta_{10} LEVi,t + \beta_{11} YEARI,t + \beta_{12} INDUSTRYit + ei,t \quad (2)$$

$$absminINVEFF,t = \beta_0 + \beta_1 CASH\ HOLDINGi,t + \beta_2 CASH\ HOLDING\_COVi,t + \beta_3 COVi,t + \beta_4 BSIZEi,t + \beta_5 INDCOMSIZEi,t + \beta_6 lnAGE,t + \beta_7 FIRMSIZEi,t + \beta_8 ROEi,t + \beta_9 MTBi,t + \beta_{10} PPEi,t + \beta_{11} LEVi,t + \beta_{12} YEARI,t + \beta_{13} INDUSTRYit + ei,t \quad (3)$$

**Table 2.** Variable Definition

Variable	Definition	Source
<b>Dependent</b>		
Investment efficiency	The residual value of Huang's (2020) regression model, which has been absolute value and multiplied by 1. This variable shows the value of investment efficiency	Annual Report
<b>Independent</b>		
Cash Holding	Cash and cash equivalents divided by total assets	Annual Report
<b>Controls:</b>		
COV	COVID-19 Pandemic coded as 1, if the YEAR of the firms indicating 2019 & 2020	
BSIZE	Natural logarithm from the total number of the board in the firms	Annual Report
INDCOMSIZE	The number of independent commissioners is divided by the total number of commissioners.	Annual Report
lnAGE	Company age when listed on the IDX to date	Annual Report
FIRMSIZE	Natural logarithm of total assets	Annual Report
ROE	Profit before tax divided by total equity	ORBIS
MTB	Market-to-book ratio	ORBIS
PPE	Plant, property, the assets divided by total assets	ORBIS
LEV	Total liability divided by total assets	ORBIS

**RESULTS AND DISCUSSION**

**Descriptive Statistics**

Table 4 provides the descriptive statistics of the variables utilized in the research. The study examined a sample comprising 895 companies listed on the IDX between 2014 and 2018. To minimize extreme values, all variables underwent winsorization at the 1% and 99% thresholds.

**Table 3.** Samples Distribution According to Overinvestment and Underinvestment

<b>Panel A: Overinvestment and Underinvestment Sample Distribution by Year</b>							
Year	Sample Underinvestment		Sample Overinvestment		Total		
	N	%	N	%	N	%	
2013	204	59%	139	41%	343	100%	
2014	181	55%	147	45%	328	100%	
2015	193	59%	135	41%	328	100%	
2016	198	58%	141	42%	339	100%	
2017	198	61%	125	39%	323	100%	
2018	203	60%	138	40%	341	100%	
2019	229	57%	174	43%	403	100%	
2020	102	32%	214	68%	316	100%	
<b>Total</b>	<b>1.508</b>	<b>55%</b>	<b>1.213</b>	<b>45%</b>	<b>2.721</b>	<b>100%</b>	

  

<b>Panel B: Overinvestment and Underinvestment Sample Distribution by Industries</b>							
SIC	Sample Underinvestment		Sample Overinvestment		Total		
	N	%	N	%	N	%	
(SIC 0) Agriculture, Forestry and Fisheries	100	60%	68	40%	168	100%	
(SIC 1) Mining	228	58%	166	42%	394	100%	
(SIC 2) Construction Industries	352	50%	358	50%	710	100%	
(SIC 3) Manufacturing	300	62%	181	38%	481	100%	
(SIC 4) Transportation, Communications and Utilities	294	68%	138	32%	432	100%	
(SIC 5) Wholesale & Retail Trade	151	54%	128	46%	279	100%	
(SIC 7) Service Industries	62	27%	166	73%	228	100%	
(SIC 8) Health, Legal, and Educational Services and Consulting	21	72%	8	28%	29	100%	
<b>Total</b>	<b>1.508</b>	<b>55%</b>	<b>1.213</b>	<b>45%</b>	<b>2.721</b>	<b>100%</b>	

**Table 4.** Descriptive Statistics

	Mean	Median	Minimum	Maximum
<i>absminINVEFF</i>	-0.109	-0.013	-2.488	0.000
<i>CASH</i>	0.104	0.066	0.000	0.963
<i>HOLDING</i>				
<i>COV</i>	0.257	0.000	0.000	1.000
<i>BSIZE</i>	8.875	8.000	4.000	21.000
<i>INDCOMSIZE</i>	0.382	0.333	0.000	3.000
<i>lnAGE</i>	3.531	3.584	1.099	4.796
<i>FIRMSIZE</i>	27.821	28.352	14.999	32.261
<i>ROE</i>	0.040	0.052	-1.252	1.354
<i>MTB</i>	2.287	1.144	-1.685	28.113
<i>PPE</i>	0.381	0.349	0.000	0.932
<i>LEV</i>	0.530	0.492	0.052	2.661

In this study, the variable of interest is referred to as "absminINVEFF," which measures investment efficiency using a model created by the authors cited as [24]. According to the study, the INVEFF scores range from a maximum of 0.000 to a minimum of -2.488, with an average score of -0.109. These scores reflect a wide range of investment efficiency among the firms. Some scores are close to zero, indicating high investment efficiency, while others, such as -2.488, suggest a lack of investment efficiency.

Additionally, the study needs to differentiate between underinvestment and overinvestment since the focus is on investment efficiency as determined by the firms. The independent variable considered in the study is "CASH HOLDING," which measures the proportion of cash and cash equivalents to total

assets in the firms. On average, the firms included in the study have a cash holding of 10.4% of total assets, with a maximum value of 96.3%. A similar pattern was observed in the research conducted by [32] on U.K. firms, where the average cash holding was 9.9% and the maximum value was 98.8%. The variable "COV," representing the impact of COVID-19, indicates the number of years since the 2019 financial year. According to Table 4, approximately 25.7% of the data used in the study were affected by COVID-19, and this variable serves as a moderator in the analysis. Furthermore, Table 4 presents several control variables: BSIZE, INDCOMSIZE, lnAGE, FIRMSIZE, ROE, MTB, PPE, and LEV. BSIZE represents the firms' total number of board members, with an average of 8 people.

INDCOMSIZE, which measures the ratio of independent commissioners to non-independent commissioners, has an average score of 0.382, indicating that 38.2% of the board of commissioners are independent. lnAGE represents the natural logarithm of the firms' age, with an average score of 3.531. FIRMSIZE is measured using the natural logarithm of total assets, with an average value of 27.821. ROE, representing the return on equity, has an average value of 0.040. MTB, the market-to-book ratio, has an average value of 2.287. PPE, the ratio of plant, property, and equipment to total assets, has an average value of 0.381 or 38.1%. Finally, LEV represents the firms' ability to pay their debts with assets, with an average value of 05.30.

**Table 5.** Pearson Correlation

Panel A: From variables absminINVEFF to lnAGE						
	[1]	[2]	[3]	[4]	[5]	[6]
[1] absminINVEFF	1.000					
[2] CASH HOLDING	-0.033*	1.000				
[3] COV	0.077***	-0.013	1.000			
[4] BSIZE	0.080***	0.075***	-0.194***	1.000		
[5] INDCOMSIZE	0.027	-0.015	0.121***	-0.010	1.000	
[6] lnAGE	-0.143***	0.019	-0.186***	0.296***	-0.050***	1.000
[7] FIRMSIZE	-0.095***	-0.001	-0.575***	0.501***	-0.034*	0.224***
[8] ROE	-0.071***	0.054***	-0.060***	0.039**	-0.026	0.054***
[9] MTB	-0.273***	0.032*	0.001	0.035*	-0.033*	-0.026
[10] PPE	-0.030	-0.338***	-0.015	0.048**	0.002	0.035*
[11] LEV	0.006	0.004	0.029	-0.015	0.039**	-0.005

  

Panel B: From variables FIRMSIZE to LEV					
	[7]	[8]	[9]	[10]	[11]
[7] FIRMSIZE	1.000				
[8] ROE	0.089***	1.000			
[9] MTB	-0.020	-0.132***	1.000		
[10] PPE	0.068***	-0.037**	0.003	1.000	
[11] LEV	-0.073***	-0.000	-0.011	-0.028	1.000

Significance is at \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

**Table 6.** Ordinary Linear Regression

	(1) absminINVEFF	(2) absminINVEFF
CASH_HOLDING_COV		0.202** (2.06)
CASH_HOLDING	-0.120** (-1.96)	-0.178** (-2.25)
COV	-0.026 (-0.81)	-0.047 (-1.45)
BSIZE	-0.000 (-0.15)	-0.000 (-0.10)
INDCOMSIZE	0.034 (0.80)	0.036 (0.84)
lnAGE	-0.036*** (-2.87)	-0.036*** (-2.84)
FIRMSIZE	-0.003 (-0.83)	-0.003 (-0.82)
ROE	-0.102*** (-4.04)	-0.103*** (-4.11)
MTB	-0.022*** (-5.26)	-0.022*** (-5.25)
PPE	0.022 (1.17)	0.023 (1.20)
LEV	-0.000*** (-3.39)	-0.000*** (-3.51)
_cons	0.266** (2.24)	0.265** (2.24)
Industry Dummies	Included	Included
Year Dummies	Included	Included
r <sup>2</sup>	0.307	0.308
N	2721	2721

t statistics in parentheses

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

**Pearson Correlation**

The study employs Pearson correlation to assess the strength of the association between two

variables. As indicated in Table 5, the results reveal that absminINVEFF exhibits a negative correlation with CASH HOLDING and COV, significant at a 10% significance level, while showing a significant

positive correlation at a 1% significance level. BSIZE, INDCOMSIZE, lnAGE, FIRMSIZE, ROE, and MTB also demonstrate significant relationships. Additionally, the findings suggest that both CASH HOLDING and COV impact investment efficiency (absminINVEFF).

### Multiple Linear Regression

The study utilizes Pearson correlation to evaluate the magnitude of the relationship between different variables. According to the findings presented in Table 5, absminINVEFF demonstrates a negative correlation with CASH HOLDING and COV, which is statistically significant at a 10% significance level. Conversely, a statistically significant positive correlation is found at a 1% significance level. The variables BSIZE, INDCOMSIZE, lnAGE, FIRMSIZE, ROE, and MTB also exhibit statistically significant relationships. Furthermore, the results indicate that both CASH HOLDING and COV exert an influence on investment efficiency (absminINVEFF).

Moreover, in Model 2 of the regression analysis, the coefficient value for CASH HOLDING\_COV and absminINVEFF is 0.202 ( $t=2.06$ ) at a 5% significance level. This finding supports the second hypothesis, which suggests that the occurrence of COVID-

19 influences the relationship between cash holding and investment efficiency. The uncertainties arising from the Pandemic have had a significant impact on firms' cash flow and have imposed limitations on conducting business activities. Furthermore, the study anticipates that this situation may arise due to the cautious approach taken by management in making investment decisions, given the elevated risks posed by the Pandemic.

### Endogeneity Issue

The treatment of the cash-holding variable in the study is predetermined. Consequently, it is essential to acknowledge that the connection between cash holdings and other dependent variables may be endogenous. Various factors can contribute to the relationship between cash holding and firm characteristics, making the issue of endogeneity particularly significant in this context. The study aims to address the potential problems associated with controlling for endogeneity by utilizing the Coarsened Exact Matching (CEM) approach. CEM serves as an alternative method to address the issue of independent selection and focuses on observed variables that have the potential to influence the results in the regression analysis, as suggested by [54, 57].

**Table 7.** Coarsened Exact Matching

PANEL A		
	CASH HOLDING <sub>1</sub> = 0	CASH HOLDING <sub>1</sub> = 1
All	1.443	1.452
Matched	1.335	1.319
Unmatched	108	133
PANEL B		
	(1)	(2)
	absminINVEFF	absminINVEFF
CASH HOLDING_COV		0.230** (2.47)
CASH HOLDING	-0.135** (-1.97)	-0.164** (-2.15)
COV	-0.060*** (-2.69)	-0.084*** (-3.49)
BSIZE	0.001 (1.12)	0.001 (1.11)
INDCOMSIZE	0.035 (1.05)	0.036 (1.08)
FIRMSIZE	-0.009*** (-3.15)	-0.009*** (-3.26)
lnAGE	-0.001*** (-2.92)	-0.001*** (-2.92)
ROE	-0.064*** (-3.32)	-0.067*** (-3.44)
MTB	-0.019*** (-4.32)	-0.019*** (-4.31)
PPE	0.045*** (2.62)	0.045*** (2.63)
LEV	-0.005 (-0.54)	-0.005 (-0.52)
_cons	0.305*** (3.75)	0.314*** (3.89)
Industry Dummies	Included	Included
Year Dummies	Included	Included
r <sup>2</sup>	0.285	0.286
N	2549	2549

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.0$



In the CEM model, eleven covariates were included. Panel A of Table 7 displays the relevant summary for CEM. Out of 1,452 connected observations, 1,319 were successfully matched, while for unconnected observations, 1,335 out of 1,443 were matched. Panel B of Table 7 presents the replication results of the model using the CEM approach. The study's findings indicate that the coefficient for CASH\_HOLDING\_COV is 0.230, which is statistically significant at a 10% significance level ( $t=2.47$ ). In column 2, CASH\_HOLDING is shown as -0.135, with a 10% significance level ( $t=-1.97$ ) in column 1. The table consistently aligns with the findings presented in Table 6, thereby supporting the hypotheses put forth in the study. Overall, the study reveals a significant relationship between cash holding and investment efficiency within the examined sample, with the impact of COVID-19 weakening this relationship.

## CONCLUSION

The primary objective of this research is to investigate the association between cash holdings and investment efficiency in non-financial public firms, considering the principles of agency theory, which suggest that management tends to make decisions that benefit their interests. The study uncovers a negative correlation between cash holdings and investment efficiency across all non-financial public firms. Additionally, the analysis considers the impact of COVID-19 as a moderating factor in the relationship between cash holdings and investment efficiency. The results indicate that COVID-19 weakens this relationship.

The moderation analysis aims to explore how firms respond to uncertain external circumstances, such as the emergence of COVID-19, in terms of their investment decisions. Contrary to the initial findings, the study suggests that firms tend to adopt a cautious approach to investing when faced with uncertain conditions, as supported by previous research [27, 28, 31]. This cautious behaviour can be attributed to management's response to volatile financial markets and the risk aversion of financial institutions due to funding limitations. As a result, investment decisions become more prudent and efficient than previously [23, 25]. To address potential concerns related to self-selection bias associated with cash holdings, the study employs the Coarsened Exact Matching (CEM) approach to validate the findings. This approach provides consistent results that support the main findings, increasing confidence in the robustness of the observed relationship and minimizing the influence of self-selection bias.

Moreover, the empirical results indicate that the COVID-19 pandemic has the potential to improve

investment efficiency in firms that possess higher levels of cash holdings. These findings offer valuable insights for firms and governments when making investment decisions during the Pandemic. Given the disruptions faced by firms in their daily operations throughout the crisis, management is likely to exercise greater caution when choosing investment opportunities. Consequently, it becomes crucial for firms to effectively manage their cash reserves and maintain adequate levels of cash holdings during times of uncertainty, such as the COVID-19 pandemic. Insufficient cash reserves may result in missed opportunities for profitable investments.

However, it is important to acknowledge the limitations of this research. Different economic and industrial conditions can significantly influence the relationship between cash holdings and investment efficiency. What holds proper in one context may not apply in another. As a result, the study's findings may be challenging to generalize widely. Therefore, future research could consider including global economic factors as part of the investment efficiency measurement.

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