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WEATHERING THE STORM: SHARIAH COMPLIANCE, DIGITAL INNOVATION, AND STOCK PERFORMANCE DURING COVID-19

Mohamad Ikhsan Modjo[1], Florencia Putridamni[2] and Ariella Shenny Lin[3]

[1] School of Accounting, BINUS University, Indonesia, mohamad.modjo@binus.edu
[2] School of Accounting, BINUS University, Indonesia, florencia.putridamni@binus.ac.id
[3] School of Accounting, BINUS University, Indonesia, ariella.lin@binus.ac.id

ABSTRACT

The COVID-19 pandemic disrupted global financial markets, highlighting the need for factors that enhance resilience. This study examines whether Shariah compliance and digital innovation, individually and together, mitigate declines in stock performance during economic downturns. Drawing on Signaling Theory and Dynamic Capabilities Theory (DCT), this study argues that Shariah compliance serves as a signal of strong governance, while digital innovation enhances adaptability. Using firm-level data from Indonesia and a difference-in-differences (DID) model, our findings suggest that both factors help firms withstand crises, with digital innovation amplifying the benefits of Shariah compliance. This study provides insights into how Islamic finance and digital transformation contribute to financial stability.

Keywords: Shariah stocks, Stock performance, COVID-19, Digital transformation.
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I. INTRODUCTION

Islamic finance, a rapidly expanding segment within global financial markets, holds particular significance in Indonesia, the world's largest Muslim-majority nation. The unprecedented COVID-19 pandemic posed severe challenges to traditional business models, emphasizing the need for swift adaptation through digital innovation to sustain operations and growth. Against this backdrop, this research investigates the critical intersection of Shariah compliance, digital innovation, and stock performance during the pandemic, aiming to provide new insights into firm resilience amid economic shocks.

The global financial turmoil triggered by COVID-19 significantly impacted businesses and stock markets worldwide. While initial studies identify a negative correlation between the pandemic's escalation and stock market performance, emerging research highlights the varying resilience of firms based on sectoral and structural characteristics. Notably, businesses in "defensive sectors," with inherently lower risk profiles and often aligned with Shariah principles, showed greater stability during the crisis (Al-Awadhi et al., 2020; Ashraf, 2020). This observation raises important questions about the buffering role of Shariah compliance against financial volatility, especially when coupled with digital innovation.

Despite substantial literature examining the pandemic's effects on financial markets, a critical knowledge gap persists. Existing studies predominantly focus on the independent effects of Shariah compliance and digital innovation on firm performance. For example, research has explored the relationship between Shariah compliance and stock performance (Cheong, 2021; Haseeb et al., 2023; Shear & Ashraf, 2022), as well as the influence of digital innovation on financial performance (Haidar et al., 2023; W. Wu et al., 2023). However, the interplay between these two factors remains unexplored, particularly during an unprecedented crisis like COVID-19. This gap is particularly surprising given their potential synergy, where digital innovation could amplify the benefits of Shariah compliance in enhancing firm resilience.

This study seeks to address this gap by analyzing the combined and individual impacts of Shariah compliance and digital innovation on the stock market performance of Indonesian firms during the pandemic. It explores whether Shariah-compliant firms exhibited better performance due to a shift in investor preferences towards more conservative and ethical investments during the crisis. Additionally, the study examines how digital innovation enabled these firms to expand their reach, maintain operational efficiency, and adapt to volatile market conditions, thereby potentially reinforcing the positive effects of Shariah compliance.

Indonesia provides a compelling context for this investigation. The country's regulatory framework strongly emphasizes sustainability and ethical business practices, aligning closely with Shariah principles. Moreover, Indonesia has seen significant growth in Shariah-compliant investments, driven by increasing demand for ethical and resilient financial options. Supported by a regulatory framework emphasizing sustainability, these investments have gained prominence during economic uncertainty — particularly through instruments listed on the Indonesia Stock Exchange (Minandar et al., 2020; Wahyono, 2022). This research adds to the discussion on Islamic finance's role in enhancing financial resilience during crises.

The paper is organized as follows: The next section reviews the relevant literature, followed by the methods section. The fourth section reports empirical findings, and the final section concludes the study.

II. THEORY AND HYPOTHESES

2.1. Theoretical Framework: Understanding Firm Resilience During Crisis

Financial crises, such as the COVID-19 pandemic, disrupt traditional business operations and financial stability, testing firms' resilience. However, firms can leverage key resources to navigate these challenges effectively. This study focuses on Shariah compliance and digital innovation as two critical resources, examining how they influence stock performance during crises. Specifically, we investigate how digital tools and strategies amplify the impact of Shariah-compliant practices, using Indonesian firms during the pandemic as a case study.

2.1.1. Signaling the Value of Shariah Compliance

Signaling Theory explains how firms communicate valuable information to investors through their actions or characteristics (Galloway & Miller, 2023). For Shariah-compliant firms, adherence to Islamic principles signals strong governance, prudent risk management, and a long-term orientation (Ramadani, 2020). These attributes are particularly attractive to risk-averse investors during periods of uncertainty.

Shariah compliance forms the foundation of Islamic finance, which fosters financial stability through its conservative financial structures and focus on ethical investments. These structures reduce exposure to volatile market conditions (Azad et al., 2018; Cheong, 2021). Moreover, the principles inherent in Shariah compliance—such as ethical business practices, sustainability, and stakeholder welfare—align with the broader concept of ethical investment, enhancing firms' appeal to socially conscious investors seeking responsible investment opportunities (Sari & Suprayogi, 2022).

In addition to financial benefits, the stricter governance frameworks inherent in Shariah compliance strengthen transparency and accountability, building investor trust. By signaling resilience and ethical commitment, Shariah-compliant firms differentiate themselves from conventional counterparts, particularly during crises when stability and integrity are highly valued. This connection between Shariah compliance, Islamic finance, and ethical investment underscores how firms adhering to these principles can achieve a competitive advantage by addressing both financial and ethical considerations.

2.1.2. Digital Innovation as a Dynamic Capability

Dynamic Capabilities Theory (DCT) highlights a firm's ability to adapt, reconfigure, and exploit resources to gain a competitive advantage in dynamic environments (Teece et al., 1997). In this study, digital innovation is conceptualized as a dynamic capability that enables firms to maximize the benefits of Shariah compliance while responding effectively to crisis-induced challenges.

Digital tools empower Shariah-compliant firms by enhancing operational efficiency and transparency. For instance, in the banking sector, the adoption of digital banking platforms by Islamic financial institutions has significantly streamlined operations, reduced transaction costs, and improved service delivery. Studies by Dahdal et al. (2022) and Mohd Haridan et al. (2023) reveal that Islamic banks leveraging blockchain technology have been able to enhance Shariah compliance by automating contract verification and ensuring real-time monitoring of financial transactions. This not only reduces the risk of non-compliance but also boosts investor confidence in the integrity of these institutions.

In the retail industry, digital innovation has enabled firms to integrate ethical practices with consumer engagement strategies. For example, companies adopting digital supply chain technologies, such as the Internet of Things (IoT) solutions, have been able to improve traceability and ensure that their operations align with ethical and sustainable principles, which are core to Shariah compliance. Research by Haidar et al. (2023) highlights how digital platforms such as e-commerce marketplaces have provided a transparent mechanism for promoting Shariah-compliant products, thereby expanding market reach and fostering customer trust.

Moreover, big data analytics plays a pivotal role in optimizing resource allocation and reducing waste, aligning with Shariah principles that discourage inefficiency (W. Wu et al., 2023). By analyzing consumer behavior and market trends, firms can develop targeted strategies that maximize value creation while adhering to ethical guidelines.

Digital innovation also facilitates operational agility, enabling firms to adapt quickly to market disruptions and changing consumer demands. In the financial sector, robo-advisors tailored for Shariah-compliant portfolios have enhanced customer satisfaction by offering personalized investment solutions that adhere to Islamic principles (Hooda et al., 2024). Similarly, in the logistics sector, digital tools such as real-time tracking systems have improved transparency and operational efficiency, ensuring compliance with ethical standards throughout the supply chain (Krishnan et al., 2024).

Furthermore, the integration of digital technologies amplifies the signaling benefits of Shariah compliance. For example, blockchain-based platforms in Islamic finance enable firms to communicate their adherence to ethical practices more effectively by providing investors with transparent records of financial transactions (Hassan et al., 2022). This not only reinforces investor trust but also attracts a broader base of socially conscious stakeholders who value both ethical and technological excellence.

Overall, the evidence from multiple sectors underscores the transformative potential of digital innovation as a dynamic capability. These technologies not only enhance operational efficiency and agility but also amplify the ethical commitments central to Shariah compliance, strengthening firms' resilience and long-term value creation during crises.

2.1.3. Integrating Shariah Compliance and Digital Innovation

The combination of Shariah compliance and digital innovation creates a powerful synergy, where digital tools amplify the operational efficiency and signaling benefits

of ethical business practices. By leveraging digital innovation, Shariah-compliant firms can showcase the tangible outcomes of their principles, strengthening trust among investors and fostering deeper customer loyalty.

This interplay enhances firms' ability to withstand crises, positioning them to not only maintain but also improve financial performance during turbulent periods. For example, digital platforms can highlight Shariah-compliant firms' commitment to ethical investments and responsible business practices, attracting a diverse investor base, including those aligned with both Islamic finance and broader sustainability goals.

Grounded in Signaling Theory and Dynamic Capabilities Theory (DCT), this framework illustrates how Shariah compliance and digital innovation interact to bolster firm resilience. Shariah compliance provides a solid foundation of ethical and sustainable practices, while digital innovation acts as a catalyst, extending these benefits through enhanced adaptability and communication. This integration equips firms with the tools to navigate economic uncertainties effectively and secure long-term competitive advantages.

2.2. The Impact of Shariah Compliance on Stock Performance During Crises

Research on the impact of Shariah compliance on stock performance during crises reveals a complex and evolving picture. Early studies, such as M. B. Hasan et al. (2021), suggest that Islamic and conventional stock indexes exhibited similar levels of volatility and declines during the COVID-19 pandemic. However, more recent findings point to several distinct advantages for Shariah-compliant firms that may contribute to their greater resilience during crises (Cheong, 2021; Haseeb et al., 2023; Shear & Ashraf, 2022). These advantages include a lower risk profile, ethical business practices, and a focus on long-term sustainability, which collectively enhance firm performance. Additionally, Shariah compliance has been associated with improved financial metrics, such as higher returns on assets (ROA) and returns on sales (ROS) (Pepis & de Jong, 2019).

Key features of Shariah compliance, such as prohibitions on excessive debt and speculative activities, play a critical role in reducing financial risk during economic downturns (Sherif, 2020). This conservative financial structure aligns with investor preferences for stability during periods of uncertainty. Research by Chowdhury et al. (2022) and Dharani et al. (2022) supports this view, reporting lower volatility and faster recovery for Shariah-compliant stocks compared to conventional counterparts during the COVID-19 shock. The resilience of these stocks is further attributed to the exclusion of high-risk sectors, such as gambling and alcohol, in Shariah-compliant investments.

In addition to lower risk profiles, Shariah compliance attracts a dedicated investor base seeking ethical investments. These investors prioritize long-term value creation and social responsibility, providing Shariah-compliant firms with a relatively stable demand for their stocks, even in volatile markets (Salvi et al., 2019). This investor loyalty can buffer Shariah-compliant stocks against market shocks and contribute to their recovery during crises.

The benefits of Shariah compliance may extend beyond immediate financial performance. By emphasizing long-term sustainability and stakeholder well-

being, principles inherent in Shariah encourage firms to adopt crisis-resilient strategies (Sadeghi, 2008; Lusyana & Sherif, 2017). In the Indonesian context, these principles align with the country's robust Islamic finance ecosystem and regulatory framework, which prioritize ethical practices and sustainability (Wahyono, 2022). This alignment has fostered a strong domestic and international investor base for Shariah-compliant assets, particularly during times of uncertainty.

Importantly, the impact of Shariah compliance on stock performance during crises may not always be immediate. Studies by Chowdhury et al. (2022) and Dharani et al. (2022) suggest a delayed positive effect, as investors reassess the risk profiles and long-term value propositions of Shariah-compliant firms. Such delays may occur due to initial market skepticism or a lack of immediate visibility of Shariah-compliant firm' advantages during crises. Wahyono (2022) further highlights the potential role of government incentives, such as tax benefits for Shariah-compliant firms, in enhancing their attractiveness and boosting performance over time.

In summary, while early evidence indicates similar performance for Shariah-compliant and conventional stocks during crises, a growing body of research underscores the unique resilience of Shariah-compliant firms. This resilience stems from their conservative financial practices, dedicated investor base, and alignment with sustainability principles. However, the full benefits of Shariah compliance may take time to materialize, particularly during market disruptions. Based on these insights, we propose the following hypothesis:

H1: Shariah compliance improves stock market performance during crises.

2.3. Digital Innovation and Stock Performance

The COVID-19 pandemic underscores the critical role of digital innovation in ensuring business resilience and profitability. Research by the Ministry of Communications and Informatics (2021) indicates a rapid digital transformation in Indonesia during the crisis, with a projected growth rate of 33.2% from 2020. This surge reflects the success stories of firms that embraced digital innovation, surviving and thriving amidst unprecedented challenges (Haidar et al., 2023; W. Wu et al., 2023).

From the perspective of Dynamic Capabilities Theory (DCT), digital innovation enhances a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. Digital technologies enable firms to sense opportunities, seize them through innovation, and reconfigure operations to maintain competitiveness. This adaptive capability is vital during crises, where agility and resilience determine survival. For example, firms that implemented digital solutions during the pandemic streamlined internal processes, optimized resource allocation, and reduced costs (W. Wu et al., 2023). These dynamic capabilities directly enhance their profitability and financial stability, fostering investor confidence.

Additionally, digital platforms facilitate effective customer interactions, product offerings, and marketing strategies (Liu & Jung, 2024). Firms leveraged these platforms to adapt to changing consumer behavior during the pandemic, retaining or expanding their customer base. The ability to quickly adapt to market shifts aligns with DCT's emphasis on agility, which is critical for navigating disruptions and creating long-term shareholder value (Chen et al., 2023).

Liu et al. (2024) further highlight the financial benefits of digital transformation, particularly its impact on stock market performance. Firms that embraced digital innovation experienced enhanced stock liquidity, reduced risk of stock price crashes, and improved accuracy in analysts' forecasts. However, the benefits of digital innovation are not always immediate. Initial implementation often involves significant investment in technology, employee training, and process reengineering, which can strain resources and disrupt traditional operations in the short term (Chen et al., 2023). For this reason, some firms may initially experience negative impacts on metrics such as return on assets (ROA) and return on equity (ROE).

Conversely, digital maturity over time enables firms to unlock the long-term value of digital innovation. Jardak & Ben Hamad (2022) emphasize that while short-term setbacks may occur, the eventual integration of digital capabilities positively impacts Tobin's Q, reflecting sustained value creation. This suggests that the benefits of digital transformation on stock performance may manifest with a delayed effect, as firms adapt and investors recognize the potential for growth and resilience.

In conclusion, digital innovation, as a dynamic capability, empowers firms to adapt, innovate, and thrive in uncertain environments. While initial implementation may involve challenges, its long-term benefits are evident in enhanced resilience, profitability, and stock market performance. Therefore, we propose the following hypothesis:

(H2): Digital innovation positively impacts a company's stock performance during crises, with a possible delayed effect.

2.4. Interaction Effect: Shariah Compliance and Digital Innovation

The interaction between Shariah compliance and digital innovation offers a unique pathway to resilience during crises. Digital tools can amplify the benefits of Shariah-compliant practices by enhancing operational efficiency, transparency, and customer trust (Alsaghir, 2023; Demirdöğen, 2021). For instance, blockchain technology provides an immutable and transparent record of financial transactions, ensuring that firms adhere to Shariah principles such as the prohibition of interest (*riba*) and unethical practices (Hassan et al., 2022). By embedding Shariah-compliance verification into blockchain systems, firms can build greater trust among investors and stakeholders, particularly those prioritizing ethical investments.

In addition to enhancing transparency, digital innovation enables firms to extend the operational benefits of Shariah compliance. For example, Islamic banks have leveraged artificial intelligence (AI) and machine learning to offer personalized financial services while adhering to Shariah principles. Robo-advisors, tailored to Shariah-compliant portfolios, provide automated, low-cost investment solutions that align with Islamic values, significantly improving customer satisfaction and expanding access to ethical investment opportunities (Yu & Alsaud, 2021). These innovations strengthen the market positioning of Shariah-compliant firms, particularly in competitive financial sectors.

The logistics sector provides another compelling example of how digital tools enhance compliance with Shariah principles. Real-time tracking systems and Internet of Things (IoT) technologies improve supply chain transparency, enabling firms to monitor goods throughout their journey (Krishnan et al., 2024). This level of oversight ensures that ethical standards are maintained across the supply chain, preventing issues such as fraud or the inclusion of prohibited (*haram*) items in shipments. By integrating these technologies, firms can demonstrate a strong commitment to ethical practices, reinforcing their value to socially conscious investors.

Furthermore, digital innovation amplifies the signaling benefits of Shariah compliance. According to Signaling Theory, firms that effectively communicate their ethical commitments to stakeholders are more likely to attract investment and foster trust (Ramadani, 2020). Digital platforms allow Shariah-compliant firms to showcase their sustainability efforts, ethical governance, and financial transparency to a broader audience. For example, digital marketing campaigns highlighting the ethical advantages of Shariah-compliant financial products can attract both Muslim and non-Muslim investors seeking socially responsible investments.

While the integration of digital innovation and Shariah compliance offers substantial benefits, the full impact of this synergy may take time to materialize. Initial implementation costs, such as upgrading IT infrastructure or training staff to use digital tools, can pose short-term challenges (Jardak & Ben Hamad, 2022). However, these investments ultimately strengthen a firm's resilience by enabling it to adapt to crises and seize opportunities in dynamic markets.

In summary, the interplay between Shariah compliance and digital innovation enhances a firm's ability to withstand crises by improving operational efficiency, transparency, and ethical signaling. By leveraging these tools, firms can align their business practices with the growing demand for sustainability and ethical governance, ensuring long-term competitive advantages in volatile markets.

Hypothesis 3 (H3): Digital innovation moderates the positive relationship between Shariah compliance and stock market performance during crises, with potential delayed effects.

III. METHODOLOGY

3.1. Data Collection and Samples

This study investigates the impact of the COVID-19 pandemic on firm performance, using daily stock price data from the Bloomberg database. The data, covering the third quarter of 2019 to the second quarter of 2020, allow us to analyze market reactions to the unfolding pandemic. We focus on the KOMPAS-100 index of the Indonesia Stock Exchange (BEI) because it comprises high-performing companies, a significant portion of which have crucial ESG scores. The KOMPAS-100 offers a concentrated pool of companies with available ESG scores, making it a more suitable sample for our analysis.

Furthermore, the KOMPAS-100, like the broader IDX Composite, represents approximately 80% of the total market capitalization of its respective population, ensuring our sample captures a substantial portion of market activity. These ESG scores are essential for our subsequent analysis of digital innovation, a factor

frequently unreported by companies listed on the broader IDX Composite index.

To analyze the relationship between daily stock movements and company financials, we merged high-frequency stock market data (daily stock returns) with lower-frequency financial data (quarterly reports). This approach, supported by prior studies (e.g., Zhong & Enke, 2019; H. Zhou et al., 2021), leverages the predictive value of quarterly financial data for understanding stock price movements. However, merging data with differing frequencies presents challenges, particularly when daily data must be aligned with quarterly information.

To address this, we used forward-fill interpolation (via the *mipolate* command in Stata) to convert quarterly data into daily observations. Forward-fill interpolation assigns the latest available quarterly value to subsequent daily observations until a new quarterly report is available. This ensures continuity but may smooth out short-term financial variations. To verify robustness, we compared results using backward-fill and linear interpolation, finding consistent patterns (H. Zhou et al., 2021).

Our primary goal was to capture daily trends in the relationship between Shariah compliance, digital innovation, and stock performance, rather than tracking precise financial fluctuations within each quarter. This focus aligns with the theoretical framework, which emphasizes the importance of high-frequency data in assessing market reactions to shocks like the COVID-19 pandemic.

In selecting indices, we also consider the Indonesia Shariah Stock Index (ISSI) alongside the Jakarta Islamic Index (*JII*). The *JII* is chosen because it filters for Shariah compliance and financial performance, aligning with our focus on high-performing firms. This choice mirrors our rationale for selecting the KOMPAS-100 index, which prioritizes top-performing companies that report ESG scores. Together, the KOMPAS-100 and *JII* represent significant portions of their respective market segments, enhancing the generalizability of our findings.

The combination of daily stock returns and quarterly financial data offers several key advantages. First, it generates a large sample size, reducing the likelihood of biased estimations. Second, daily data capture continuous market reactions to COVID-19 shocks, which quarterly data alone could not achieve. Lastly, the dataset spans three-quarters of the COVID-19 pandemic, enabling us to analyze both the immediate and extended impacts on firm performance.

This comprehensive data collection approach, incorporating firm characteristics and financial metrics, allows us to explore various mechanisms in our models while mitigating omitted variable bias. By combining robust data handling techniques and a representative sample, our study offers meaningful insights into the resilience of firms during the COVID-19 pandemic.

3.2. Dependent Variables

The primary dependent variable for measuring stock performance is the *cumulative abnormal return (CAR)*, which is obtained by first calculating the expected return (ER*it*) using this formula:

$$ER_{it} = \beta_0 + \beta_1 R_{mt} + \varepsilon, \quad (1)$$

R*mt* denotes the market return on day t over the event window, and β0 and β1 are estimated coefficients. We then compute the abnormal returns (ARit) by following Fama et al. (1969) model:

$$AR_{it} = \mathrm{R}_{it} - ER_{it}, \tag{2}$$

Finally, following the literature, we calculate *CAR* by summing up *AR* over the sixty days before and after an event date (MacKinlay, 1997):

$$CAR_{it} = \sum_{k}^{j} AR_{it}\,, \tag{3}$$

This study classifies a company as Shariah compliant if its stock is included in the *Jakarta Islamic Index* (*JII*) during the first semester of 2020 (Minandar et al., 2020; Wahyono, 2022). While *JII* consists of the 30 most liquid Shariah-compliant stocks, *JII70* includes a broader set of 70 firms. The main analysis uses *JII* due to its liquidity focus, whereas *JII70* is introduced as a robustness check to validate findings across a wider spectrum of Shariah-compliant firms. Constituents of the *JII* are from the IDX, which reviews and updates the list biannually based on criteria outlined by the *Indonesian Financial Service Authority* (*OJK*) and the *Majelis Ulama Indonesia* (MUI).

Additionally, we classify sample companies into two groups: companies with and without digital innovation. These groups are measured based on whether firms allocate spending on digital innovation initiatives, including investments in software, hardware, and IT infrastructure (Anas & Cahyawati, 2023; Muchlis et al., 2021; W. Wu et al., 2023). Digital innovation classification is based on firms' disclosed investments in digital transformation initiatives within financial reports, categorized according to standard industry benchmarks (Anas & Cahyawati, 2023). To ensure consistency, only firms with documented expenditures on software, cloud computing, AI, or digital infrastructure during Q1 2020 are considered digitally innovative.

We also construct the Size-Age (SA) index proposed by Hadlock & Pierce (2010) as a dependent variable to indicate firms' financial constraints. The size of the enterprise is the natural logarithm of total assets, and age is the total number of months since a firm's stock was publicly offered (IPO). The SA index is computed using the following formula:

$$SA_{it} = -0.737 \text{ x } Size_{it} + 0.043 \text{ x } Size^2 - 0.040 \text{ x } Age_{it} \tag{4}$$

In Equation (4), a larger SA index indicates greater financial constraint (i.e., a smaller absolute value).

This paper controls specific characteristics of companies, selected based on their relevance in past studies. Following the paper by Albuquerque et al. (2020) and Broadstock et al. (2021), these controls include the company's size, age, leverage, liquidity, and return on assets (ROA). For the final sample, we exclude stocks from

the financial sector due to their unique business models and financial reporting practices. We also remove samples with missing values in the independent variables, whereas continuous variables are winsorized at the 1% and 99% levels. The variables and their detailed definitions are discussed in Table 1.

Table 1.
Variable Definitions

Variables	Codes	Definitions
Dependent variable.		
Cumulative abnormal stock returns	*CAR*	The cumulative AR for the 60 days before and after the event date
Independent vars.		
Digital Innovation	*DInnov*	Natural log (investment in digital infrastructure)
Jakarta Islamic Index 70	*JIS70*	JIS70 = 1 if stock is constituent of *JII70*, 0 otherwise
Digital Innovation dummies	*DIV*	DIV = 1 if a firm invests in digital infrastructure, 0 otherwise
Financing constraint	*DSAi*	DSAi = 1 if SAi score in Q4-2019 > mean score, 0 otherwise.
DID vars		
Shariah compliance	*JIS*	JIS = 1 if stock is constituent of *JII*, 0 otherwise
Digital Innovation dummies	*DIV*	DIV = 1 if a firm invests in digital infrastructure, 0 otherwise
The COVID-19 pandemic period	*COVID*	COVID = 1 if a date is on or after March 2 2020, 0 otherwise.
Shariah-compliant firms with Digital Innov.	JIS×DIV	Interaction of JIS and DIV
Interaction of JIS and COVID	*JIS*×COVID	Interaction of JIS and COVID
Interaction of DIV and COVID	*DIV*×COVID	Interaction of DIV and COVID
Interaction of JIS, DIV, and COVID	JIS×DIV×COVID	Interaction of JIS*DIV* COVID
Control vars.		
Age of a firm	*Age*	Natural log (time since IPO in months)
Size of a firm	*Size*	Natural log (total assets).
Stock historical volatility	*Vola*	Stock volatility as calculated from daily raw returns
Total debt relative to total assets	*Leverage*	Total firm debt / total firm assets
Research and Development	*RND*	Natural log (R&D expenses).
Liquidity of a firm	*Liquidity*	Total Cash + cash equivalent in firm asset/ total current liabilities.
Return on total assets	*ROA*	Net income/ total assets
Financing Constraint variable		
Size-Age Index	*SAi*	Firm financing costrain calculated as SA = -0.737 * Size_it + 0.043 * Size^2 - 0.040 * Age (Hadlock & Pierce, 2010)

3.3. Empirical Models

This study uses the difference-in-differences (DID) estimation approach to analyze the different outcomes between Shariah compliance and non-compliance firms during the COVID-19 shock. Our DID is specified as follows:

$$CAR_{it} = \beta_0 + \beta_1 JIS_i + \beta_2\, COVID_t + \beta_3\, JIS_i * \ COVID_t + \theta X_{it} + \lambda_i + \mu_t + \varepsilon_{it} \quad (5)$$

CARit represents the cumulative abnormal return of stock (i) at time (t). The JIS*i* is a dummy variable that equals one if the company's stock belongs to the *JII* index or zero otherwise. COVID*t* is a dummy variable that equals one for periods on or after the event date (March 2, 2020). JIS*i* × COVID*t* represents the interaction term between JIS*i* and COVID*t*. The control vector *Xit* comprises a series of control variables for company characteristics. The above specification also controls individual company fixed effects and day-period fixed effects.

The DID regression for analyzing the effect of digital innovation could be obtained by replacing the JIS*i* in Equation (5) with DIV*j* dummy variables, where DIV*j* is equal to 1 if the company invests in digital innovation initiatives, including investments in software, hardware, and IT infrastructure and 0 otherwise.

$$CAR_{it} = \beta_0 + \beta_1 DIV_j + \beta_2\, COVID_t + \beta_3\, DIV_j \times COVID_t + \theta X_{it} + \lambda_i + \mu_t + \varepsilon_{it} \quad (6)$$

The JIS*i* × COVID*t* (Equation 5), or DIV*j* × COVIDt (Equation 6), is our coefficient of interest, representing the joint effect of JIS*i*, or DIV*j*, and COVID-19 shock. This method assumes parallel trends, implying that in the absence of COVID-19 shock, *CAR*s would have followed similar paths over time for the treatments (JIS*i* or DIV*j*) and their control groups. To check this assumption, we will plot pre-pandemic trends of *CAR*s for Shariah-compliant firms (and firms with digital innovations) relative to their respective controls.

3.3.1. Triple Differences

Shariah-compliant stocks are considered a defensive asset class. Their adherence to Islamic principles tends to moderate their performance, lessening the impact of market crises such as the COVID-19 pandemic. This moderating effect can offer investors a degree of protection against severe losses during economic downturns. This study also explores whether a firm's digital innovation further moderates this resilience during an economic downturn. Using a novel triple difference test, the research examines the interaction between Shariah compliance and digital innovation to provide valuable insights into how companies can navigate challenging economic periods.

This triple difference test examines the moderating roles of both digital innovation and Shariah compliance on firm stock resilience during the COVID-19 pandemic. The sample is first divided into Shariah-compliant and non-compliant companies, indicated by the variable JIS*i*. To facilitate this test, the study utilizes the previously introduced DIV*j* variable, which equals one if the company's stock belongs to a firm with digital innovation and zero otherwise.

This analysis further incorporates interaction terms to capture the combined effects of digital innovation, Shariah compliance, and the pandemic. DIVj×COVIDt indicates whether a stock belongs to a firm with digital innovation during the pandemic. This variable is derived from the interaction between DIVj and the binary variable COVIDt, which equals one during the pandemic period and zero otherwise. Similarly, DJISit represents the interaction between DIVj and JISi, while JISi×COVIDt captures the interaction between JISi and COVIDt. Finally, JISi×DIVj×COVIDt represents the three-way interaction between JISi, DIVj, and COVIDt.

Following previous research (Buchanan et al., 2018; Cui et al., 2018; Sun et al., 2023), the outcome variable CAR_{it} is described with the following specifications:

$$CAR_{it} = \alpha * (JIS_i \times DIV_j \times COVID_t) + \beta_1(DIV_j \times JIS_i) + \beta_2 (JIS_i \times COVID_t) + \beta_3(DIV_j \times COVID_t) + \lambda_i + \mu_t + \varepsilon_{it} \quad (7)$$

The triple difference approach is implemented using three multiple interaction terms as per Equation (7), which include firm-fixed effects to account for time-invariant firm-specific factors. This study focuses on the triple interaction term α, which is critically important. It is an estimation of whether the differences in responses between companies with Shariah compliance and digital innovation and companies with Shariah compliance without digital innovation compared to their respective control groups are significant following the COVID-19 pandemic.

3.4. Event Window

Our study employs a difference-in-differences (DID) and triple-difference model framework to analyze the impact of COVID-19 on the stock performance of Shariah-compliant and digitally innovative firms compared to their non-compliant counterparts. The selection of the event window (the period considered to be directly affected by the event) is crucial for accurate analysis.

We have chosen a **collapsed window** encompassing February 6, 2020, to March 24, 2020, as our primary event window. This specific period aligns with the "collapsed" or "feverish" phase identified in previous studies (Engelhardt et al., 2021; Fahlenbrach et al., 2021; D. Zhou & Zhou, 2022). During this period, the global stock market experienced a significant decline due to the initial shock and uncertainty surrounding the COVID-19 pandemic.

The justification for the collapsed window lies in the confluence of market volatility and policy uncertainty. This timeframe captures the period of heightened market instability caused by the initial outbreak of the pandemic and its immediate economic repercussions. Simultaneously, this window coincides with the peak of uncertainty surrounding government policies and potential responses to the crisis. Essentially, it isolates a period where both market behavior and government actions were highly unpredictable, making it a distinct and impactful segment for analysis.

To gain a more comprehensive understanding, we will also conduct analyses using two additional windows:

1. **Post-Collapsed Window**: This window encompasses the entire first half of 2020, allowing us to observe how the market reacted to the first wave of government interventions, such as economic stimulus packages and lockdown policies.
2. **Extended Window**: To assess long-term market dynamics and potential rebound effects, we will conduct robustness checks using a wider window encompassing 90 days before and after the key event date (February 6, 2020).

Employing multiple event windows provides a more comprehensive understanding of COVID-19's impact across distinct market phases. This allows us to analyze the initial shock, the effectiveness of policy interventions, and potential signs of recovery. Furthermore, analyzing multiple windows provides robustness checks. Consistent findings across different timeframes strengthen the validity of our conclusions. This multi-window approach ultimately yields a more comprehensive understanding of how these factors influenced firms during the pandemic.

3.5. Descriptive Analysis

Table 2 summarizes the key characteristics of the variables used in our study. The sample size of *12,489* observations reflects the total number of daily stock returns employed in our analysis. This comprehensive dataset allows us to capture the nuanced daily fluctuations in firm performance throughout the study period.

Table 2.
Summary Statistics

Variable	N	Mean	SD	Min	Max
car	12489	0.1118	0.1910	-0.2581	0.6793
SAi	12489	-2.0958	0.7126	-3.4319	-0.2294
DIGinnov	12489	3.4930	5.1117	0.1044	16.4688
Size	12489	17.0924	1.0330	15.1335	19.6552
Age	12489	5.2696	0.6603	3.1781	7.2738
ROA	12489	0.0438	0.0639	-0.0409	0.3587
RND	12489	1.2712	3.2841	0.1044	13.5530
Vola	12489	0.0298	0.0106	0.0113	0.0519
Leverage	12489	0.2716	0.1871	0.0002	0.7092
Liquidity	12489	1.5093	1.3039	0.1203	8.5600
DebtEquity	12489	0.8430	0.9287	0.0002	5.1593
JIS	12489	0.4203	0.4936	0.0000	1.0000
JIS70	12489	0.6522	0.4763	0.0000	1.0000
DIV	12489	0.3043	0.4601	0.0000	1.0000
COVID	12489	0.5028	0.5000	0.0000	1.0000
JIS×COVID	12489	0.2113	0.4083	0.0000	1.0000
DIV×COVID	12489	0.1530	0.3600	0.0000	1.0000
JIS×DIV×COVID	12489	0.0802	0.2715	0.0000	1.0000

To achieve this, we examine data for *69 firms* listed on the KOMPAS-100 index of the Indonesia Stock Exchange (BEI). The specific timeframe for this analysis is captured through multiple event windows detailed in the "*Event Window*" section (Section 3.4). The length of these windows varies depending on the stage of the COVID-19 pandemic we are examining. By multiplying the number of firms (*n*) by the total number of days across all event windows (*t*), we arrive at the total number of observations (*12,489*) used to calculate the daily *CAR* (cumulative abnormal return) for each firm.

The distribution of the *CAR* index, ranging from *-0.2581 to 0.6793*, indicates some variation in firm performance. The *median (0.0495)* being lower than the *mean (0.1118)* suggests a *positive skew* in the distribution. This pattern implies that while some firms experienced significant positive returns during the observation period, the majority had lower returns. The *standard deviation (0.1910)* further reflects this moderate variation in firm performance.

Key variables include the dummy indicators for *Digital Innovation (DIV)* and *Shariah-compliant firms (JIS)*. The *DIV variable* (1 for firms engaged in digital innovation and 0 otherwise) has an average value of *0.3043*, indicating that *about one-third* of the sample engaged in digital innovation during the first quarter of 2020—a period marked by the onset of COVID-19. Similarly, the *JIS variable* (1 for Shariah-compliant firms and 0 for others) averages 0.4203, revealing that slightly *less than half (42%)* of the firms in our sample are Shariah-compliant.

Our analysis also incorporates several control variables—*firm size, age, debt-to-equity ratio, and return on assets (ROA)*—to better isolate the effects of digital innovation and Shariah compliance on firm performance. The *Size-Age Index (SAi)*, included as a dependent variable, averages *-2.095* and ranges from *-3.432 to -0.229*, indicating its role in exploring financing constraints. The *average firm size* is *17.092* (ranging from *15.133 to 19.655*), and the *average firm age* is *5.27*. It is important to note that the variable *"Age"* represents the natural logarithm of time since *IPO in months*. Therefore, the decimal values for the minimum and maximum of *"Age"* are expected as they reflect the logarithmic transformation. The *debt-to-equity ratio* averages *0.8430*, reflecting a moderately high level of firm indebtedness, while *ROA* averages *0.0438*. *Interaction terms*, such as *"JIS×COVID,"* are also included to examine how factors like *Shariah compliance* moderate the impact of the *COVID-19 pandemic*.

Additionally, we conduct a *correlation analysis* using the *natural log of digital spending* as a proxy for *digital innovation*. As presented in *Table 3*, the *correlation coefficient* between *digital innovation* and *firm size* is 0.277, suggesting *a modest positive association*—consistent with the expectation that *larger firms, with greater resources, tend to invest more in digital innovation*. Similarly, *the correlation between digital innovation and R&D spending is 0.233*, indicating that *higher R&D investments are modestly associated with increased digital innovation*. The *modest strength* of these correlations may partly result from the *logarithmic transformation* of digital spending, which compresses the scale and potentially dampens the magnitude of observed relationships.

Table 3.
Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) car	1.000																
(2) SAi	0.039	1.000															
(3) DIGinnov	0.032	0.342	1.000														
(4) Size	0.044	0.929	0.277	1.000													
(5) Age	0.013	0.019	-0.091	0.380	1.000												
(6) ROA	-0.197	-0.183	0.023	-0.155	0.080	1.000											
(7) RND	-0.001	-0.023	0.233	0.083	0.260	0.233	1.000										
(8) Vola	0.239	0.083	0.020	0.135	0.130	-0.251	-0.041	1.000									
(9) Leverage	0.089	0.307	0.122	0.261	-0.087	-0.446	-0.102	0.246	1.000								
(10) Liquidity	-0.076	-0.208	-0.081	-0.248	-0.130	0.138	0.018	-0.148	-0.483	1.000							
(11) DebtEquity	0.079	0.187	0.121	0.151	-0.088	-0.363	-0.071	0.214	0.864	-0.387	1.000						
(12) JIS	0.038	0.298	0.082	0.341	0.164	0.108	0.043	0.070	-0.113	-0.097	-0.098	1.000					
(13) DIV	0.037	0.229	0.734	0.179	-0.083	0.059	0.202	0.038	0.087	-0.038	0.088	0.175	1.000				
(14) COVID	0.458	-0.005	-0.009	0.004	0.020	-0.200	-0.012	0.600	0.020	0.014	0.027	0.000	0.000	1.000			
(15) ISCOVID	0.275	0.181	0.042	0.209	0.108	-0.021	0.026	0.394	-0.060	-0.042	-0.059	0.608	0.107	0.515	1.000		
(16) DIVCOVID	0.282	0.138	0.428	0.112	-0.038	-0.065	0.119	0.375	0.063	-0.026	0.062	0.105	0.598	0.537	0.403	1.000	
(17) DISCOVID	0.191	0.119	0.249	0.141	0.101	0.057	0.081	0.212	-0.100	-0.043	-0.081	0.427	0.402	0.361	0.702	0.673	1.000

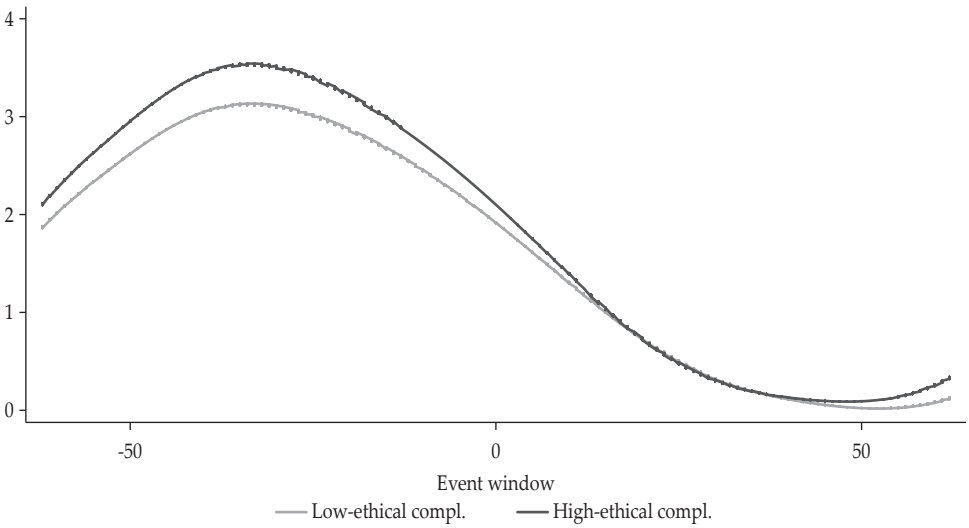

Figure 1.
Cumulative Abnormal Return Trend

Building on these insights, Figure 1 provides a visual depiction of market responses around the event date. Figure 1 represents *CAR*s for the *60 days before and after* the event date. As shown in the figure, the trendline rises initially and then falls around the announcement date. Notably, the downward trend in *CAR* is more pronounced *16 days after* the event date [0,16], coinciding with the so-called *"collapse period"* when the COVID-19 pandemic severely impacted global financial markets. Conversely, an upward trend in *CAR*s emerges *50 days after* the event date. This revival likely reflects a stock market *anomaly* triggered by the announcement of *economic stimulus* and *tax incentives* by *the Indonesian government* and *Bank Indonesia* at the end of *March 2020* (Phan & Narayan, 2020; Sinaga et al., 2022). The subsequent market response is further evidenced by a *significant influx of new investors*, particularly *middle- and high-income individuals* investing via *digital applications* (Modjo & Santoso, 2022; Wahyono, 2022).

Moreover, the interaction between *Shariah compliance* and *digital innovation* offers a unique pathway to resilience during crises. Digital tools can amplify the benefits of Shariah-compliant practices by enhancing *operational efficiency*, *transparency, and customer trust* (Alsaghir, 2023; Demirdöğen, 2021). For instance, *blockchain technology* provides an *immutable* and *transparent* record of financial transactions, ensuring that firms adhere to *Shariah principles* such as the prohibition of *interest (riba)* and *unethical practices* (Hassan et al., 2022). By embedding *Shariah-compliance verification* into *blockchain systems*, firms can build greater trust among *investors* and *stakeholders*, particularly those prioritizing *ethical investments*.

In addition to enhancing *transparency*, *digital innovation* enables firms to extend the *operational benefits* of *Shariah compliance*. For example, *Islamic banks* have leveraged *artificial intelligence (AI)* and *machine learning* to offer personalized *financial services* while adhering to Shariah principles. *Robo-advisors* tailored to *Shariah-compliant portfolios* provide *automated*, *low-cost investment solutions* that align with

Islamic values, significantly improving *customer satisfaction* and expanding access to *ethical investment opportunities* (Yu & Alsaud, 2021). These innovations strengthen the *market positioning of Shariah-compliant firms*, particularly in *competitive financial sectors*.

IV. EMPIRICAL RESULTS

4.1. Baseline Regression

The baseline *Difference-in-Differences (DID)* regression results presented in Table 4 reveal significant findings on the impact of *Shariah compliance (JIS)* and *digital innovation (DIV)* during the COVID-19 pandemic on firm stock performance *(CAR)*. Notably, *Shariah-compliant firms* demonstrated greater resilience, as evidenced by the significantly positive coefficient of *JIS×COVID* in both the *collapsed (0.0151)* and *post-collapsed windows (0.0176)*. This suggests a *higher average CAR* than *non-compliant firms*, even after accounting for other factors. These findings align with previous research discussed in *Section 2* on the resilience of *Shariah-compliant firms* during crises.

Although *Shariah-compliant firms* may have had *lower CARs before COVID*, indicated by the negative and significant *JIS coefficients*, several possible explanations exist. These reasons include industry concentration in *lower-growth sectors*, investment limitations in specific activities (Dharani et al., 2022), and an *investor base* that prioritizes *long-term value* and *ethical considerations* (Salvi et al., 2019).

Table 4.
Baseline DID Regression

Dependent variable: Cumulative Abnormal Return (*CAR*)	Collapsed Window	Post-collapsed	Collapsed Window	Post-collapsed
	(1)	(2)	(3)	(4)
JIS×COVID	.0151***	.0176***		
	(.0047)	(.0031)		
DIV×COVID			.042***	.0456***
			(.0046)	(.0031)
JIS	-2.854***	-.5186***		
	(.582)	(.1604)		
DIV			.058***	-.2111
			(.0175)	(.1597)
COVID	.3989***	-.1576***	.3942***	-.1646***
	(.0157)	(.0202)	(.0157)	(.0202)
Size	.7655***	.115***	.018**	.0857***
	(.1472)	(.0162)	(.0081)	(.0165)
Age	-.0044	.2225*	-.0129	.0283
	(.0138)	(.1307)	(.0127)	(.129)
ROA	10.2171***	-.3195***	-.5898***	-.2961***
	(2.1365)	(.0688)	(.195)	(.0665)
RND	.2375***	.0033***	.0074***	-.0005
	(.0477)	(.001)	(.0018)	(.001)

Table 4.
Baseline DID Regression (Continued)

Dependent variable: Cumulative Abnormal Return (*CAR*)	Collapsed Window	Post-collapsed	Collapsed Window	Post-collapsed
	(1)	(2)	(3)	(4)
Vola	10.2958***	2.2569***	10.047***	2.4099***
	(.831)	(.2868)	(.834)	(.2798)
Leverage	.959***	-.0882**	.1302***	-.0931**
	(.2003)	(.0409)	(.0497)	(.0398)
Liquidity	.0557***	.0186***	.0423***	.0202***
	(.0058)	(.0032)	(.0035)	(.0034)
_cons	-12.8342***	-3.0935***	-.5277***	-1.7018***
	(2.4594)	(.6408)	(.0824)	(.6401)
Firm dummies	Yes	Yes	Yes	Yes
Day-period dummies	Yes	Yes	Yes	Yes
Observations	2277	8349	2277	8349
R-squared	.9034	.8799	.9057	.8818

Robust standard errors are in parentheses.

*** p<.01, ** p<.05, * p<.1

Similarly, the *positive* and *significant coefficient for DIV×COVID* in both windows suggests that firms that implemented *digital innovation* during COVID saw a *positive impact* on their stock performance. Interestingly, the coefficients for *DIV×COVID* are *higher than those for JIS×COVID* across both windows. This finding suggests that *digital innovation* had a *stronger positive impact* on *stock performance* than *Shariah compliance* during this turbulent period.

Furthermore, the *positive* and *significant coefficient* for *DIV* in the *collapsed window* suggests a *slightly higher average CAR* for firms that implemented *digital innovation* during COVID. These results could be an early indication of the benefits of digitalization. However, this effect disappears in the *post-collapsed window*, indicating *a possible delayed impact*.

Possible reasons for this *delayed effect* include *initial financial difficulties*, as suggested by Chen et al. (2023), who argue that firms undergoing *digital transformation* might face *initial financial challenges*, negatively affecting traditional metrics like *ROA* and *ROE*. Their idea aligns with the findings of Nasiri et al. (2020), who highlight the importance of *effective performance measurement systems* in translating *digital capabilities* into *financial outcomes*. Additionally, as noted by Jardak & Ben Hamad (2022), while *digital maturity* might initially *negatively impact* traditional financial metrics, it can *positively affect Tobin's Q*, capturing the *long-term value-creation potential* of *digital transformation*. This suggests that the *full benefits* of *digital innovation* on *stock performance* might take *time to materialize*.

The *control variables*, essential for our model's validity, have expected signs and significance levels. Larger *firm size, higher liquidity, and greater R&D intensity* all had positive coefficients, indicating that these characteristics played a significant role in *firm survival* during the crisis. These findings are consistent with prior research (Albuquerque et al., 2020; Demers et al., 2021; Li et al., 2022), further validating our study's results.

Overall, our *baseline analysis* confirms the *hypotheses H1 & H2*, underscoring the *crucial role* of *Shariah compliance* and *digital innovation* in *firm performance* during crises. These findings have significant implications for understanding *firm resilience* and the *potential benefits* of *digital transformation*, particularly in times of crisis.

4.1.1. Parallel Trend Test

A critical assumption of the *Difference-in-differences (DID)* model is that control and treatment groups exhibited *similar pre-event trends* in stock performance before the COVID-19 pandemic (the "event"). This assumption is crucial because it isolates the impact of COVID-19 on the treatment group (firms with a specific characteristic such as *Shariah compliance* or *digital innovation*).

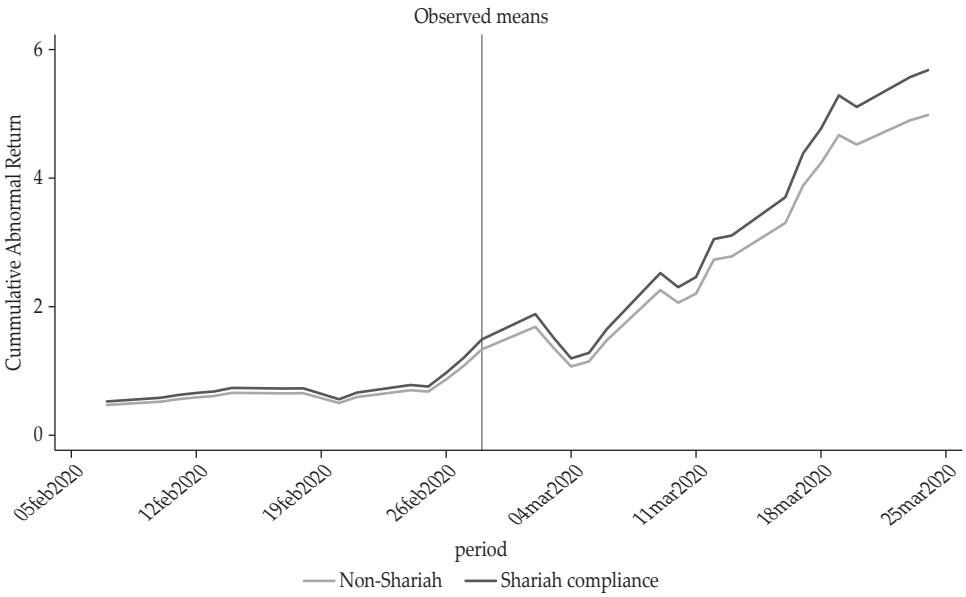

Figure 2.
Graphical Diagnostics for Parallel Trends

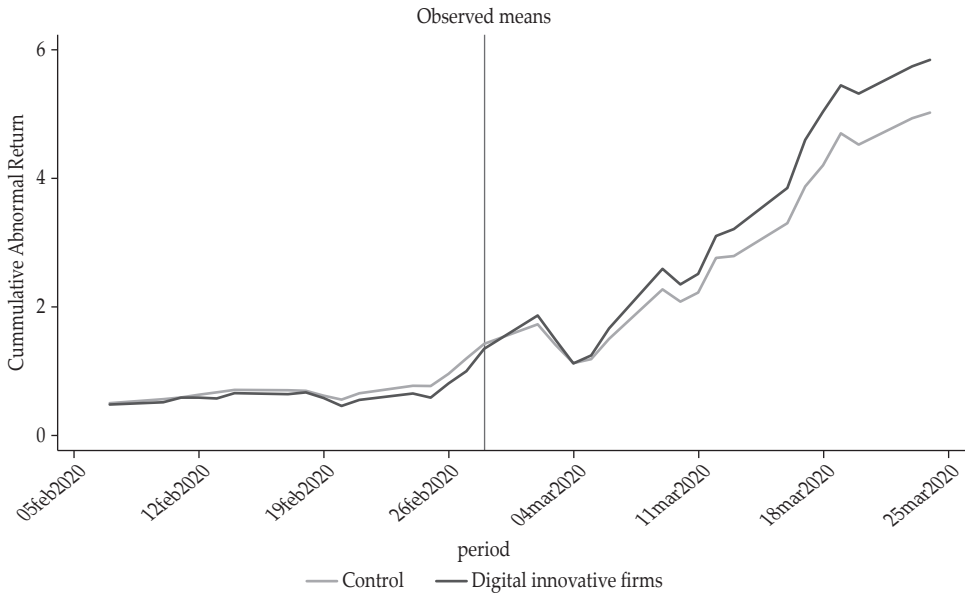

Figure 2.
Graphical Diagnostics for Parallel Trends (Continued)

Figure 2 visually assesses this assumption using *a parallel trend test*. It plots the average *Cumulative Abnormal Returns (CAR)* for both *Shariah-compliant firms* and their *control group*, as well as *digitally innovative firms* and their *control group*.

The key finding from Figure 2 is the *matching pre-event CAR dynamics* for both comparisons. In simpler terms, the lines for the *control* and *treatment groups* show *similar fluctuations* in *CAR* before the event date (marked in the figure). This suggests that no significant pre-COVID-19 events *disproportionately impacted* one group compared to the other. Thus, these results strenghten the validity of this study's *parallel trend assumption* for the *DID model*.

4.2. The Moderating Effect of Digital Innovation

We extend our analysis by employing a *triple-difference regression* (*Equation 7*) to examine *the moderating effect* of *digital innovation (DIV)* on *Shariah compliance (JIS)* during the COVID-19 pandemic. This analysis aims to determine whether *digital innovation* enhances the resilience of *Shariah-compliant firms*.

Table 5.
Triple Differences Regression Results

Dependent variable: Cumulative Abnormal Return (*CAR*)	Collapsed Window (1)	Post-collapsed (2)
JIS×DIV×COVID	.0221**	.0146**
	(.009)	(.006)
JIS×COVID	.0032	.0077**
	(.0059)	(.0038)
DIV×COVID	.03***	.037***
	(.0067)	(.0046)
DIV×JIS	.3037	-2.2487***
	(59.2023)	(.7975)
Size	.0445	.0865***
	(9.6435)	(.0166)
Age	-.2153	.0826
	(5.0554)	(.129)
ROA	-.2422	-.3368***
	(165.6008)	(.0677)
RND	.3539	-.0008
	(0.000)	(.001)
Vola	9.9867***	2.2929***
	(.8312)	(.2886)
Leverage	-.306	-.0973**
	(18.2197)	(.0399)
Liquidity	.0136	.0187***
	(1.0832)	(.0033)
Control variables	Yes	Yes
Firm dummies	Yes	Yes
Day-period dummies	Yes	Yes
Observations	2277	8349
R-squared	.9554	.9315

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

The results in Table 5 present *significant and positive coefficients* for *JIS×DIV×COVID* in both the *collapsed (0.0221)* and *post-collapsed windows (0.0146)*, indicating a *positive moderating effect* of *digital innovation* on *Shariah compliance*. These suggest that firms that were both *Shariah-compliant* and adopted *digital innovation* during COVID-19 experienced an even greater *positive impact* on their *stock performance (CAR)* compared to firms with only one of these characteristics. These results highlight the potential of *digital innovation* to *strengthen the resilience of Shariah-compliant firms* during times of crisis.

Furthermore, the *positive and significant coefficient for JIS×COVID* in the *post-collapsed window (0.0077)* provides additional evidence that *Shariah-compliant firms* demonstrated *greater resilience* during the crisis. However, the coefficient in the *collapsed window (0.0032)* is insignificant, suggesting a *possible delayed effect of Shariah compliance* on *stock performance*. As noted by Wahyono (2022), this *delayed positive*

impact may stem from *government incentives*, such as *tax benefits* for *Shariah-compliant firms* during crises, which were only announced *after the collapsed window*. These incentives likely *enhanced* the *attractiveness of Shariah-compliant firms* to investors, thereby *boosting their performance*.

The *positive and significant coefficients for DIV×COVID* in both windows (*0.030 and 0.037*) further confirm the *beneficial impact of digital innovation* on *stock performance* during the pandemic, consistent with the initial analysis. Additionally, the coefficients for *most control variables* align with expectations. *Firm size, volatility, leverage, and liquidity* significantly influence *CAR*, with *size and liquidity* exerting *positive effects*, while *volatility* and *leverage* have *negative effects*.

These findings support the hypotheses that *both Shariah compliance* and *digital innovation contribute to enhanced stock performance* during crises. Notably, the *positive and significant triple interaction term (JIS×DIV×COVID)* highlights the *moderating effect of digital innovation*, indicating that *Shariah-compliant firms* that adopted *digital transformation* during *COVID-19* experienced an *even greater positive impact* on their *stock performance*.

4.3. Analyzing the Mechanism: The Moderating Effect of Financial Constraints

Building on the established link between *Shariah compliance, digital innovation, and stock performance* during COVID-19 (Tables 4 & 5), this section explores the underlying mechanism driving this association, focusing on *financial constraints*. To measure financial constraints, we use the *Size-Age Index* (*SAI*) as the dependent variable, a widely adopted proxy for firms' financing limitations (Hadlock & Pierce, 2010; Whited & Wu, 2006).

Table 6.
Financial Constraints as Mechanism

Dependent variable: Size-Age Index (SAi)	Collapsed Window	Post-collapsed	Collapsed Window	Post-collapsed
	(1)	(2)	(3)	(4)
JIS×COVID	0.000*	.0024***		
	(.000)	(.0003)		
DIV×COVID			0.000	.0031***
			(.000)	(.0002)
JIS	1.3219***	.0727***		
	(.000)	(.0165)		
DIV			-.0365***	.0967***
			(.000)	(.0167)
COVID	0.000***	-.0031***	0.000***	-.0033***
	(.000)	(.0011)	(.000)	(.0011)
Size	.4432***	.7391***	.7896***	.7373***
	(.000)	(.0018)	(.000)	(.0019)
Age	-.3993***	-.2615***	-.394***	-.2777***
	(.000)	(.0148)	(.000)	(.0147)
ROA	-2.2832***	-.1131***	2.7359***	-.1074***
	(.000)	(.0075)	(.000)	(.0074)

Table 6.
Financial Constraints as Mechanism (Continued)

Dependent variable: Size-Age Index (SAi)	Collapsed Window	Post-collapsed	Collapsed Window	Post-collapsed
	(1)	(2)	(3)	(4)
RND	-.129***	.0005***	-.0221***	.0002***
	(.000)	(.0001)	(.000)	(.0001)
Vola	0***	-.0861***	0***	-.0576***
	(.000)	(.0132)	(.000)	(.0134)
Leverage	-.2135***	-.0332***	.1742***	-.0327***
	(.000)	(.0039)	(.000)	(.0039)
Liquidity	-.007***	.0018***	-.0008***	.0021***
	(.000)	(.0002)	(.000)	(.0002)
_cons	-7.7895***	-13.2776***	-13.496***	-13.1722***
	(.000)	(.0645)	(.000)	(.0661)
Firm dummies	Yes	Yes	Yes	Yes
Day-period dummies	Yes	Yes	Yes	Yes
Observations	2277	8349	2277	8349
R-squared	.9999	.9999	.9999	.9999

Robust standard errors are in parentheses.

*** p<.01, ** p<.05, * p<.1

Table 6 presents the results, showing that the coefficient for COVID is negative and significant only in *the post-collapsed window*, suggesting that financial constraints became more pronounced as the economic downturn persisted. This finding aligns with prior research indicating that while firms may initially rely on internal liquidity buffers or short-term credit access during a crisis, prolonged economic disruptions increase financing difficulties over time (Espinosa-Méndez et al., 2023; Hu, 2023; Zhang et al., 2023).

Shariah compliance (JIS) and *digital innovation (DIV)* exhibit different impacts on financial constraints across the two periods. In the *collapsed window*, neither *JIS* nor *DIV* significantly affects *SAI*, suggesting that these factors do not immediately alleviate financial constraints at the peak of the crisis. This result is consistent with the notion that in the early stages of a financial crisis, heightened uncertainty limits firms' ability to leverage their compliance status or technological capabilities for financial relief (Beck et al., 2013; M. Hasan & Dridi, 2011; Md. B. Hasan et al., 2022). Additionally, the strong governance and financial discipline associated with *Shariah-compliant firms* likely enhance investor and lender confidence, contributing to improved financing opportunities during the recovery period (Ramadani, 2020).

Similarly, *digital innovation (DIV)* significantly reduces financial constraints in the *post-collapsed window*, suggesting that firms investing in digital transformation are better positioned to adapt and improve their financial health over time. This finding aligns with *Dynamic Capabilities Theory* (Teece et al., 1997), which posits that firms that develop and deploy technological capabilities can reconfigure resources to respond to external shocks, leading to long-term resilience (Krishnan et al., 2024; X. Wu et al., 2024). While *digital innovation* requires high initial investment,

it enhances efficiency, market reach, and cost management, ultimately improving firms' financial standing.

Moreover, the interaction terms *JIS×COVID* and *DIV×COVID* are positive and significant in the *post-collapsed window*, confirming that *digital innovation* amplifies the positive influence of *Shariah compliance* on financial constraints. This suggests that firms combining strong ethical governance with *technological advancements* are better positioned to maintain financial stability. Prior research highlights that *digital tools* improve *transparency* and *accountability*, reinforcing investor confidence in firms with *strong ethical* foundations (Hassan et al., 2022; Hooda et al., 2024).

These findings indicate that in the later stages of the pandemic, *Shariah-compliant* firms benefit from gradually implemented financial support measures, reducing financial constraints. Meanwhile, *digital innovation*, though initially financially burdensome, ultimately enhances firms' financial resilience, underscoring the importance of long-term investment in technology.

Overall, the results suggest that financial constraints play a critical role in the relationship between *Shariah compliance*, *digital innovation*, and *stock performance*. *Shariah compliance* helps alleviate *financial constraints*, while *digital innovation*, despite presenting initial financial challenges, ultimately strengthens firms' financial position. Additionally, *digital innovation* enhances the *financial stability* of *Shariah-compliant* firms, reinforcing the importance of integrating both factors for long-term sustainability.

4.4. Robustness Checks

To solidify the credibility of our results and address potential concerns about the chosen measures and timeframe, we conduct two robustness tests (Tables 7 and 8). These tests ensure that our conclusions are independent of specific methodological choices.

4.4.1. Alternative Measure of Shariah Compliance

Our primary analysis utilizes the *JII index* to quantify *Shariah compliance*. However, to confirm that our findings are not specific to this measure, we conduct a robustness test using the *JII70* index as an alternative indicator (Table 7). The *JII70 index* incorporates stricter criteria for *Shariah-compliant* firms, potentially offering a more refined measure.

By replicating the *DID regression* with *JII70*, we achieved two key objectives:

- **Proxy Independence**: We verify that our conclusions hold regardless of the specific *Shariah compliance* measure used. This strengthens the generalizability of our results and reduces the risk that a particular index's idiosyncrasies drive the results.
- **Confirmation of Positive Effect**: If the positive impact of *Shariah compliance* on *stock performance* persists with the stricter *JII70 index*, it increases our confidence that this relationship is genuine and not an artifact of the chosen measure.

Table 7.
JIS 70 DID Regression

Dependent variable: Cumulative abnormal return (*CAR*)	Collapsed Window	Post-collapsed	Collapsed Window	Post-collapsed
	(1)	(2)	(3)	(4)
JIS70×COVID	.0231***	.0227***		
	(.0056)	(.0039)		
DIV×COVID			.042***	.0456***
			(.0046)	(.0031)
JIS70	.0714***	-.448***		
	(.0176)	(.1606)		
DIV			.058***	-.2111
			(.0175)	(.1597)
COVID	.392***	-.1632***	.3942***	-.1646***
	(.0159)	(.0203)	(.0157)	(.0202)
Size	.0389***	.0985***	.018**	.0857***
	(.0058)	(.0168)	(.0081)	(.0165)
Age	-.0527***	.2107	-.0129	.0283
	(.0126)	(.1302)	(.0127)	(.129)
ROA	-.8328***	-.3076***	-.5898***	-.2961***
	(.2465)	(.068)	(.195)	(.0665)
RND	.0028*	.0031***	.0074***	-.0005
	(.0015)	(.001)	(.0018)	(.001)
Vola	10.035***	2.1033***	10.047***	2.4099***
	(.8347)	(.2953)	(.834)	(.2798)
Leverage	.0778*	-.1037**	.1302***	-.0931**
	(.0455)	(.0413)	(.0497)	(.0398)
Liquidity	.0267***	.0201***	.0423***	.0202***
	(.0027)	(.0032)	(.0035)	(.0034)
_cons	-.6701***	-2.7646***	-.5277***	-1.7018***
	(.0609)	(.6428)	(.0824)	(.6401)
Firm dummies	Yes	Yes	Yes	Yes
Day-period dummies	Yes	Yes	Yes	Yes
Observations	2277	8349	2277	8349
R-squared	.9038	.8801	.9057	.8818

Robust standard errors are in parentheses.

*** p<.01, ** p<.05, * p<.1

As expected, Table 7 displays a positive coefficient for *JIS70×COVID*. This reinforces our initial findings, indicating that *Shariah-compliant* firms (as measured by *JII70*) exhibit greater resilience during the crisis window. Additionally, the positive effect on *digital innovation* (*DIV*) remains significant in this robustness test.

4.4.2. Extended Window Analysis

The primary analysis uses standard *CAR windows* to focus on a specific timeframe around the *COVID-19* event. However, the impact of a major event like a pandemic

might not be fully captured within a short window. We conduct a robustness test to address this concern using an *extended window* period of **[-90, 90] days** around the *COVID-19* event (Table 8). This extended window allows us to capture potential *delayed effects* that might not be evident in the shorter timeframe used for *CAR calculations*.

Table 8.
DID and Triple Difference Regression for Extended Window

Dependent variable: Cumulative abnormal return (*CAR*)	**Extended Window**	**Extended Window**	**Extended Window**
JIS70×DIV×COVID	-	-	.0353***
			(.0059)
JIS70×COVID	.0236***	-	.011***
	(.0031)		(.0037)
DIV×COVID		.042***	-.0034
		(.0046)	(.0051)
JIS70	.0231	-	-
	(.0746)	-	
DIV		.058***	-
		(.0175)	
DJIS70			-.3338
			(.3848)
COVID	-.1212***	.3942***	
	(.013)	(.0157)	
Size	.0607***	.018**	.0617***
	(.0121)	(.0081)	(.0122)
Age	-.1358**	-.0129	-.1529***
	(.0538)	(.0127)	(.0541)
ROA	.259***	-.5898***	.2465***
	(.0182)	(.195)	(.018)
RND	-.0034***	.0074***	-.0032***
	(.0006)	(.0018)	(.0006)
Vola	.8198***	10.047***	.8729***
	(.2079)	(.834)	(.2076)
Leverage	.001	.1302***	.0043
	(.0179)	(.0497)	(.0177)
Liquidity	-.0051**	.0423***	-.0039
	(.0025)	(.0035)	(.0025)
_cons	-.4256	-.5277***	-
	(.3062)	(.0824)	
Firm dummies	Yes	Yes	Yes
Day-period dummies	Yes	Yes	Yes
Observations	12489	2277	12489
R-squared	.8604	.9057	.8968

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

The results in Table 8 continue to support our initial findings. *Shariah compliance (JIS70)* and *digital innovation* remain crucial for *stock performance* during crises. Notably, the positive effects of these factors become more pronounced in the extended window analysis. This suggests that the *long-term benefits* of *digital innovation* for *Shariah-compliant* firms may take time to materialize.

In summary, the robustness checks validate our initial findings, emphasizing the importance of *Shariah compliance* and *digital innovation* for firm performance during crises. Shariah compliance and digital innovation function as complementary safeguards, enhancing stock market resilience and fostering long-term value creation.

V. CONCLUSIONS AND RECOMMENDATIONS

Our study for Indonesia explores the link between *Shariah compliance*, *digital innovation*, and stock performance during the COVID-19 pandemic. The findings suggest that both characteristics act as safeguards, enhancing firms' resilience during crises. *Shariah compliance* is associated with improved stock performance during the crisis window, likely due to access to alternative financing channels and robust risk management practices. *Digital innovation* shows a positive long-term impact, indicating that investments in digital transformation require time to yield benefits. *Financial constraints* play a crucial mediating role—while *digital innovation* may initially exacerbate these constraints, it ultimately contributes to improved financial health. In contrast, *Shariah compliance* appears to alleviate financial constraints during turbulent periods.

Based on these insights, we offer several practical and feasible recommendations. First, practitioners should actively combine *Shariah-compliant* practices with targeted *digital innovation* initiatives to build a resilient operational framework. Recognizing that *digital transformation* is a long-term investment, firms are encouraged to adopt a phased implementation strategy, allowing for gradual integration and continuous refinement. Second, firms should develop *financial strategies* to mitigate the short-term costs associated with *digital innovation*, while regulatory bodies should refine frameworks to support *digital innovation* and *Shariah compliance*, fostering a more stable and resilient financial market. Third, establishing clear guidelines that assist firms in aligning their *digital transformation* efforts with *Shariah compliance* can ensure sustainable growth. Implementing *incentivization programs* or *alternative financing options* could alleviate initial financial constraints and further encourage investment in *digital innovation*.

Lastly, future research directions could extend studies to diverse geographical regions to validate and generalize these findings across different market environments. Conducting detailed *case studies* on *digital transformation* initiatives within *Shariah-compliant firms* could provide best practices and critical success factors. Additionally, exploring the *heterogeneity* in firms' capabilities regarding *Shariah compliance* and *digital readiness* may offer deeper insights into their differential impacts on stock performance. Despite certain limitations, our findings provide valuable insights into how firms can strategically integrate *Shariah compliance* and *digital innovation* to enhance resilience and long-term financial stability.

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