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Corporate Cash Holdings and Investment Efficiency: Do Women Directors and Financial Crisis Matter?

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Abstract: This study investigates the relationship between corporate cash holdings and investment efficiency, with a focus on how COVID-19 and the presence of women directors may influence this relationship. Using data from Indonesian public companies during the COVID-19 period, comprising 2350 firm-year observations, we employ fixed-effect regression models with industry and year controls to test our hypotheses. Robustness and endogeneity tests are conducted to ensure the reliability of our findings. Our research reveals that companies with larger cash reserves tend to experience decreased investment efficiency during the COVID-19 crisis. Moreover, the negative impact of substantial cash reserves on investment efficiency is exacerbated by the presence of female directors on the board. However, our findings also suggest that female directors can mitigate the adverse effects of excessive cash reserves on a company's investment efficiency, particularly during unforeseen economic challenges such as the pandemic.

Keywords: cash holdings; investment efficiency; women directors; COVID-19; governance

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1. Introduction

Do companies that maintain high levels of cash regularly contribute to improved investment efficiency? Additionally, does the presence of female directors on the board influence policies related to excess cash and enhance investment effectiveness? Recently, the financial and corporate investment sectors were shaken by an economic crisis that almost occurred, impacting the global economy (Batuman et al. 2022; Qu et al. 2022; Deng and Zhao 2022). The COVID-19 pandemic, as a global issue, significantly altered the investment landscape, causing cash management challenges for many companies (De Vito and Gómez 2020; Zheng 2022). The crisis has caused some companies to hold excessive cash reserves that can lead to complex effects on a company's investment efficiency.

Maintaining robust cash reserves is crucial for companies to weather sudden economic disruptions and uncertainties, such as those encountered during the COVID-19 pandemic. Firms with ample cash on hand can more easily navigate emergencies, including abrupt revenue declines or escalating operating costs (Arslan-Ayaydin et al. 2014). Moreover, a surplus of cash allows for companies to seize unexpected investment opportunities, such as acquisitions or business expansions, highlighting their resilience during tough economic periods. Beyond managing short-term crises, substantial cash reserves enhance a company's reputation among investors, creditors, and other stakeholders, signaling sound financial management and effective risk control (Quah et al. 2021; Rocca et al. 2019). However, the relationship between cash reserves and investment efficiency is complex. While some studies suggest that substantial cash holdings help firms avoid bankruptcy and continue investing despite market turbulence, others argue that excessive cash reserves may signal a lack of profitable investment opportunities (Jayakody et al. 2023; El Ghoul et al. 2023). This can lead companies to miss out on high-return projects, ultimately reducing long-term

investment productivity and affecting shareholder value. Therefore, understanding the balance between maintaining sufficient cash reserves and ensuring efficient investment is essential for corporate financial strategy, especially in times of economic uncertainty.

During financial crises, such as the COVID-19 pandemic, maintaining high levels of cash is essential for corporate resilience, yet it presents a complex impact on investment efficiency (Bhuiyan and Hooks 2019). Companies with substantial cash reserves can better withstand economic shocks, manage disruptions, and seize investment opportunities, but they also risk overinvestment in low-return projects and inefficiencies due to agency costs. Prior research suggests the presence of female directors on corporate boards can significantly influence cash management policies and enhance investment efficiency (Houqe et al. 2023; Gull et al. 2018). Female directors bring diverse perspectives, improve governance, and promote prudent risk management, which is crucial during crises. Their generally risk-averse nature ensures that cash is judiciously allocated to high-return investments, balancing the need for liquidity with strategic investment (Mnif and Cherif 2020; Cahyono et al. 2023b). This diversity in boardroom decision-making fosters comprehensive risk assessments and strategic agility, enabling firms to navigate financial stress effectively. Thus, firms with balanced cash reserves and diverse boards are more resilient, leveraging their liquidity and governance structures to adapt swiftly to market changes and maintain investment efficiency (Sun et al. 2012; Trinh et al. 2022). This synergistic relationship highlights the importance of gender diversity in corporate governance, particularly in enhancing firm performance and resilience during economic downturns.

This study was conducted in Indonesia, a country distinguished by its pronounced differences in perspectives compared to other developing nations (Duong et al. 2020; Benlemlih and Bitar 2018). These differences are evident across social, economic, cultural, and political domains (Khan 2022; Bhutta et al. 2022; Jones et al. 2022). Indonesia's capital market possesses unique characteristics that provide valuable insights to international audiences regarding enhanced investment prospects and funding opportunities (Moin et al. 2020; Goodell et al. 2021a; Guizani and Abdalkrim 2022). With a large population and a rapidly expanding middle class, Indonesia's consumer market is growing, driving demand for a wide range of goods and services (Harris and Li 2021). This trend presents promising investment opportunities in sectors such as retail, technology, manufacturing, and financial services (Tang and Zhang 2020).

Utilizing a sample of Indonesian public companies with a total of 2456 firm-year observations during 2010–2021, we examine the relationship between corporate cash holdings and investment efficiency, moderated by the presence of female directors on the board. Our study found that companies with higher corporate cash holdings tended to experience a decline in investment efficiency during the COVID-19 crisis period. Additionally, these results show that the negative impact of high cash holdings on investment efficiency is mitigated when there are female directors in the boardroom. Furthermore, these findings suggest that the presence of female directors on the board can play an important role in mitigating the adverse impact of excessive cash accumulation on a company's ability to invest efficiently, especially when facing unexpected economic challenges such as the pandemic crisis. The implication is that gender diversity in corporate decision-making can help strike a balance between maintaining liquidity through large cash reserves and ensuring effective utilization of funds for long-term growth.

This study makes several significant contributions to the existing literature. First, while previous research has explored the general relationship between cash holdings and investment efficiency, our study provides nuanced insights into how this relationship changes during economic crises like COVID-19. We found that both cash holdings and investment efficiency actually decreased during the pandemic, highlighting the complexities of managing cash reserves in turbulent times (Sheu and Lee 2012; Sikveland et al. 2022). Second, our research extends the literature on gender diversity in corporate governance by demonstrating that the presence of female directors can mitigate the negative impacts of economic crises on cash holdings and investment efficiency. This finding emphasizes

the tangible contributions that women in leadership positions can make to a company's performance and resilience (Adams and Ferreira 2009; Dezsö and Ross 2012). Third, by focusing on Indonesian public companies, our study provides valuable insights into the unique characteristics of an emerging market. Indonesia's distinctive social, economic, cultural, and political contexts offer a rich backdrop for understanding how different perspectives influence corporate behavior and investment strategies (Moin et al. 2020; Goodell et al. 2021b; Guizani and Abdalkrim 2022).

This paper will be processed as follows: Section 2 explains the literature review and hypothesis development. Section 3 reports the data and research methods. Section 4 presents empirical results and discussion. Section 5 is the conclusion.

2. Literature Review and Hypothesis Development

Previous studies have demonstrated that cash holdings significantly impact investment efficiency. High levels of cash reserves within a company can affect its ability to allocate resources effectively (He and Wintoki 2016; Soesanto and Wijaya 2022; Tang and Zhang 2020). When a company holds excessive unproductive cash, it may hinder growth and reduce opportunities for more profitable investments. Researchers have found that excessive cash holdings can lead to agency problems and inefficient cash use, contributing to investment inefficiency (Biddle et al. 2009; Sheu and Lee 2012). Ozkan (2002) noted that cash reserves are crucial for stimulating growth (Cahyono et al. 2024). Therefore, it is important to determine the optimal level of cash holdings. Too much cash can lead to underutilization or investment in less profitable projects, decreasing asset returns. Conversely, too little cash can restrict a company's ability to take advantage of profitable investment opportunities.

The asymmetric information perspective suggests that managers act in the shareholders' interest (Chen et al. 2020). This happens because the information gap between principals (shareholders) and agents (managers) leads to higher costs for financing and project selection (Myers and Majluf 1984). As a result of these higher costs, managers might pass up good investment opportunities (Benlemlih and Bitar 2018). On the other hand, the agency view argues that managers often pursue their own interests (Chen et al. 2020). Jensen and Meckling (1976) explain that managers aim to take advantage of investment opportunities to generate wealth, not just for the shareholders. This can lead to agency problems and result in inefficient investments (Lang et al. 1991; Blanchard et al. 1994; Benlemlih and Bitar 2018). Therefore, we propose that cash holdings may have a positive relationship with company investments, supporting our hypothesis as follows:

Hypothesis 1. *Ceteris paribus, corporate cash holdings are positively related to investment efficiency.*

Previous research shows that the economic crisis caused by COVID-19 affects investment efficiency through various complex mechanisms (Yip et al. 2022; Yang et al. 2017). Financial market disruptions, changes in consumer behavior, and increased business uncertainty can impact how companies allocate resources for investment. During crises like the COVID-19 pandemic, companies often face declining revenue and cash flow while operational and financial costs remain stable or even rise (Liu et al. 2022a; Chen and Liu 2023). In this scenario, investment decisions become crucial as companies must prioritize the use of limited resources.

Disruptions in supply, demand, and distribution can alter corporate investment plans (Anagnostopoulou et al. 2023; Amess et al. 2015; Aksar et al. 2022). Changes in consumer preferences, industry trends, and production capacity can force companies to adjust or halt planned investments. This can decrease investment efficiency in the short term, as projects expected to yield optimal outcomes might be delayed or canceled (Matejić et al. 2022). High uncertainty also affects the risk evaluation and returns of investment projects (Alnori and Bugshan 2022; Alkhataybeh et al. 2022). Companies might prefer safer, lower-

risk investments over riskier ones with higher potential returns, impacting their overall investment portfolio and resource allocation. Based on this understanding, we propose the following hypothesis:

Hypothesis 2. *Ceteris paribus, the economic crisis due to COVID-19 has an impact on investment efficiency.*

The COVID-19 crisis has significantly influenced the relationship between cash holding and investment efficiency in various and sometimes conflicting ways. Previous studies have indicated that the pandemic's effects can alter how companies manage their cash reserves and investment decisions (Arslan-Ayaydin et al. 2022). On one hand, the pandemic has made many companies more cautious in their financial management. Due to high economic uncertainty and potential revenue declines, some companies have increased their cash reserves as a safety measure (Abed et al. 2022; Ahiadorme et al. 2018). In this scenario, the relationship between cash holding and investment efficiency may become more positive, as companies prioritize maintaining liquidity and stability. On the other hand, the pandemic has also brought unprecedented challenges. Sharp revenue decreases in certain industries have made it difficult for some companies to meet their financial needs (Ardianto et al. 2024; Phan et al. 2019). Therefore, these companies might reduce investments or halt ongoing projects, which can harm investment efficiency in the short term.

Several studies suggest that during economic crises, the relationship between cash reserves and investment efficiency can be influenced in complex and sometimes contradictory ways (Lang et al. 1991; Blanchard et al. 1994; Benlemlih and Bitar 2018). Economic downturns typically increase market uncertainty and risk, leading companies to prioritize liquidity and maintain larger cash reserves as a safety net against instability. In such scenarios, having ample cash reserves can positively affect investment efficiency by allowing companies to survive and retain financial flexibility during challenging times (Blanchard et al. 1994).

However, excessive accumulation of cash reserves can hinder investment efficiency. Companies overly focused on maintaining high liquidity might miss out on more profitable investment opportunities (Arianpoor and Mehrfard 2022; Brahmana and Kontesa 2023). This risk increases if a very conservative cash management policy reduces funding for potentially higher-yielding projects in the future. In such cases, the connection between cash reserves and investment efficiency could become negative. Therefore, we suspect that the impact of the COVID-19 economic crisis on corporate cash holdings and investment efficiency may vary inconsistently:

Hypothesis 3. *Ceteris paribus, the economic crisis due to COVID-19 has an impact on the relationship between corporate cash holdings and investment efficiency.*

Past research indicates that having a diverse gender composition on corporate boards can significantly impact their operations (Atif et al. 2019). Wan Ismail et al. (2023) found that boards with female members tend to be more careful and thorough in managing financial policies. Women directors often contribute unique viewpoints and a broader outlook on risk, sustainability, and corporate governance (Ningsih et al. 2023; Roychowdhury et al. 2019).

Previous research suggests that having female directors on corporate boards can improve investment efficiency through various positive mechanisms (Loukil and Yousfi 2016; Atif et al. 2019; Wan Ismail et al. 2023). This study explores how gender diversity impacts corporate investment decisions. One key benefit is that female directors bring diverse perspectives and risk assessments to the table (Cambrea et al. 2020). Their different experiences and leadership styles foster inclusive discussions and evaluations of investment projects, leading to more balanced and informed decisions. Additionally, gender diversity can enhance group dynamics by encouraging thorough discussions, improving risk and

opportunity identification, and reducing the risk of "groupthink" that can hinder the critical evaluation of investments. Therefore, we propose the following hypothesis:

Hypothesis 4. *Ceteris paribus, the presence of female directors influences the relationship between corporate cash holdings and investment efficiency.*

Female directors can help counteract reduced investment efficiency caused by holding cash during the COVID-19 economic crisis. They contribute diverse perspectives and decision-making approach, which research suggests can improve risk assessment in uncertain times. Specifically, during economic crises, female directors may offer valuable insights into evolving market trends and consumer preferences, thereby mitigating negative impacts on investment efficiency (Sarang et al. 2021; Wu et al. 2022).

Diversity in leadership benefits companies by enhancing their sensitivity to changing customer needs and behaviors. This, in turn, helps companies adjust their investment strategies more effectively. Female directors, for instance, contribute uniquely to risk assessment. Research indicates that women often exhibit a more cautious approach to risk, influencing how investment projects are chosen and managed (Lee et al. 2023; Zou et al. 2021). This cautious stance can be particularly advantageous during economic crises, steering companies away from overly speculative ventures and towards more solidly grounded options (Lei et al. 2022).

Furthermore, studies suggest that having women in leadership roles on corporate boards can promote policies that are more sustainable and focused on the long term (Li et al. 2020; Li et al. 2021). This could translate into decisions that consider the broader impacts of investments, even in times of crisis. Such an approach helps companies stay committed to their long-term goals and avoid making choices solely for short-term gains (Liu et al. 2022a). Therefore, having female directors can help mitigate the negative effects on investment efficiency caused by holding onto cash during economic crises like the one triggered by COVID-19 (Liu et al. 2022b). However, it is essential to note that these effects can vary depending on factors such as the directors' experiences, backgrounds, and individual traits.

Hypothesis 5. *Ceteris paribus, the presence of a female director can reduce the negative impact of decreasing investment efficiency on cash holdings during the economic crisis due to COVID-19.*

3. Data and Research Methods

3.1. Data and Sample

The study examined companies listed on the Indonesia Stock Exchange from 2010 to 2021, using data from their annual reports. To ensure data quality, specific criteria were applied: companies lacking complete investment efficiency data were initially excluded, along with those missing control variables. This process resulted in a final sample of 2721 companies observed annually throughout the study period (Table 1). To mitigate the impact of outliers and extreme values, all continuous variables in the dataset underwent winsorization, which adjusts extreme values at the 1st and 99th percentiles. This method aims to minimize potential distortions in the data caused by unusually high or low values. This study used STATA 17.0 software and utilized fixed-effect regression to data analysis techniques using industry-fixed effects and year-fixed effects.

Table 1. Samples distribution according to overinvestment and underinvestment.

SIC	Underinvestment		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 and 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%
Total	1508	55%	1.213	45%	2721	100%

3.2. Variable Operationalization

The effective use of financial resources in a company involves managing and allocating funds both from within and outside the organization through appropriate financial strategies. This study primarily investigates cash holdings, which are calculated by dividing cash and cash equivalents by total assets. To assess the impact of the COVID-19 pandemic, a moderating factor called COVID-19 (COV) is introduced. COV equals 1 if a company's fiscal year falls between 2019 and 2020, reflecting the years directly affected by the pandemic. This research focuses on investment efficiency as the outcome variable, which examines how companies make investment decisions to achieve a balanced approach without leaning towards excessive or inadequate investments. Investment efficiency is measured using a model developed by Huang (2020), with residuals derived from the corresponding equation.

$$INVEST\ (CAPX, R\&D) = \beta 0 + \beta 1\ \mathrm{MTB}_{i,t} - 1 + \beta 2\ SG_{i,t} - 1 + \beta 3\ OCF_{i,t} + \beta 4\ LEV_{i,t} - 1 + \beta 5\ LOGSALE_{i,t} - 1 + e_{i,t} \quad (1)$$

The residual values obtained are converted into absolute values and then multiplied by −1 to ensure that the variable "absminINVEFF" reflects the company's investment efficiency in the negative direction. This adjustment is necessary to align the variable's value with the concept of investment efficiency, where a higher "absminINVEFF" value indicates greater investment efficiency. Furthermore, this study includes several control variables based on the previous literature. These control variables consist of board size (BSIZE), the natural logarithm of company age (lnAGE), company size 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).

3.3. Empirical Specification

The analytical methods employed in this study encompass descriptive statistics, Pearson correlation analysis, and least square regression analysis. Prior to conducting the analysis, it was necessary to winsorize each variable utilized in the dataset. This step was undertaken to address the potential presence of outliers, which could adversely affect the data distribution and lead to biased or inaccurately transcribed data. The winsorization process involved modifying the extreme values of the variables, specifically adjusting them to the 1st and 99th percentiles. All control variables, with the exception of the dummy

variable, underwent winsorization in order to mitigate the impact of outliers on the data distribution. The regression model applied in this study was a clustered regression by firm, implemented using Stata 17.0 software. The equation model utilized in this study is as follows:

$$\text{absminINVEFF} = \beta_0 + \beta_1\ \text{CASH HOLDINGS}_{i,t} + \beta_2\ \text{COV19}_{i,t} + \beta_3\ \text{FEMDIR}_{i,t} + \beta_4\ \text{BSIZE}_{i,t} + \beta_5\ \text{INDCOMSIZE}_{i,t} + \beta_6\ \text{LnAGE}_{i,t} + \beta_7\ \text{FIRMSIZE}_{i,t} + \beta_8\ \text{ROE}_{i,t} + \beta_9\ \text{MTB}_{i,t} + \beta_{10}\ \text{PPE}_{i,t} + \beta_{11}\ \text{LEV}_{i,t} + e$$

$$\text{absminINVEFF} = \beta_0 + \beta_1\ \text{CASH HOLDINGS}_{i,t} + \beta_2\ \text{COV19}_{i,t} + \beta_3\ \text{FEMDIR}_{i,t} + \beta_4\ \text{CASH HOLDINGSxCOV19}_{i,t} + \beta_5\ \text{BSIZE}_{i,t} + \beta_6\ \text{INDCOMSIZE}_{i,t} + \beta_7\ \text{LnAGE}_{i,t} + \beta_8\ \text{FIRMSIZE}_{i,t} + \beta_9\ \text{ROE}_{i,t} + \beta_{10}\ \text{MTB}_{i,t} + \beta_{11}\ \text{PPE}_{i,t} + \beta_{12}\ \text{LEV}_{i,t} + e$$

$$\text{absminINVEFF} = \beta_0 + \beta_1\ \text{CASH HOLDINGS}_{i,t} + \beta_2\ \text{COV19}_{i,t} + \beta_3\ \text{FEMDIR}_{i,t} + \beta_4\ \text{CASH HOLDINGSxFEMDIR}_{i,t} + \beta_5\ \text{BSIZE}_{i,t} + \beta_6\ \text{INDCOMSIZE}_{i,t} + \beta_7\ \text{LnAGE}_{i,t} + \beta_8\ \text{FIRMSIZE}_{i,t} + \beta_9\ \text{ROE}_{i,t} + \beta_{10}\ \text{MTB}_{i,t} + \beta_{11}\ \text{PPE}_{i,t} + \beta_{12}\ \text{LEV}_{i,t} + e$$

$$\text{absminINVEFF} = \beta_0 + \beta_1\ \text{CASH HOLDINGS}_{i,t} + \beta_2\ \text{COV19}_{i,t} + \beta_3\ \text{FEMDIR}_{i,t} + \beta_4\ \text{CASH HOLDINGSxCOV19}_{i,t} + \beta_5\ \text{CASH HOLDINGSxFEMDIR}_{i,t} + \beta_6\ \text{BSIZE}_{i,t} + \beta_7\ \text{INDCOMSIZE}_{i,t} + \beta_8\ \text{LnAGE}_{i,t} + \beta_9\ \text{FIRMSIZE}_{i,t} + \beta_{10}\ \text{ROE}_{i,t} + \beta_{11}\ \text{MTB}_{i,t} + \beta_{12}\ \text{PPE}_{i,t} + \beta_{13}\ \text{LEV}_{i,t} + e$$

where absminINVEF is the dependent variable, CASH HOLDINGS is the independent variable, and COV19 and FEMDIR are moderating variables. The definition and operationalization of all variables are shown in Table 2.

Table 2. Variable definition and operationalization.

Variable	Definition	Source
absminINVEFF	The residual value of Huang (2020)'s regression model, which is an absolute value, is multiplied by 1. This variable shows the value of investment efficiency	Annual Report
Cash Holding	Cash and cash equivalents divided by total assets	Annual Report
FEMDIR	Dummy variables, which take a value of 1 if in a boardroom that serves at least one female director, and 0 otherwise	Annual Report
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 commissioner	Annual Report
lnAGE	How long the firm has been established	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, and the assets divided by total assets	ORBIS
LEV	Total liability divided by total assets	ORBIS

4. Empirical Result and Discussion

4.1. Statistics Descriptive

The provided Table 3 displays descriptive statistics of the variables used in the research. To mitigate extreme values, all variables underwent winsorization at the 1% and 99% thresholds. In this study, the variable of interest is referred to as "absminINVEF", which measures investment efficiency using a model created by the cited author. According to the research, INVEF 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 levels among the companies. Some scores are close to zero, indicating high investment efficiency, while others, like −2.488, indicate a lack of investment efficiency.

Furthermore, this study does not differentiate between underinvestment and overinvestment as its focus lies on investment efficiency determined by the company itself. The independent variable considered in this research is "CASH HOLDING", which measures the proportion of cash and cash equivalents to total assets in the company. On average, companies included in this study possess a cash ownership of 10.4% of total assets, with a maximum value of 96.3%. A similar pattern is observed in research conducted on UK

companies, where the average cash ownership is 9.9%, and the maximum value is 98.8%. The variable "COV", representing the impact of COVID-19, indicates the number of years since the fiscal year 2019. Based on Table 3, around 25.7% of the data used in this study are affected by COVID-19, and this variable serves as a moderator in the analysis. Furthermore, Table 3 presents several control variables: BSIZE, INDCOMSIZE, lnAGE, FIRMSIZE, ROE, MTB, PPE, and LEV. BSIZE represents the total number of board members in the company, with an average of eight individuals.

Table 3. Descriptive statistics.

	Mean	Median	Minimum	Maximum
absminINVEFF	−0.109	−0.013	−2.488	0.000
CASH HOLDING	0.104	0.066	0.000	0.963
FEMDIR	0.575	0.000	0.000	1.000
COV	0.257	0.000	0.000	1.000
BSIZE	8.875	8.000	4.000	21.000
INDCOMSIZE	0.382	0.333	0.000	3.000
lnAGE	3.531	3.584	1.099	4.796
FIRMSIZE	27.821	28.352	14.999	32.261
ROE	0.040	0.052	−1.252	1.354
MTB	2.287	1.144	−1.685	28.113
PPE	0.381	0.349	0.000	0.932
LEV	0.530	0.492	0.052	2.661

4.2. Pearson Correlation

This research employs Pearson correlation to assess the strength of the relationship between two variables. As demonstrated in Table 4, the research findings indicate that absminINVEFF exhibits a negative correlation with CASH HOLDING and COV, significant at the 10% significance level, whereas it shows a significant positive correlation at the 1% significance level. BSIZE, INDCOMSIZE, lnAGE, FIRMSIZE, ROE, and MTB also show significant relationships. Furthermore, these findings suggest that CASH HOLDING and COV impact investment efficiency (absminINVEFF).

Table 4. Pearson correlation.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] absminINVEFF	1.000						
[2] CASH HOLDING	−0.033 *	1.000					
[3] FEMDIR	0.234 *	0.246 **					
[4] COV	0.077 ***	0.324 **	−0.013	1.000			
[5] BSIZE	−0.080 ***		0.075 ***	−0.194 ***	1.000		
[6] INDCOMSIZE	0.027	0.452 *	−0.015	0.121 ***	−0.010	1.000	
[7] lnAGE	−0.143 ***	0.531 ***	0.019	−0.186 ***	0.296 ***	−0.050 ***	1.000
[8] FIRMSIZE	−0.095 ***	0.753 **	−0.001	−0.575 ***	0.501 ***	−0.034 *	0.224 ***
[9] ROE	−0.071 ***	0.432 ***	0.054 ***	−0.060 ***	0.039 **	−0.026	0.054 ***
[10] MTB	−0.273 ***	0.753 ***	0.032 *	0.001	0.035 *	−0.033 *	−0.026
[11] PPE	−0.030	0.423 **	−0.338 ***	−0.015	0.048 **	0.002	0.035 *
[12] LEV	0.006	0.512 *	0.004	0.029	−0.015	0.039 **	−0.005

	[8]	[9]	[10]	[11]	[12]
[8] FIRMSIZE	1.000				
[9] ROE	0.089 ***	1.000			
[10] MTB	−0.020	−0.132 ***	1.000		
[11] PPE	0.068 ***	−0.037 **	0.003	1.000	
[12] LEV	−0.073 ***	−0.000	−0.011	−0.028	1.000

Significance is at * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

4.3. Main Result

The results of OLS regression are presented in Table 5. The research findings indicate a significant negative relationship between CASH HOLDINGS and investment efficiency, with a coefficient value of −0.120 (t = −1.96) at a significance level of 10%. Moreover, during economic crises, the presence of CASH HOLDINGS by companies has been shown to have a detrimental impact on investment efficiency. The results demonstrate a significant negative correlation with a coefficient value of −0.202 (t = −2.06) at a significance level of 5%. Interestingly, investment efficiency tends to increase as the level of CASH HOLDINGS held by the company rises. When the company's board includes female directors, there is a significant positive association with a coefficient value of 0.432 (t = 3.21) at a significance level of 1%. Importantly, during crisis periods, this relationship remains unaffected and does not significantly influence investment efficiency. It is evident that the interaction between CASH HOLDINGS, COVID-19, and female board directors (CASH HOLDINGSxCOV19xFEMDIR) is positively and significantly related to investment efficiency, with a coefficient value of 0.531 (t = 2.31) at a significance level of 5%. These findings support the company's policy of involving female directors on the board to enhance effectiveness in shaping strategic policies (Cahyono et al. 2023a).

Table 5. Ordinary linear regression.

	(1)	(2)	(3)	(4)
	absminINVEFF	**absminINVEFF**	**absminINVEFF**	**absminINVEFF**
CASH HOLDINGxCOV19		−0.202 **		
		(−2.06)		
CASH HOLDINGxFEMDIR			0.432 ***	
			(3.21)	
CASH HOLDINGSxFEMDIRxCOV19				0.531 **
				(2.31)
CASH HOLDING	−0.120 **	−0.178 **	−0.124 **	−0.162 **
	(−1.96)	(−2.25)	(−2.14)	(−2.25)
FEMDIR	0.234 ***	0.321 **	0.121 **	0.421 **
	(3.44)	(2.21)	(2.43)	(2.33)
COV19	−0.026	−0.047	−0.041	−0.423
	(−0.81)	(−1.45)	(−1.32)	(−1.51)
BSIZE	−0.000	−0.000	−0.000	−0.000
	(−0.15)	(−0.10)	(−0.12)	(−0.54)
INDCOMSIZE	0.034	0.036	0.023	0.036
	(0.80)	(0.84)	(0.92)	(0.94)
lnAGE	−0.036 ***	−0.026 ***	−0.126 ***	−0.056 ***
	(−2.87)	(−2.84)	(−2.92)	(−2.71)
FIRMSIZE	−0.003	−0.003	−0.323	−0.831
	(−0.83)	(−0.82)	(−0.92)	(−0.93)
ROE	−0.102 ***	−0.103 ***	−0.213 ***	−0.422 ***
	(−4.04)	(−4.11)	(−4.32)	(−4.91)
MTB	−0.022 ***	−0.022 ***	−0.122 ***	−0.422 ***
	(−5.26)	(−5.25)	(−5.92)	(−5.54)
PPE	0.022	0.023	0.232	0.023
	(1.17)	(1.20)	(1.32)	(1.20)
LEV	−0.000 ***	−0.000 ***	−0.000 ***	−0.000 ***
	(−3.39)	(−3.51)	(−3.83)	(−3.51)
_cons	0.266 **	0.265 **	0.235 **	0.265 **
	(2.24)	(2.24)	(2.54)	(2.24)
Industry Dummies	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included
r2	0.307	0.308	0.309	0.321
N	2721	2721	2721	2721

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4. Endogeneity Concern

4.4.1. Coarsened Exact Matching

The objective of the study is to deal with potential problems linked to accounting for external influences by using the Coarsened Exact Matching (CEM) technique. CEM acts as an alternative approach to tackle the problem of biased selection and focuses on observable variables that could potentially impact the outcomes in the statistical analysis, as suggested by the reference. The CEM model includes eleven covariates. Part A of Table 6 presents the relevant overview of CEM outcomes. Among a total of 1452 linked observations, 1319 were successfully matched, while for unlinked observations, 1335 out of 1443 were matched. Part B of Table 6 provides the replicated outcomes of the model using the CEM approach. The research's findings suggest that the coefficient for CASH HOLDING_COV is 0.230, which holds statistical significance at a 10% level of significance (t = 2.47). In the second column, CASH HOLDING is represented as −0.135, with a significance level of 10% (t = −1.97) in the first column. The table consistently aligns with the findings presented in Table 5, thus providing support for the hypotheses proposed in the study.

Table 6. Coarsened Exact Matching.

Panel A				
	Cash Holdings = 0		Cash Holdings = 1	
All	1.443		1.452	
Matched	1.335		1.319	
Unmatched	108		133	
	(1)	(2)	(3)	(4)
	absminINVEFF	absminINVEFF	absminINVEFF	absminINVEFF
CASH HOLDINGxCOV19		0.230 **		
		(2.47)		
CASH HOLDINGSxFEMDIR			0.345 ***	
			(3.22)	
CASH HOLDINGSxCOV19xFEMDIR				0.521 ***
				(3.21)
CASH HOLDING	−0.135 **	−0.164 **	−0.142 **	−0.144 **
	(−1.97)	(−2.15)	(−2.12)	(−2.45)
FEMDIR	−0.232 ***	−0.244 ***	−0.261 **	−0.362 ***
	(−2.99)	(−2.85)	(−2.42)	(−2.55)
COV19	−0.060 ***	−0.084 ***	−0.062 ***	−0.034 ***
	(−2.69)	(−3.49)	(−2.79)	(−3.79)
BSIZE	0.001	0.001	0.002	0.033
	(1.12)	(1.11)	(1.13)	(1.24)
INDCOMSIZE	0.035	0.036	0.038	0.037
	(1.05)	(1.08)	(1.15)	(1.23)
FIRMSIZE	−0.009 ***	−0.009 ***	−0.019 ***	−0.019 ***
	(−3.15)	(−3.26)	(−3.25)	(−3.56)
LnAGE	−0.001 ***	−0.001 ***	−0.031 ***	−0.052 ***
	(−2.92)	(−2.92)	(−2.52)	(−2.92)
ROE	−0.064 ***	−0.067 ***	−0.094 ***	−0.027 ***
	(−3.32)	(−3.44)	(−3.42)	(−3.74)
MTB	−0.019 ***	−0.019 ***	−0.029 ***	−0.059 ***
	(−4.32)	(−4.31)	(−4.62)	(−4.51)
PPE	0.045 ***	0.045 ***	0.045 ***	0.345 ***
	(2.62)	(2.63)	(2.65)	(2.81)
LEV	−0.005	−0.005	−0.045	−0.025
	(−0.54)	(−0.52)	(−0.34)	(−0.42)

Table 6. *Cont.*

Panel A				
	Cash Holdings = 0		Cash Holdings = 1	
All	1.443		1.452	
Matched	1.335		1.319	
Unmatched	108		133	
	(1)	(2)	(3)	(4)
	absminINVEFF	absminINVEFF	absminINVEFF	absminINVEFF
_cons	0.305 ***	0.314 ***	0.335 ***	0.324 ***
	(3.75)	(3.89)	(3.35)	(3.39)
Industry Dummies	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included
r2	0.285	0.286	0.292	0.296
N	2549	2549	2549	2549

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4.2. Propensity Score Matching

The results of the PSM analysis have been conducted and displayed in Table 7. We identified pairs that matched with the smallest difference in tendency scores. Specifically, we matched each observation with absminINVEFF = 1 with a unique observation with absminINVEFF = 0 using a caliper width of 0.001. Panel A presents the t-test after matching all character variables. It can be seen that there is no significant difference in covariates between companies with high and low investment efficiency. This means that the matching approach was successful. Additionally, through this analysis, we also found that the relationship between CASH HOLDINGS and investment efficiency (absminINVEFF) is significantly positive with a coefficient value (t-value) of 0.332 (t-value: 2.57) at a 5% significance level.

Table 7. Propensity Score Matching.

	absminINVEFF = 1	**absminINVEFF = 0**	**Diff.**	**t-Value**
CASH HOLDINGxCOV19	2.737	2.316	0.421	0.975
CASH HOLDINGSxFEMDIR	9.261	9.030	0.232	0.358
CASH HOLDINGSxCOV19xFEMDIR	32.526	33.000	−0.474	−0.067
CASH HOLDING	9.842	10.211	−0.368	−0.473
COV19	0.789	0.789	−0.000	−0.000
BSIZE	69.947	66.632	3.316	0.475
INDCOMSIZE	0.000	0.001	−0.001	−0.001
FIRMSIZE	20.623	20.709	−0.086	−0.120
LnAGE	0.406	0.496	−0.090	−1.463
ROE	5.266	2.311	2.955	1.020
MTB	0.211	0.263	−0.053	−0.372
PPE	0.235	0.187	0.047	0.869
LEV	0.321	0.380	−0.059	−0.950
	(1)	(2)	(3)	(4)
	absminINVEFF	absminINVEFF	absminINVEFF	absminINVEFF
CASH HOLDINGxCOV19		0.332 **		
		(2.57)		
CASH HOLDINGSxFEMDIR			0.421 ***	
			(3.42)	

Table 7. *Cont.*

	absminINVEFF = 1	**absminINVEFF = 0**	**Diff.**	**t-Value**
	(1)	(2)	(3)	(4)
	absminINVEFF	absminINVEFF	absminINVEFF	absminINVEFF
CASH HOLDINGSxCOV19xFEMDIR				0.523 ***
				(3.42)
CASH HOLDING	−0.132 **	−0.264 **	−0.342 **	−0.144 **
	(−1.99)	(−2.35)	(−2.32)	(−2.42)
FEMDIR	−0.232 *	−0.464 ***	−0.842 **	−0.644 **
	(−1.89)	(−2.45)	(−2.22)	(−2.92)
COV19	−0.062 ***	−0.124 ***	−0.042 ***	−0.036 ***
	(−2.63)	(−3.79)	(−2.49)	(−3.74)
BSIZE	0.002	0.031	0.032	0.035
	(1.14)	(1.21)	(1.33)	(1.23)
INDCOMSIZE	0.025	0.056	0.058	0.035
	(1.35)	(1.28)	(1.45)	(1.24)
FIRMSIZE	−0.109 ***	−0.409 ***	−0.319 ***	−0.039 ***
	(−3.25)	(−3.56)	(−3.55)	(−3.55)
LnAGE	−0.031 ***	−0.031 ***	−0.031 ***	−0.052 ***
	(−2.62)	(−2.32)	(−2.32)	(−2.93)
ROE	−0.034 ***	−0.037 ***	−0.064 ***	−0.027 ***
	(−3.22)	(−3.24)	(−3.42)	(−3.75)
MTB	−0.039 ***	−0.059 ***	−0.089 ***	−0.054 ***
	(−4.42)	(−4.81)	(−4.22)	(−4.53)
PPE	0.025 ***	0.035 ***	0.035 ***	0.343 ***
	(2.82)	(2.93)	(2.55)	(2.89)
LEV	−0.105	−0.205	−0.345	−0.027
	(−0.44)	(−0.72)	(−0.34)	(−0.44)
_cons	0.345 ***	0.344 ***	0.345 ***	0.323 ***
	(3.25)	(3.93)	(3.55)	(3.35)
Industry Dummies	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included
r2	0.292	0.286	0.292	0.296
N	2149	2149	2149	2149

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4.3. Heckman (1979) Two-Stage Least Square

Presented in column 1 of Table 8, the results of our initial stage procedure reveal a significant positive relationship between the instrument (MEAN_CASH HOLDINGS) and investment efficiency (absminINVEFF). Subsequently, we computed the inverse Mills ratio using probit regression estimates and incorporated it as a control to re-estimate the main model in Equation (1) during the second stage procedure. From this point, we ascertain that the outcomes remain consistent, indicating that CASH HOLDINGS has a significant relationship with investment efficiency (absminINVEFF), displaying a coefficient value of 0.651 (t-value: 3.49) at the 1% significance level. The inverse ratio (MILSS) yields nonsignificant results, thereby reinforcing our argument for consistency and the lack of bias in our findings.

Table 8. Heckman (1979) Two-Stage Least Square.

	1st Stage	2nd Stage		
		(1)	(2)	(3)
		absminINVEFF	absminINVEFF	absminINVEFF
MeanCASH HOLDINGS	0.330 ***			
	(6.55)			
CASH HOLDINGxCOV19		0.431 **		
		(2.67)		
CASH HOLDINGSxFEMDIR			0.474 ***	
			(3.83)	
CASH HOLDINGSxCOV19xFEMDIR				0.561 ***
				(3.49)
CASH HOLDING	0.065 **	−0.264 **	−0.342 **	−0.144 **
	(2.15)	(−2.35)	(−2.32)	(−2.42)
FEMDIR	−0.536 ***	−0.634 **	−0.542 ***	−0.444 ***
	(−3.27)	(−2.85)	(−3.32)	(−2.82)
COV19	0.003	−0.124 ***	−0.042 ***	−0.036 ***
	(0.83)	(−3.79)	(−2.49)	(−3.74)
BSIZE	−0.721 ***	0.031	0.032	0.035
	(−3.52)	(1.21)	(1.33)	(1.23)
INDCOMSIZE	0.087 **	0.056	0.058	0.035
	(2.08)	(1.28)	(1.45)	(1.24)
FIRMSIZE	1.087 ***	−0.409 ***	−0.319 ***	−0.039 ***
	(3.18)	(−3.56)	(−3.55)	(−3.55)
LnAGE	−0.046 ***	−0.031 ***	−0.031 ***	−0.052 ***
	(−5.05)	(−2.32)	(−2.32)	(−2.93)
ROE	−0.345	−0.037 ***	−0.064 ***	−0.027 ***
	(−1.44)	(−3.24)	(−3.42)	(−3.75)
MTB	0.352	−0.059 ***	−0.089 ***	−0.054 ***
	(0.65)	(−4.81)	(−4.22)	(−4.53)
PPE	0.088	0.035 ***	0.035 ***	0.343 ***
	(0.26)	(2.93)	(2.55)	(2.89)
LEV	−0.377	−0.205	−0.345	−0.027
	(−0.35)	(−0.72)	(−0.34)	(−0.44)
MILLS		−0.415	−0.925	−0.327
		(−0.52)	(−0.44)	(−0.92)
_cons	0.011 ***	0.344 ***	0.345 ***	0.323 ***
	(3.88)	(3.93)	(3.55)	(3.35)
Industry Dummies	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included
r2	0.298	0.286	0.292	0.296
N	2149	2149	2149	2149

t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusions

The study concludes that maintaining high levels of cash reserves negatively impacts a company's investment efficiency, particularly during economic crises such as the COVID-19 pandemic. Companies with larger cash holdings experienced a more significant decline in their ability to make efficient investments during the crisis period, suggesting that excessive liquidity can lead to suboptimal investment decisions. In addition, the presence of female directors on the board is found to mitigate the negative effects of high cash reserves on investment efficiency (Jiang et al. 2021). Female directors contribute diverse perspectives and enhance corporate decision-making processes, which helps promote a more strategic and effective use of cash reserves. This finding emphasizes the importance of gender diversity in corporate governance, highlighting its role in improving investment efficiency even during economic downturns. Overall, this research emphasizes the necessity for companies to adopt balanced cash management practices to avoid inefficiencies and ensure

long-term growth and resilience. It also highlights that gender diversity in the boardroom is not just a matter of social equity but a strategic asset that enhances company performance and stability during crises. These conclusions advocate for integrating balanced cash management and diversity strategies into corporate policies to sustain investment efficiency and robust financial performance under varying economic conditions.

The findings have several important implications for corporate strategy and policy-making. Companies should be cautious about maintaining excessive cash reserves, as they can negatively impact investment efficiency. A balanced approach to cash management is crucial to avoid inefficiencies. Additionally, the positive impact of female directors on investment efficiency suggests that gender diversity in the boardroom can enhance strategic decision-making and resilience during economic downturns. Policymakers and regulatory bodies might consider promoting gender diversity in corporate boards as part of broader governance reforms to enhance corporate performance and investment efficiency.

Future research could explore several avenues to build on these findings. Longitudinal studies could investigate the long-term impact of cash holdings on investment efficiency, considering different economic cycles. Examining the impact of cash holdings and board diversity on investment efficiency across different industries could provide more nuanced insights. Additionally, further studies could examine the impact of other diversity metrics (e.g., ethnicity, age) on investment efficiency to provide a holistic view of the benefits of diverse boards. Finally, research could delve deeper into how different types of economic crises (e.g., financial vs. health crises) specifically impact the relationship between cash holdings, board diversity, and investment efficiency.

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References

Abed, Ibtihal A., Nazimah Hussin, Mostafa A. Ali, Hossam Haddad, Maha Shehadeh, and Elina F. Hasan. 2022. Creative accounting determinants and financial reporting quality: Systematic literature review. *Risks* 10: 76. [CrossRef]

Adams, Renée B., and Daniel Ferreira. 2009. Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics* 94: 291–309. [CrossRef]

Ahiadorme, Johnson Worlanyo, Agyapomaa Gyeke-Dako, and Joshua Yindenaba Abor. 2018. Debt holdings and investment cash flow sensitivity of listed firms. *International Journal of Emerging Markets* 13: 943–58. [CrossRef]

Aksar, Muhammad, Shoib Hassan, M. Kayani, Suleman Khan, and Tanvir Ahmed. 2022. Cash holding and investment efficiency nexus for financially distressed firms: The moderating role of corporate governance. *Management Science Letters* 12: 67–74. [CrossRef]

Alkhataybeh, Ahmad, Safaa Adnan AlSmadi, Mohammad Ziad Shakhatreh, and Mohammad A. Khataybeh. 2022. Government Ownership and Corporate Cash Holdings: Empirical Evidence from the Amman Stock Exchange. *Sustainability* 14: 11168. [CrossRef]

Alnori, Faisal, and Abdullah Bugshan. 2022. Cash holdings and firm performance: Empirical analysis from Shariah-compliant and conventional corporations. *International Journal of Islamic and Middle Eastern Finance and Management* 16: 498–515. [CrossRef]

Amess, Kevin, Sanjay Banerji, and Athanasios Lampousis. 2015. Corporate cash holdings: Causes and consequences. *International Review of Financial Analysis* 42: 421–33. [CrossRef]

Anagnostopoulou, Seraina C., Lenos Trigeorgis, and Andrianos E. Tsekrekos. 2023. Enhancement in a firm's information environment via options trading and the efficiency of corporate investment. *Journal of Banking & Finance* 149: 106809.

Ardianto, Ardianto, Nadia Anridho, Suham Cahyono, Abu Hanifa Md Noman Alam, and Iman Harymawan. 2024. The role of risk management committee on the relationship between corporate carbon emission disclosure and capital structure. *Corporate Social Responsibility and Environmental Management* 31: 1–32. [CrossRef]
Arianpoor, Arash, and Niloufar Mehrfard. 2022. The impact of managerial attributes on cash holding and investment efficiency and the mediator role of cash holding. *Journal of Islamic Accounting and Business Research* 14: 610–28. [CrossRef]
Arslan-Ayaydin, Özgür, Chris Florackis, and Aydin Ozkan. 2014. Financial flexibility, corporate investment and performance: Evidence from financial crises. *Review of Quantitative Finance and Accounting* 42: 211–50. [CrossRef]
Arslan-Ayaydin, Özgür, Shimin Chen, Serene Xu Ni, and James Thewissen. 2022. Is cross-listing a panacea for improving earnings quality? The case of H-and B-share firms in China. *International Review of Financial Analysis* 81: 102113. [CrossRef]
Atif, Muhammad, Benjamin Liu, and Allen Huang. 2019. Does board gender diversity affect corporate cash holdings? *Journal of Business Finance and Accounting* 46: 1003–29. [CrossRef]
Batuman, Billur, Yilmaz Yildiz, and Mehmet Baha Karan. 2022. The impact of the global financial crisis on corporate cash holdings: Evidence from Eastern European countries. *Borsa Istanbul Review* 22: 678–87. [CrossRef]
Benlemlih, Mohammed, and Mohammad Bitar. 2018. Corporate social responsibility and investment efficiency. *Journal of Business Ethics* 148: 647–71. [CrossRef]
Bhuiyan, Md Borhan Uddin, and Jill Hooks. 2019. Cash holding and over-investment behavior in firms with problem directors. *International Review of Economics & Finance* 61: 35–51.
Bhutta, Umair Saeed, Adeel Tariq, Muhammad Farrukh, Ali Raza, and Muhammad Khalid Iqbal. 2022. Green bonds for sustainable development: Review of literature on development and impact of green bonds. *Technological Forecasting and Social Change* 175: 121378. [CrossRef]
Biddle, Gary C., Gilles Hilary, and Rodrigo S. Verdi. 2009. How does financial reporting quality relate to investment efficiency? *Journal of Accounting and Economics* 48: 112–31. [CrossRef]
Blanchard, Olivier Jean, Florencio Lopez-de-Silanes, and Andrei Shleifer. 1994. What do firms do with cash windfalls? *Journal of Financial Economics* 36: 337–60. [CrossRef]
Brahmana, Rayenda Khresna, and Maria Kontesa. 2023. Sea surface temperature anomalies and cash holdings: Evidence from fisheries companies. *Marine Policy* 148: 105452. [CrossRef]
Cahyono, Suham, Ardianto Ardianto, and Mohammad Nasih. 2024. Breaking barriers: CEOs STEM educational background and corporate climate change disclosure. *International Journal of Accounting and Information Management* 32: 651–84. [CrossRef]
Cahyono, Suham, Iman Harymawan, and Khairul Anuar Kamarudin. 2023a. The Impacts of Tenure Diversity on Boardroom and Corporate Carbon Emission Performance: Exploring from the Moderating Role of Corporate Innovation. *Corporate Social Responsibility and Environmental Management* 30: 2507–35. [CrossRef]
Cahyono, Suham, Iman Harymawan, Damara Ardelia Kusuma Wardani, and Khairul Anuar Kamarudin. 2023b. Does auditor ethnicity matter in determining audit fees? Some empirical evidence from Indonesia. *Accounting Research Journal* 36: 384414. [CrossRef]
Cambrea, Domenico Rocco, Paolo Tenuta, and Vincenzo Vastola. 2020. Female directors and corporate cash holdings: Monitoring vs. executive roles. *Management Decision* 58: 295–312. [CrossRef]
Chen, Hanwen, Daoguang Yang, Joseph H. Zhang, and Haiyan Zhou. 2020. Internal controls, risk management, and cash holdings. *Journal of Corporate Finance* 64: 101695. [CrossRef]
Chen, Yen-Chang, and Ying-Sing Liu. 2023. Market Efficiency and Stock Investment Loss Aversion Guide During COVID-19 Pandemic Events: The Case for Applying Data Mining. *SAGE Open* 13: 1–14. [CrossRef]
De Vito, Antonio, and Juan-Pedro Gómez. 2020. Estimating the COVID-19 cash crunch: Global evidence and policy. *Journal of Accounting and Public Policy* 39: 106741. [CrossRef]
Deng, Liurui, and Yiwen Zhao. 2022. Investment lag, financially constraints and company value—Evidence from China. *Emerging Markets Finance and Trade* 58: 3034–47. [CrossRef]
Dezsö, Cristian L., and David Gaddis Ross. 2012. Does female representation in top management improve firm performance? A panel data investigation. *Strategic Management Journal* 33: 1072–89. [CrossRef]
Duong, Huu Nhan, Justin Hung Nguyen, My Nguyen, and S. Ghon Rhee. 2020. Navigating through economic policy uncertainty: The role of corporate cash holdings. *Journal of Corporate Finance* 62: 101607. [CrossRef]
Ghoul, Sadok El, Omrane Guedhami, Sattar Mansi, and He (Helen) Wang. 2023. Economic Policy Uncertainty, Institutional Environments, and Corporate Cash Holdings. *Research in International Business and Finance* 65: 101887. [CrossRef]
Goodell, John W., Abhinav Goyal, and Andrew Urquhart. 2021a. Uncertainty of uncertainty and firm cash holdings. *Journal of Financial Stability* 56: 100922. [CrossRef]
Goodell, John W., Satish Kumar, Weng Marc Lim, and Debidutta Pattnaik. 2021b. Artificial intelligence and machine learning in finance: Identifying foundations, themes, and research clusters from bibliometric analysis. *Journal of Behavioral and Experimental Finance* 32: 100577. [CrossRef]
Guizani, Moncef, and Gaafar Abdalkrim. 2022. Board gender diversity, financial decisions and free cash flow: Empirical evidence from Malaysia. *Management Research Review* 45: 198–216. [CrossRef]
Gull, Ammar Ali, Mehdi Nekhili, Haithem Nagati, and Tawhid Chtioui. 2018. Beyond Gender Diversity: How Specific Attributes of Female Directors Affect Earnings Management. *British Accounting Review* 50: 255–74. [CrossRef]
Harris, Chris, and Zhe Li. 2021. Negative operating cash flows and investment inefficiency. *Managerial Finance* 47: 1408–27. [CrossRef]

He, Zhaozhao, and M. Babajide Wintoki. 2016. The cost of innovation: R&D and high cash holdings in U.S. firms. *Journal of Corporate Finance* 41: 280–303. [CrossRef]
Heckman, James J. 1979. Sample selection bias as a specification error. *Econometrica* 47: 153–61. [CrossRef]
Houqe, Muhammad Nurul, Reza Monem, and Tony van Zijl. 2023. Business Strategy, Cash Holdings, and Dividend Payouts. *Accounting and Finance* 63: 3999–4035. [CrossRef]
Huang, Kelly. 2020. Management forecast errors and corporate investment efficiency. *Journal of Contemporary Accounting & Economics* 16: 100208.
Jayakody, Shashitha, David Morelli, and Jaideep Oberoi. 2023. Political Uncertainty, Corruption, and Corporate Cash Holdings. *Journal of Corporate Finance* 82: 102447. [CrossRef]
Jensen, Michael C., and William H. Meckling. 1976. Theory of the firm: Managerial behavior agency costs and ownership structure. *Journal of Financial Economics* 3: 305–60. [CrossRef]
Jiang, Jie, Jack Hou, Cangyu Wang, and HaiYue Liu. 2021. COVID-19 impact on firm investment—Evidence from Chinese publicly listed firms. *Journal of Asian Economics* 75: 101320. [CrossRef] [PubMed]
Jones, Edward, Hao Li, and Oluwagbenga Adamolekun. 2022. Excess Cash Holdings, Stock Returns, and Investment Organicity: Evidence from UK Investment Announcements. *Abacus* 58: 603–47. [CrossRef]
Khan, Safi Ullah. 2022. Financing constraints and firm-level responses to the COVID-19 pandemic: International evidence. *Research in International Business and Finance* 59: 101545. [CrossRef] [PubMed]
Lang, Larry HP, RenéM Stulz, and Ralph A. Walkling. 1991. A test of the free cash flow hypothesis. The case of bidder returns. *Journal of Financial Economics* 29: 315–35. [CrossRef]
Lee, Chien-Chiang, Chih-Wei Wang, and Bui Tien Thinh. 2023. Green development, climate risks, and cash flow: International evidence. *Pacific Basin Finance Journal* 79: 102021. [CrossRef]
Lei, Xin-tu, Qing-yuan Xu, and Cheng-ze Jin. 2022. Nature of property right and the motives for holding cash: Empirical evidence from Chinese listed companies. *Managerial and Decision Economics* 43: 1482–500. [CrossRef]
Li, Chun, Yanling Yang, and Linzhu Ren. 2020. Genetic evolution analysis of 2019 novel coronavirus and coronavirus from other species. *Infection, Genetics and Evolution* 82: 104285. [CrossRef]
Li, Zhiyong, Jonathan Crook, Galina Andreeva, and Ying Tang. 2021. Predicting the risk of financial distress using corporate governance measures. *Pacific-Basin Finance Journal* 68: 101334. [CrossRef]
Liu, Guangqiang, Lingyun Zhang, and Ziqin Xie. 2022a. Environmental taxes and corporate cash holdings: Evidence from China. *Pacific Basin Finance Journal* 76: 101888. [CrossRef]
Liu, Haiyue, Jie Jiang, Rui Xue, Xiaofan Meng, and Shiyang Hu. 2022b. Corporate environmental governance scheme and investment efficiency over the course of COVID-19. *Finance Research Letters* 47: 102726. [CrossRef] [PubMed]
Loukil, Nadia, and Ouidad Yousfi. 2016. Does gender diversity on corporate boards increase risk-taking? *Canadian Journal of Administrative Sciences* 81: 66–81. [CrossRef]
Matejić, Tijana, Snežana Knežević, Vesna Bogojević Arsić, Tijana Obradović, Stefan Milojević, Miljan Adamović, Aleksandra Mitrović, Marko Milašinović, Dragoljub Simonović, Goran Milošević, and et al. 2022. Assessing the Impact of the COVID-19 Crisis on Hotel Industry Bankruptcy Risk through Novel Forecasting Models. *Sustainability* 14: 4680. [CrossRef]
Mnif, Yosra, and Imen Cherif. 2020. Female Board Directorship and Earnings Management. *Pacific Accounting Review* 33: 114–41. [CrossRef]
Moin, Abdul, Yilmaz Guney, and Izidin El Kalak. 2020. The effects of ownership structure, sub-optimal cash holdings and investment inefficiency on dividend policy: Evidence from Indonesia. *Review of Quantitative Finance and Accounting* 55: 857–900. [CrossRef]
Myers, Stewart C., and Nicholas S. Majluf. 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 13: 187–221. [CrossRef]
Ningsih, Sri, Khusnul Prasetyo, Novi Puspitasari, and Suham Cahyono. 2023. Earnings Management and Sustainability Reporting Disclosure. *Risks* 11: 137.
Ozkan, Aydin. 2002. The determinants of corporate debt maturity: Evidence from UK firms. *Applied Financial Economics* 12: 19–24. [CrossRef]
Phan, Hieu V., Nam H. Nguyen, Hien T. Nguyen, and Shantaram Hegde. 2019. Policy uncertainty and firm cash holdings. *Journal of Business Research* 95: 71–82. [CrossRef]
Qu, Xin, Majella Percy, Fang Hu, and Jenny Stewart. 2022. Can CEO equity-based compensation limit investment-related agency problems? *Accounting & Finance* 62: 2579–614.
Quah, Heidi, Janto Haman, and Dharmendra Naidu. 2021. The effect of stock liquidity on investment efficiency under financing constraints and asymmetric information: Evidence from the United States. *Accounting & Finance* 61: 2109–50.
Rocca, Maurizio La, Tiziana La Rocca, Raffaele Staglianò, Pino Vecellio, and Fabiola Montalto. 2019. Gender diversity, cash holdings and the role of the institutional environment: Empirical evidence in Europe. *Applied Economics* 51: 3137–52. [CrossRef]
Roychowdhury, Sugata, Nemit Shroff, and Rodrigo S. Verdi. 2019. The effects of financial reporting and disclosure on corporate investment: A review. *Journal of Accounting and Economics* 68: 101246. [CrossRef]
Sarang, Aitzaz Ahsan Alias, Nicolas Aubert, and Xavier Hollandts. 2021. Board Gender Diversity and Corporate Cash Holdings. *Finance* 42: 7–49. [CrossRef]

Sheu, Her-Jiun, and Shiou-Ying Lee. 2012. Excess cash holdings and investment: The moderating roles of financial constraints and managerial entrenchment. *Accounting & Finance* 52: 287–310.
Sikveland, Marius, Jinghua Xie, and Dengjun Zhang. 2022. Determinants of capital structure in the hospitality industry: Impact of clustering and seasonality on debt and liquidity. *International Journal of Hospitality Management* 102: 103172. [CrossRef]
Soesanto, Stefan, and Hendra Wijaya. 2022. The Effect of Readability of annual reports and value relevance of financial information on agency costs with analyst coverage as moderating variable. *Jurnal Akuntansi dan Keuangan* 24: 46–56. [CrossRef]
Sun, Qian, Kenneth Yung, and Hamid Rahman. 2012. Earnings quality and corporate cash holdings. *Accounting & Finance* 52: 543–71.
Tang, Dragon Yongjun, and Yupu Zhang. 2020. Do shareholders benefit from green bonds? *Journal of Corporate Finance* 61: 101427. [CrossRef]
Trinh, Nga Thu, Thanh Pham Thien Nguyen, and Son Hong Nghiem. 2022. Economic policy uncertainty and other determinants of corporate cash holdings of Australian energy companies. *International Journal of Energy Sector Management* 16: 1192–213. [CrossRef]
Wan Ismail, Wan Adibah, Khairul Anuar Kamarudin, Akmalia Mohamad Ariff, and Wan Nordin Wan-Hussin. 2023. Women on board, strength of auditing and reporting standards and analysts' forecasts accuracy: International evidence. *Journal of Applied Accounting Research* 24: 380–402. [CrossRef]
Wu, Yizhong, Chien-Chiang Lee, Chi-Chuan Lee, and Diyun Peng. 2022. Geographic proximity and corporate investment efficiency: Evidence from high-speed rail construction in China. *Journal of Banking & Finance* 140: 106510.
Yang, Xingquan, Liang Han, Wanli Li, Xingqiang Yin, and Lin Tian. 2017. Monetary policy, cash holding and corporate investment: Evidence from China. *China Economic Review* 46: 110–22. [CrossRef]
Yip, Rita W.Y., Danqing Young, Beibei Liu, and Zhichen Wang. 2022. Acquiring firms' transparency and their returns around M&A announcements: Evidence from China. *Journal of International Accounting, Auditing and Taxation* 48: 100487.
Zheng, Michael. 2022. Is cash the panacea of the COVID-19 pandemic: Evidence from corporate performance. *Finance Research Letters* 45: 102151. [CrossRef]
Zou, Ying, Zhuoming Zhong, and Jia Luo. 2021. Ethnic diversity, investment efficiency, mediating roles of trust and agency cost. *Economic Analysis and Policy* 69: 410–20. [CrossRef]