APTISI Transactions on Technopreneurship (ATT)
Vol. 7, No. 2, July 2025, pp. 676−686
E-ISSN: 2656-8888 | P-ISSN: 2655-8807, DOI:10.34306

Macroeconomic and Price of Oil and Gold on Liabilities of Hajj Fund Management Agency

Lilies Sulistyowati[1*], Muhammad Zilal Hamzah[2], Nirdukita Ratnawati[3]
[1,2,3]Professor of Economics, Universitas Trisakti, Indonesia
[1]lilies.sulistyowati@yahoo.com, [2]mhd_zilal_hamzah@trisakti.ac.id, [3]nirdukita.ratnawati@trisakti.ac.id
***Corresponding Author**

Article Info

Article history:

Submission November 8, 2024
Revised February 7, 2025
Accepted August 28, 2025
Published September 4, 2025

Keywords:

Inflation
Exchange Rate
Oil Price
Gold Price
Liabilities

ABSTRACT

This study examines the influence of macroeconomic variables on the sustainability of hajj funds managed by the Indonesian Hajj Financial Management Agency (BPKH). Using monthly data from 2019-2023, the research employed multiple linear regression analysis followed by dynamic systems modeling to assess fund sustainability. The regression **results** show that GDP growth and exchange rates positively influence hajj fund assets ($p<0.05$), while BI-7 Day Reverse Repo Rate, inflation, and Jakarta Islamic Index negatively affect fund assets. Dynamic system simulations reveal that under current conditions (ROI 6.78%, subsidy portion 40%), hajj funds will face deficit by 2030. However, optimistic scenarios with increased ROI to 10% and reduced subsidy portions to 20% ensure fund sustainability until 2050, with assets reaching IDR 569 trillion. These **findings** suggest that BPKH should enhance investment portfolio returns while the government should reconsider subsidy allocation policies to ensure long-term sustainability of hajj fund management in Indonesia.

DOI: https://doi.org/10.34306/att.v7i2.533

1. INTRODUCTION

The Indonesian hajj fund management system faces an unprecedented sustainability crisis that threatens the financial security of over 5.3 million prospective pilgrims. As the world largest Muslim nation, Indonesia contributes 12.7% of global Muslim population, yet only 221,000 citizens can perform hajj annually due to Saudi Arabian quota restrictions [1]. This massive demand-supply imbalance has created waiting periods extending up to 46 years, transforming hajj fund management from a short-term financial service into a complex long-term investment challenge requiring sophisticated financial engineering [2, 3].

The establishment of BPKH in 2017 marked a paradigm shift from bureaucratic management by the Ministry of Religious Affairs to professional investment management. Within six years, BPKH Assets Under Management (AUM) grew from IDR 65.4 trillion to IDR 166 trillion, representing one of the world largest faith-based investment funds [1]. However, this apparent success masks a fundamental sustainability crisis: the fund investment returns (benefit values) averaging 6.78% annually cannot match hajj cost escalations of 9.1% per year, creating a structural deficit that threatens long-term viability. The phenomenon gap becomes evident when examining the financial dynamics [4]. In 2023, BPKH subsidized IDR 40 million (44.7%) of the IDR 90 million per-pilgrim cost, requiring IDR 9.1 trillion from investment returns. However, actual returns

generated only IDR 10.1 trillion, which after deducting IDR 2.3 trillion for virtual account distributions to waiting pilgrims, resulted in a IDR 1.3 trillion deficit [5]. This deficit was covered by ”savings” from the COVID-19 period when no pilgrimages occurred, but such reserves are rapidly depleting [6].

The sustainability crisis is exacerbated by three interconnected factors. First, 86% of hajj costs are denominated in foreign currencies (USD for flights, SAR for Saudi services), creating significant exchange rate exposure. Second, the political economy of subsidy determination involves annual negotiations between the Ministry of Religious Affairs and Parliament, often prioritizing short-term political gains over long-term sustainability. Third, existing regulations limit BPKH investment options, with 96.9% of portfolios concentrated in low-yielding government sukuk averaging 5-6% returns, insufficient to match cost escalations.

Despite the critical nature of this sustainability challenge, existing research exhibits significant gaps in understanding the complex dynamics of hajj fund management. Previous studies have adopted fragmented approaches, examining individual factors in isolation without capturing systemic interactions. Elshafei, analyzed oil prices and exchange rates impact on hajj costs but ignored the broader macroeconomic environment and investment performance [7]. Similarly, Salatalohy and Wibowo examined inflation and interest rates effects on sukuk returns but limited their analysis to the 2010-2018 period without considering long-term sustainability [8]. Investigated Islamic equity market performance but failed to connect market dynamics to hajj fund management strategies [9].

Existing research overlooks several key aspects. No study has integrated multiple macroeconomic variables to assess their simultaneous impact on hajj fund sustainability or used dynamic systems modeling to capture feedback loops and non-linear relationships. Additionally, long-term scenario simulations that identify tipping points and sustainability thresholds are lacking. The relationship between regulatory constraints and investment performance remains unexplored, and no research combines quantitative modeling with policy analysis to offer actionable recommendations for addressing the sustainability crisis.

International comparative studies further reveal this gap significance. Malaysia Tabung Haji, established in 1963, faced similar challenges and required government bailouts of MYR 19.9 billion in 2018 due to unsustainable investment practices [10]. In contrast, Singapore MUIS adopted dynamic asset allocation strategies achieving 8-10% returns while maintaining capital preservation [11, 12]. Despite these instructive cases, no research has systematically analyzed how these international experiences apply to Indonesia unique demographic and regulatory context, leaving policymakers without evidence-based guidance for reform.

This study introduces three novel contributions to the literature on faith-based fund management and Islamic finance. The first contribution lies in methodological innovation through the integration of econometric analysis with system dynamics modeling. While previous studies employed static regression models assuming linear relationships, this research develops a dynamic systems approach that captures feedback loops, time delays, and non-linear interactions between macroeconomic variables, investment performance, and policy decisions. This methodology, adapted from industrial and environmental systems modeling, represents the first application of such comprehensive analytical framework to hajj fund management, offering a more nuanced understanding of complex financial dynamics.

The second contribution advances theory Triple Bottom Line framework to Islamic finance contexts [13–15]. This study demonstrates how the profit-people-planet trinity translates into specific hajj fund management dimensions: investment returns representing financial sustainability, pilgrim welfare (maslahah) embodying social responsibility, and intergenerational equity ensuring environmental and temporal justice. This theoretical extension is grounded in Tawhidi String Relation (TSR) theory, showing how Islamic epistemology guides sustainable financial management through the integration of divine guidance with empirical analysis [16–18]. By bridging Western sustainability concepts with Islamic financial principles, this research creates a novel theoretical framework applicable to other faith-based investment contexts [19].

The third contribution provides practical significance through evidence-based policy simulations revealing previously unknown sustainability thresholds. The findings that current policies lead to fund depletion by 2030, while specific combinations of 10% ROI and 20% subsidy ratios ensure sustainability through 2050, offer precise targets for policymakers. This precision in policy prescription, derived from rigorous modeling rather than intuition or political compromise, provides actionable guidance for preventing a looming financial crisis affecting millions of Muslims. The simulation results enable policymakers to understand the long-term consequences of their decisions and make informed choices balancing immediate political pressures with intergenerational responsibilities.

2. LITERATURE REVIEW

2.1. Theoretical Framework

The theoretical foundation of this study draws Triple Bottom Line concept [13], emphasizing the integration of profit, people, and planet for organizational sustainability. In the context of BPKH, "profit" translates to investment returns that must be optimized while maintaining shariah compliance and social responsibility toward pilgrims [20, 21].

From an Islamic perspective, the Tawhidi String Relation (TSR) theory provides guidance for achieving maslahah (public interest) through the induction of knowledge based on the principles of the Qur'an [22]. This framework emphasizes that sustainable management of Hajj funds must balance financial gain with social welfare and religious obligations.

2.2. Macroeconomic Factors and Fund Management

Previous research has demonstrated a relationship between macroeconomic variables and investment performance. Exchange rate stability significantly impacts cross-border investment returns. In the context of the Hajj, this is particularly relevant, as 86% of Hajj costs are denominated in foreign currencies (USD and SAR) [23].

Inflation impact on fund management has been documented, who found that inflation erodes purchasing power and affects long-term fund sustainability. For hajj funds, this translates to reduced real returns and increased pressure on subsidy allocations [24, 25].

The influence of monetary policy through central bank rates has been examined by Hudaya and Firmansyah [6], showing that interest rate changes affect both investment returns and operational costs. For BPKH, which invests primarily in shariah-compliant instruments, these effects are transmitted through Islamic banking rates and sukuk yields.

2.3. Islamic Finance and Hajj Fund Management

Islamic finance principles prohibit riba (interest), gharar (excessive uncertainty), and maysir (gambling), requiring hajj funds to be invested in shariah-compliant instruments [26]. The Jakarta Islamic Index (JII) serves as a benchmark for shariah-compliant equity investments in Indonesia, comprising the 30 most liquid Islamic stocks [27–29].

Studies on hajj fund management in other countries provide comparative insights. Malaysia Tabung Haji, established in 1963, offers lessons in balancing commercial returns with social obligations [8]. However, Indonesia unique demographic and regulatory environment requires tailored approaches to ensure sustainability.

2.4. Hypothesis Development

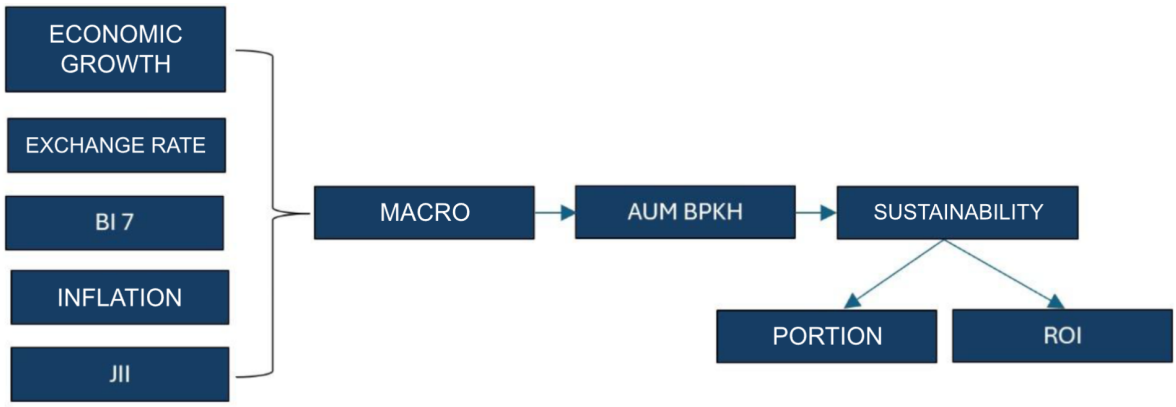

Figure 1. Theoritical Framework

Based on the theoretical framework and empirical evidence from previous studies, we develop the following hypotheses regarding the influence of macroeconomic variables on hajj fund sustainability as illustrated in Figure 1.

Economic growth, measured through GDP, represents the overall health of the economy and influences citizens financial capacity. Economic prosperity enhances individuals ability to save for religious obligations. In the Indonesian context, higher GDP growth translates to increased disposable income, enabling more citizens to register for hajj and maintain their savings [23]. Additionally, a robust economy provides BPKH with better investment opportunities and more stable returns.

H1: GDP growth has a positive and significant influence on BPKH fund assets.

The exchange rate plays a crucial role in hajj fund management as 86% of hajj costs are denominated in foreign currencies (USD for flights and SAR for Saudi Arabian services). While a weaker rupiah increases operational costs, it paradoxically benefits BPKH foreign currency investments and reserves. When BPKH holds assets in foreign currencies, rupiah depreciation increases the rupiah value of these holdings, potentially offsetting increased operational costs [27].

H2: Exchange rate (IDR/USD) has a positive and significant influence on BPKH fund assets.

The BI-7 Day Reverse Repo Rate serves as the benchmark for Islamic banking returns and affects sukuk valuations. Higher policy rates typically lead to increased yields on new fixed-income investments but reduce the market value of existing sukuk holdings through the inverse price-yield relationship. Since BPKH portfolio is heavily weighted toward sukuk (96.9% in SBSN), rate increases can significantly impact portfolio valuations [6, 28].

H3: BI-7 Day Reverse Repo Rate has a negative and significant influence on BPKH fund assets.

Inflation erodes the purchasing power of financial assets and reduces real investment returns. For hajj funds, persistent inflation poses a dual challenge, it increases operational costs while simultaneously reducing the real value of investment returns. Vukonic demonstrated that inflation particularly impacts long-term savings programs like hajj funds. In the Indonesian context, where hajj waiting periods extend up to 46 years, inflation protection becomes critical for maintaining fund sustainability [29].

H4: Inflation has a negative and significant influence on BPKH fund assets.

The Jakarta Islamic Index (JII) represents the performance of shariah-compliant equities in Indonesia. While equity investments offer potential for higher returns, they also introduce volatility to the portfolio. During market downturns, negative sentiment in Islamic capital markets can reduce portfolio values and create pressure on fund stability. Prasetyo et al. found that Islamic equity indices are sensitive to both domestic and global economic conditions, potentially amplifying portfolio risks during turbulent periods [24, 27]

H5: Jakarta Islamic Index has a negative and significant influence on BPKH fund assets.

Drawing from Elkington Triple Bottom Line theory and the concept of intergenerational equity in Islamic finance, sustainable hajj fund management requires balancing current benefits with long-term preservation. The sustainability of BPKH funds depends on maintaining positive net cash flows where investment returns exceed subsidy allocations and operational costs [4, 30].

H6: BPKH fund assets have a significant influence on the long-term sustainability of hajj fund management.

3. RESEARCH METHODOLOGY

This study employs a mixed-methods approach that combines quantitative analysis through multiple linear regression with dynamic systems modeling to examine the relationships between macroeconomic variables and hajj fund assets while projecting long-term sustainability scenarios [31]. The research was conducted in two distinct phases, the first phase focused on establishing statistical relationships between key macroeconomic indicators and hajj fund performance, while the second phase developed comprehensive dynamic system simulations to forecast various sustainability scenarios under different economic conditions [6, 32].

The data collection process involved gathering monthly time-series data spanning from January 2019 to December 2023, sourced from official and authoritative institutions to ensure data reliability and validity. Gross Domestic Product (GDP) data were obtained from the Central Statistics Agency (BPS), while exchange rates and the BI-7 Day Reverse Repo Rate were collected from Bank Indonesia official databases [33, 34]. Inflation data, measured through the Consumer Price Index (CPI), were also sourced from BPS, and the Jakarta Islamic Index values were retrieved from the Indonesia Stock Exchange. The BPKH fund data, representing the core dependent variable of the study, were extracted from audited financial reports to ensure accuracy and transparency in the analysis [35, 36].

The multiple linear regression analysis was designed to examine the complex relationships between macroeconomic indicators and the performance of hajj fund assets managed by BPKH. The theoretical foun-

dation for variable selection was grounded in financial economics literature, particularly portfolio theory and macroeconomic impact studies on institutional fund management [37, 38]. The econometric model specification follows the general form of multivariate regression analysis, where the dependent variable is explained by a linear combination of independent variables plus a stochastic error term [39]. The operational definitions and measurements of all variables used in this study are presented in Table 1 below, which provides a comprehensive framework for understanding the empirical analysis:

Table 1. Operational Variable Definitions and Measurements

Variable	Operational Definition	Measurement	Scale	Data Source	Expected Sign
		Dependent Variable			
AUM	Assets Under Management representing the total value of hajj funds managed by BPKH	Total fund value in trillion IDR at the end of each month	Ratio	BPKH Audited Financial Reports	-
		Independent Variables			
GDP	Economic growth indicator measuring the rate of change in total economic output	Year-on-year percentage change in real GDP	Ratio	Central Statistics Agency (BPS)	Positive (+)
KURS	Exchange rate of Indonesian Rupiah against US Dollar reflecting currency stability	Monthly average IDR/USD exchange rate	Ratio	Bank Indonesia	Positive (+)
RATE	Monetary policy rate representing the cost of capital and investment returns	BI-7 Day Reverse Repo Rate in percentage	Ratio	Bank Indonesia	Negative (-)
INFL	General price level changes affecting purchasing power and real returns	Year-on-year percentage change in Consumer Price Index	Ratio	Central Statistics Agency (BPS)	Negative (-)
JII	Islamic capital market performance indicator	Monthly closing index value	Ratio	Indonesia Stock Exchange	Positive (+)

Source : [40–42]

The regression model is formally specified as:

$$AUM_t = \beta_0 + \beta_1 \text{GDP}_t + \beta_2 \text{KURS}_t + \beta_3 \text{RATE}_t + \beta_4 \text{INFL}_t + \beta_5 \text{JII}_t + \varepsilon_t \quad (1)$$

Where:

- t denotes the time period (monthly observations).
- β_0 represents the intercept term.
- β_1 through β_5 are the partial regression coefficients measuring the marginal effect of each independent variable on AUM.
- ε_t is the stochastic error term assumed to follow normal distribution with zero mean and constant variance.

4. RESULT AND DISCUSSION

4.1. Regression Analysis Results

The empirical analysis reveals significant relationships between macroeconomic variables and BPKH fund assets [43]. Table 2 presents the regression results examining the influence of economic indicators on Assets Under Management (AUM).

Table 2. Multiple Linear Regression Results: Macroeconomic Determinants of BPKH Fund Assets

Variable	Coefficient	Standard Error	t-statistic	p-value
Constant	148,892.3	12,345.6	12.06	0.0000
GDP	3.07E-05	1.77E-06	17.33	0.0000***
KURS	0.003511	0.000296	12.10	0.0401**
RATE	-738.133	77.378	-9.54	0.0000***
INFL	-195.124	75.923	-2.57	0.0129**
JII	-0.0336	0.0166	-2.03	0.0476**

Model Summary: $R^2 = 0.941$; Adjusted $R^2 = 0.935$; F-statistic = 171.01 ($p < 0.0001$); Durbin-Watson = 1.892; Note: ***p < 0.01, **p < 0.05, *p < 0.10.

The model demonstrates strong explanatory power with an R^2 of 0.941, indicating that 94.1% of the variation in BPKH fund assets is explained by the selected macroeconomic variables [22, 44, 45]. All variance inflation factors remain below the critical threshold of 10, confirming the absence of severe multicollinearity [46].

4.2. Dynamic Systems Simulation Results

The dynamic systems analysis extends beyond static regression to examine long-term sustainability trajectories under different policy scenarios. Table 3 presents the simulation results for three scenarios spanning 2024-2050.

Table 3. Dynamic Simulation Results: Fund Sustainability Scenarios

Scenario	Key Assumptions	2025 AUM (IDR Trillion)	AUM 2030 (IDR Trillion)	AUM 2040 (IDR Trillion)	AUM 2050 (IDR Trillion)	AUM Break-Even Year	Sustainability Status
	ROI	Subsidy					
Normal	6.78%	40%	220.4	230.1	195.3	142.7	2029
Pessimistic	5.00%	60%	159.2	98.5	45.2	12.3	2025
Optimistic	10.00%	20%	245.8	318.7	435.2	569.1	N/A

The empirical findings provide new insights into the complex dynamics governing hajj fund sustainability in Indonesia. The positive influence of GDP growth ($\beta = 3.07E-05, p < 0.001$) on fund assets aligns with [47] theoretical framework, confirming that economic prosperity directly enhances citizens capacity to save for religious obligations. This relationship is particularly significant given Indonesia sustained economic growth trajectory, suggesting that continued economic development will support fund expansion [48, 49].

The positive coefficient for exchange rate ($\beta = 0.003511, p < 0.05$) reveals a counterintuitive but economically rational finding. While rupiah depreciation increases operational costs for hajj services, it simultaneously enhances the rupiah value of BPJKH foreign currency holdings. This natural hedging mechanism, where 86% of hajj costs are foreign-denominated while significant assets are held in foreign currencies, provides an important risk management insight previously overlooked in the literature. The negative impact of monetary policy rates ($\beta = -738.133, p < 0.001$) on fund assets reflects the inverse relationship between interest rates and bond prices, particularly significant given BPJKH 96.9% allocation to government sukuk. This finding extends [50] work by quantifying the sensitivity of Islamic institutional portfolios to rate changes, highlighting the need for duration management strategies in sukuk-heavy portfolios.

The inflation effect ($\beta = -195.124, p < 0.05$) confirms [51] theoretical predictions about the erosion of real returns in long-term savings programs. With waiting periods extending to 46 years, the cumulative impact of inflation poses a fundamental challenge to fund sustainability, necessitating investment strategies to generate real returns above inflation. The negative influence of the Jakarta Islamic Index ($\beta = -0.0336, p < 0.05$) suggests that equity market volatility creates instability in fund values, supporting [7] findings on Islamic equity sensitivity. This result implies that while diversification into equities offers growth potential, it must be carefully balanced against volatility risks.

The dynamic simulation results reveal a critical sustainability challenge that static analyses cannot capture. Under current policies (6.78% ROI, 40% subsidy), the fund faces deficits by 2030, with AUM declining from a peak of IDR 232 trillion to unsustainable levels. This finding directly addresses the research gap identified by [52, 53] regarding long-term fund viability, demonstrating that current operational parameters are insufficient for intergenerational equity. The optimistic scenario demonstrates that achieving sustainability requires simultaneous improvements in investment returns (10% ROI) and subsidy efficiency (20% allocation). This finding contributes to policy discourse by quantifying the specific targets needed for fund sustainability, moving beyond general recommendations to actionable benchmarks [54, 55].

These results contribute to the broader literature on Islamic social finance by demonstrating how macroeconomic management and investment strategies must be integrated for sustainable religious fund management. This study extends the Triple Bottom Line framework to a religious context, demonstrating that financial sustainability enables both social (affordable access to Hajj) and spiritual (fulfillment of religious obligations) goals [56, 57]. For Indonesian society, these findings have profound implications. The potential fund deficit threatens the accessibility of hajj pilgrimage for millions of citizens, particularly those from lower economic segments who rely on subsidies [58]. The research demonstrates that proactive policy adjustments are essential to prevent a crisis that would affect not only individual religious aspirations but also social equity and national stability [59].

The methodological contribution of combining regression analysis with dynamic systems modeling provides a template for analyzing other long-term sustainability challenges in developing countries facing similar socioeconomic constraints. This study offers new perspectives on balancing religious obligations with financial sustainability, highlighting the need for policy interventions that consider citizens' sensitivities and long-term welfare.

5. MANAGERIAL IMPLICATION

The evidence presented in this study underscores that ensuring hajj fund sustainability is not merely a technical financial challenge but a fundamental test of Indonesia ability to balance competing inter-generational interests while fulfilling religious obligations. The empirical findings provide policymakers and fund managers with quantitative foundations for evidence-based reforms essential to preserving this critical institution for future generations of Indonesian Muslims.

6. CONCLUSION

This study provides empirical answers to critical questions regarding the sustainability of Indonesia hajj fund management system. The research demonstrates that macroeconomic variables exert significant and measurable influences on BPKH fund assets, with each variable playing a distinct role in determining fund trajectory. Economic growth (GDP) and exchange rate movements positively contribute to fund expansion, with GDP growth enhancing citizens' saving capacity and currency depreciation increasing the value of foreign-denominated assets. Conversely, monetary policy rates, inflation, and Islamic capital market volatility negatively impact fund values, creating systematic risks that compound over extended waiting periods.

The integration of regression analysis with dynamic systems modeling reveals a fundamental sustainability challenge previously unquantified in the literature. Under current operational parameters specifically a 6.78% return on investment coupled with 40% subsidy allocations the fund faces depletion by 2030, directly threatening the religious aspirations of millions of Indonesian Muslims. The finding that only significant improvements in investment returns (achieving 10% ROI) combined with reduced subsidy burdens (maximum 20%) can ensure long-term viability provides clear empirical benchmarks for policy reform. This quantification of sustainability thresholds represents a key contribution to both Islamic finance literature and public policy discourse.

The study advances theoretical understanding by successfully adapting Elkington Triple Bottom Line framework to religious fund contexts, demonstrating how financial sustainability serves as the foundation for achieving social equity and spiritual fulfillment objectives. The methodological contribution of combining static econometric analysis with dynamic systems simulation offers a robust analytical framework applicable to other long-term social funds facing similar demographic and economic pressures.

7. DECLARATIONS

7.1. About Authors

Sulistyowati (SS) https://orcid.org/0009-0000-3287-1837

Muhammad Zilal Hamzah (MZ) https://orcid.org/0000-0001-6546-4736

Nirdukita Ratnawati (NR) https://orcid.org/0000-0002-1053-9339

7.2. Author Contributions

Conceptualization: SS and MZ; Methodology: NR; Software: SS; Validation: MZ; Formal Analysis: NR, SS, and MZ; Investigation: NR; Resources: SS; Data Curation: MZ; Writing Original Draft Preparation: NR and SS; Writing Review and Editing: SS, MZ, and NR; Visualization: SS; All authors, SS, MZ, and NR have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] A. Ben Amar, "On the role of islamic banks in the monetary policy transmission in saudi arabia," *Eurasian Economic Review*, vol. 12, no. 1, pp. 55–94, 2022.

[2] E. T. Asimeng and D. Heinrichs, "Why do paratransit operators resist participation in bus rapid transit? case evidence from bogota, mexico city, johannesburg and lagos," *Transport Reviews*, vol. 41, no. 1, pp. 115–135, 2021.

[3] S. Sylvia, "Sociopreneurship to reduce extreme poverty in the coastal areas of pangkajene islands: A literatur review," *Entrepreneurship and Small Business Research*, 2022.

[4] G. Cheng and C. He, "Analysis of bus travel characteristics and predictions of elderly passenger flow based on smart card data," *Electronic Research Archive*, vol. 30, no. 12, pp. 4256–4276, 2022.

[5] D. Ahmad, N. Lutfiani, A. D. A. R. Ahmad, U. Rahardja, Q. Aini *et al.*, "Blockchain technology immutability framework design in e-government," *Jurnal Administrasi Publik (Public Administration Journal)*, vol. 11, no. 1, pp. 32–41, 2021.

[6] S. Choi, D. Lee, S. Kim, and S. Tak, "Framework for connected and automated bus rapid transit with sectionalized speed guidance based on deep reinforcement learning: Field test in sejong city," *Transportation Research Part C: Emerging Technologies*, vol. 148, p. 104049, 2023.

[7] A. S. Mossalem Ahmed Elshafei, M. Shrahili, M. Kayid, and S. Mohammad, "Impact of fluctuations in global oil prices on saudi arabia's gross domestic product: A machine learning analysis," *Journal of Radiation Research and Applied Sciences*, vol. 18, no. 2, p. 101436, 2025.

[8] S. N. Mohd Roslen, M.-S. Chua, and R. A. Hj Mohd Ruslan, "Long-run asymmetric effects of financial risks on sukuk market development: empirical evidence from malaysia," *Journal of Islamic Accounting and Business Research*, 2024.

[9] A. Almaida, U. Abbas, W. Ahmad Watto, M. A. Asdullah, M. Fahlevi, D. Amrul Ichdan *et al.*, "The islamic effect: Exploring the dynamics of islamic events on sustainable performance of islamic and conventional stock markets," *Uncertain Supply Chain Management*, vol. 12, pp. 235–248, 2023.

[10] M. Afif, K. Zahro, N. S. Awaludin *et al.*, "Bridging waqf and sukuk: Cross-country insights from indonesia and malaysia on islamic social finance innovation," *Muslim Heritage*, vol. 10, no. 1, pp. 91–105, 2025.

[11] L. M. Franciosi, "Islamic finance and sustainable development: Key ethical features and proactive initiatives promoting financial inclusion: Islamic finance and sustainable development," *European Journal of Islamic Finance*, vol. 12, no. 2, pp. 30–47, 2025.

[12] J. Aripin, "Hajj fund investment: A comparative contemporary fiqh study on maslahah and public policy perspectives in indonesia," *MILRev: Metro Islamic Law Review*, vol. 4, no. 1, pp. 360–388, 2025.
[13] A. A. Jan, F.-W. Lai, and M. Tahir, "Developing an islamic corporate governance framework to examine sustainability performance in islamic banks and financial institutions," *Journal of Cleaner Production*, vol. 315, p. 128099, 2021.
[14] M. L. Hamidi and A. C. Worthington, "Islamic banking sustainability: theory and evidence using a novel quadruple bottom line framework," *International Journal of Bank Marketing*, vol. 39, no. 5, pp. 751–767, 2021.
[15] A. Jan, M. N. Mata, P. A. Albinsson, J. M. Martins, R. B. Hassan, and P. N. Mata, "Alignment of islamic banking sustainability indicators with sustainable development goals: Policy recommendations for addressing the covid-19 pandemic," *Sustainability*, vol. 13, no. 5, p. 2607, 2021.
[16] L. Raimi, "Do islamic epistemology and ethics advance the understanding and promotion of sustainable development? a systematic review using prisma," *International Journal of Ethics and Systems*, 2024.
[17] A. Susanto and T. Mariyanti, "Implementation of tawhidi string relations (tsr) on household consumption," *Indonesian Journal of Business, Accounting and Management*, vol. 4, no. 2, pp. 1–7, 2021.
[18] A. Susanti, D. Fatah, and Z. M. Ali, "An analysis of problems and solutions in the low level of cash waqf in indonesia using analytic network process (anp)," *Tazkia Islamic Finance and Business Review*, vol. 19, no. 1, pp. 22–64, 2025.
[19] M. Faza', N. Badwan, and M. Hamdan, "Determinants of effective shariah compliance auditing in palestine: a theoretical and conceptual analysis," *Journal of Money Laundering Control*, vol. 27, no. 5, pp. 845–857, 2024.
[20] C. De Villiers and R. Dimes, "Will the formation of the international sustainability standards board result in the death of integrated reporting?" *Journal of Accounting & Organizational Change*, vol. 19, no. 2, pp. 279–295, 2023.
[21] G. D. Carnegie, P. Ferri, L. D. Parker, S. I. Sidaway, and E. E. Tsahuridu, "Accounting as technical, social and moral practice: the monetary valuation of public cultural, heritage and scientific collections in financial reports," *Australian Accounting Review*, vol. 32, no. 4, pp. 460–472, 2022.
[22] R. Ahli, M. F. Hilmi, and A. Abudaqa, "The influence of leadership dynamics and workplace stress on employee performance in the entrepreneurial sector and the moderating role of organizational support," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 6, no. 3, pp. 300–313, 2024.
[23] I. G. N. A. Suaryana, N. Noviari, and I. G. A. E. Damayanthi, "The impact of indonesian financial accounting standard implementation, credit risk, and credit restructuring on allowance for credit losses in indonesia," *Banks and Bank Systems*, vol. 17, no. 3, p. 177, 2022.
[24] M. M. Saeed, "Corporate governance and international financial reporting standards compliance among ghanaian-listed companies," *International Journal of Managerial and Financial Accounting*, vol. 17, no. 3, pp. 331–348, 2025.
[25] Y. Xue, "Does an abnormal change in deferred tax assets interfere with analysts' earnings forecasts?" *China Journal of Accounting Research*, vol. 15, no. 3, p. 100255, 2022.
[26] H. Crisóstomo de Castro Filho, O. Abílio de Carvalho Júnior, O. L. Ferreira de Carvalho, P. Pozzobon de Bem, R. dos Santos de Moura, A. Olino de Albuquerque, C. Rosa Silva, P. H. Guimaraes Ferreira, R. Fontes Guimarães, and R. A. Trancoso Gomes, "Rice crop detection using lstm, bi-lstm, and machine learning models from sentinel-1 time series," *Remote Sensing*, vol. 12, no. 16, p. 2655, 2020.
[27] D. Perdana, S. A. Bin-Nashwan, A. Muneeza, and M. K. Hassan, "Financial sustainability challenges of hajj financial management agency (bpkh): What really matters?" in *Islamic Finance in Eurasia*. Edward Elgar Publishing, 2024, pp. 222–251.
[28] D. A. Damayanti, S. Muchsin *et al.*, "Analysis of dynamic governance in the implementation of hajj at the office of the ministry of religious affairs of blitar regency." *Journal Return*, vol. 3, no. 10, 2024.
[29] A. Aziz, R. M. Syam, M. Z. N. Hasbi, A. S. Prabuwono *et al.*, "Hajj funds management based on maqasid al-shari'ah; a proposal for indonesian context," *AL-IHKAM: Jurnal Hukum & Pranata Sosial*, vol. 18, no. 2, pp. 544–567, 2023.
[30] A. S. Putri and A. P. Priyono, "Impact of income tax exemption on bpkh's financial performance in hajj fund management (2018–2023)," *Akuntansi: Jurnal Akuntansi Integratif*, vol. 11, no. 01, pp. 56–74, 2025.
[31] Q. A. Qurotul Aini, M. B. Mukti Budiarto, P. Poh Putra, and U. R. Untung Rahardja, "Exploring e-learning challenges during the global covid-19 pandemic: A review," *Jurnal Sistem Informasi (Journal of*

Information System), vol. 16, no. 2, pp. 47–65, 2020.
[32] D. Subandi and Y. Machmudi, "The role of the governments of indonesia and saudi arabia in organizing the hajj pilgrimage 2015–2021," *Journal of Strategic and Global Studies*, vol. 5, no. 1, p. 4, 2022.
[33] A. S. Elnara, B. M. Elvan, D. P. Emine, and F. A. Saraswati, "Applications for systematic smart contracts on blockchain," *Blockchain Frontier Technology*, vol. 3, no. 1, pp. 1–6, 2023.
[34] F. A. Osra, J. S. Alzahrani, M. S. Alsoufi, O. A. Osra, and A. Z. Mirza, "Environmental and economic sustainability in the hajj system," *Arabian Journal of Geosciences*, vol. 14, no. 20, p. 2121, 2021.
[35] M. M. Aydin, "The modeling of effective parameters on public bus passengers' boarding time prediction," *Journal of Engineering Research*, vol. 10, no. 1B, pp. 1–16, 2022.
[36] F. Zulfikarijah and B. M. Santi, "Factor analysis of operations strategy at umrah and hajj bureaus," in *Economic Sustainability and Social Equality in the Technological Era*. Routledge, 2025, pp. 218–229.
[37] I. Maulid and A. Amirsyah, "Analysis of the hajj fund management based on the fatwa of the national sharia council (dsn) number 122 concerning the management of bpih fund and special bpih based on sharia principles," *ADI Journal on Recent Innovation*, vol. 3, no. 1, pp. 21–35, 2021.
[38] J. Jones, E. Harris, Y. Febriansah, A. Adiwijaya, and I. N. Hikam, "Ai for sustainable development: Applications in natural resource management, agriculture, and waste management," *International Transactions on Artificial Intelligence*, vol. 2, no. 2, pp. 143–149, 2024.
[39] M. M. Rahman, "Sample size determination for survey research and non-probability sampling techniques: A review and set of recommendations," *Journal of Entrepreneurship, Business and Economics*, vol. 11, no. 1, pp. 42–62, 2023.
[40] F. J. Hasanov, M. H. Al Rasasi, S. S. Alsayaary, and Z. Alfawzan, "Money demand under a fixed exchange rate regime: the case of saudi arabia," *Journal of Applied Economics*, vol. 25, no. 1, pp. 385–411, 2022.
[41] F. Chen, S. Ahmad, G. Jiang, and J. Chen, "Factors affecting textiles products exports of major producers: A gravity model approach," *Sage Open*, vol. 13, no. 4, p. 21582440231213688, 2023.
[42] M. A. Ramady, *Financial regulation and liberation: Saudi Arabia's path towards true global partnership*. Springer Nature, 2021.
[43] V. Sarastuti, R. L. Karunia, E. Hasan, and A. Shabri, "Hajj financial management operational analysis at ministry of religion affairs," *Journal of Business Administration Economics & Entrepreneurship*, pp. 15–27, 2022.
[44] M. Subhan, A. H. Anshary, F. Azhari, N. Haisy *et al.*, "Use of hajj funds for infrastructure development: A review of deposit contract and use of hajj funds," *Journal of Law and Sustainable Development*, vol. 11, no. 10, pp. e852–e852, 2023.
[45] N. Nagaraj, H. L. Gururaj, B. H. Swathi, and Y.-C. Hu, "Passenger flow prediction in bus transportation system using deep learning," *Multimedia tools and applications*, vol. 81, no. 9, pp. 12 519–12 542, 2022.
[46] S. A. P. Changir and D. Febriani, "Governance of the hajj financial management agency (bpkh) based on sharia governance principles," *Halal Tourism and Pilgrimage*, vol. 4, no. 1, 2024.
[47] N. K. Kundu and M. R. McKay, "Channel estimation for reconfigurable intelligent surface aided miso communications: From lmmse to deep learning solutions," *IEEE Open Journal of the Communications Society*, vol. 2, pp. 471–487, 2021.
[48] M. B. de Melo, D. Daldegan-Bueno, M. G. Menezes Oliveira, and A. L. de Souza, "Beyond anova and manova for repeated measures: Advantages of generalized estimated equations and generalized linear mixed models and its use in neuroscience research," *European Journal of Neuroscience*, vol. 56, no. 12, pp. 6089–6098, 2022.
[49] X. Zhai and Y. Shen, "Short-term bus passenger flow prediction based on graph diffusion convolutional recurrent neural network," *Applied Sciences*, vol. 13, no. 8, p. 4910, 2023.
[50] H. M. Lane and S. C. Murray, "High throughput can produce better decisions than high accuracy when phenotyping plant populations," *Crop Science*, vol. 61, no. 5, pp. 3301–3313, 2021.
[51] Z. Cheng, M. Trepanier, and L. Sun, "Real-time forecasting of metro origin-destination matrices with high-order weighted dynamic mode decomposition," *Transportation science*, vol. 56, no. 4, pp. 904–918, 2022.
[52] T. Nguyen Hoang, H. T. Do, D. H. Bui, D. K. Pham, T. A. Hoang, and D. N. Do, "Evaluation of non-linear growth curve models in the vietnamese indigenous mia chicken," *Animal Science Journal*, vol. 92, no. 1, p. e13483, 2021.
[53] P. M. dos Santos and M. Â. Cirillo, "Construction of the average variance extracted index for construct val-

idation in structural equation models with adaptive regressions," *Communications in Statistics-Simulation and Computation*, vol. 52, no. 4, pp. 1639–1650, 2023.

[54] Q. Ouyang, Y. Lv, J. Ma, and J. Li, "An lstm-based method considering history and real-time data for passenger flow prediction," *Applied Sciences*, vol. 10, no. 11, p. 3788, 2020.

[55] N. D. Noviati, S. D. Maulina, and S. Smith, "Smart grids: Integrating ai for efficient renewable energy utilization," *International Transactions on Artificial Intelligence*, vol. 3, no. 1, pp. 1–10, 2024.

[56] S. Pranata, K. Hadi, M. H. R. Chakim, Y. Shino, and I. N. Hikam, "Business relationship in business process management and management with the literature review method," *ADI Journal on Recent Innovation*, vol. 5, no. 1Sp, pp. 45–53, 2023.

[57] L. Xian and L. Tian, "Passenger flow prediction and management method of urban public transport based on sdae model and improved bi-lstm neural network," *Journal of Intelligent & Fuzzy Systems*, no. Preprint, pp. 1–15, 2023.

[58] J. Siswanto, V. A. Goeltom, I. N. Hikam, E. A. Lisangan, and A. Fitriani, "Market trend analysis and data-based decision making in increasing business competitiveness," *Sundara Advanced Research on Artificial Intelligence*, vol. 1, no. 1, pp. 1–8, 2025.

[59] J. M. Wooldridge, "Two-way fixed effects, the two-way mundlak regression, and difference-in-differences estimators," *Available at SSRN 3906345*, 2021.