

Fuzzy Agent-Based Modeling of Islamic Crowdfunding Platforms: Governance, Technology, Regulation, Trust, Digital Literacy, and Economic Stability in Advancing Financial Inclusion

Siti Fatimah Mohd Kassim¹, Muhammad Azizur Rahman Ramli², Siti Noradibah Md Zain³, Zurina Shafii⁴

^{1,2,3}Dr., Management and Science University, Department of Accounting and Finance, ⁴Prof, Dr., University Sains Islam Malaysia, Faculty of Economics and Muamalat

DOI Link: <http://dx.doi.org/10.6007/IJARAFMS/v15-i3/26216>

Published Online: 05 September 2025

Abstract

This study explores how platform transparency, Shariah governance quality, technological readiness, and regulatory support influence investor trust and, in turn, promote financial inclusion in Islamic crowdfunding platforms. Despite the rapid growth of this sector, limited research has explored the combined effects of these factors under conditions of uncertainty and behavioral complexity. To address this gap, a fuzzy agent-based simulation (FABS) model was developed using fuzzy logic in Python to capture the ambiguity inherent in human decision-making and regulatory environments. The simulation model's heterogeneous investor agents whose trust levels respond dynamically to platform characteristics, moderated by economic stability and digital literacy. Findings reveal that transparency and strong Shariah governance significantly enhance investor trust, particularly when digital literacy is high. Technological readiness and regulatory support further strengthen trust, while economic stability amplifies these effects. These results highlight the nonlinear and adaptive nature of trust formation and its pivotal role in advancing financial inclusion. This study contributes methodologically by introducing a novel FABS framework tailored to Islamic fintech ecosystems and conceptually by offering insights into the behavioral dynamics shaping investor trust. Practically, the findings suggest that platform developers and policymakers should prioritize transparency, robust governance, and investor education to enhance platform effectiveness. Future research should extend this model to incorporate other stakeholders such as regulators and fundraisers, validate findings with empirical data, and explore cross-border applications to strengthen policy design and platform scalability.

Keywords: Fuzzy Agent-based Simulation, Islamic crowdfunding, Financial Inclusion, Platform Transparency, Python, Shariah Governance, Investor Trusts, Digital Literacy

Introduction

In order to guarantee that people and businesses have access to reasonably priced financial products and services that satisfy their needs, financial inclusion is still a crucial objective for economies around the world (Halim, 2024; Al Berto et al., 2025). According to the principles of Maqasid al-Shariah, which are the main goals of Islamic law and aim to protect religion, life, intellect, lineage, and wealth, financial inclusion in the context of Islamic finance is not only an economic goal but also a moral one (Naim, 2003; Kholid & Bachtiar, 2015). Islamic finance offers a distinctive framework to promote financial inclusion, especially among underprivileged and marginalized communities, with its emphasis on social justice, risk-sharing, and ethical investment (Hassan & Kayed, 2009; Marzban et al., 2014).

Innovative financial technology (fintech) solutions have emerged because of the financial services industry's profound transformation brought about by the rapid advancement of digital technologies (Forward et al., 2022). Crowdfunding has become one of these important alternative financing methods (Muneeza & Mustapha, 2021; Muneeza et al., 2018). Crowdfunding is the process of using online platforms to collect modest sums of money from a large number of people. In order to avoid the principles of interest prohibition (riba), uncertainty (gharar), and unethical investments, Islamic crowdfunding modifies this model within a Shariah-compliant framework (Jatmiko et al., 2024). It presents a fresh and exciting opportunity to promote social welfare programs, small and medium-sized businesses (SMEs), and entrepreneurship in a way that aligns with Islamic moral principles.

By using technology to enable investments, donations, and financing in a Shariah-compliant way, Islamic crowdfunding platforms like LauchGood, Sadaqa House, and GlobalSadaqah have shown how digital transformation can close gaps in conventional financial services (Karakulah & Muneeza, 2024). By encouraging social welfare projects, supporting zakat and waqf initiatives, and empowering small enterprises without access to traditional financial institutions, these platforms help not only economic development but also more general society development.

Islamic crowdfunding has great promise but also notable difficulties. The sustainable development of the industry depends on careful consideration of Shariah governance, regulatory compliance, platform credibility, and investor protection (Ahmed et al., 2015; Gundogdu, 2018). Maximizing Islamic crowdfunding's influence on financial inclusion depends on addressing these issues as it develops (Muneeza et al., 2018).

Using Fuzzy agent-based simulation, this paper aims to explore the role of Islamic crowdfunding platforms in fostering financial inclusion. It will address the operational models of Islamic crowdfunding, evaluate the possibilities and contributions of these platforms, underline the obstacles they encounter, and suggest ways to improve their impact in creating a more inclusive and ethical Islamic financial environment. This paper will be further improved when the actual field work is done to collect the real data.

Literature Review

A growing body of literature differentiates Islamic crowdfunding from its conventional counterparts. Conventional crowdfunding, according to Gerber and Hui (2013), is driven by market mechanisms that may not always consider ethical or social impacts in depth.

Conversely, Islamic crowdfunding platforms must adhere to additional layers of scrutiny regarding Shariah compliance. The dual accountability to both investors and religious authorities adds a unique dimension to Islamic crowdfunding (Purwatiningsih et al., 2024). In practice, this means that projects financed through these platforms are assessed not only for their commercial viability but also for their alignment with Islamic ethical standards. Researchers have argued that this extra due diligence offers a competitive edge in terms of trust and transparency, while also presenting unique regulatory challenges. Therefore, Islamic crowdfunding can bridge funding gaps for SMEs and socially responsible projects, promoting ethical and sustainable growth (Ramli et al., 2023; Faudzi et al., 2021; Mustafida et al., 2021; Kapital Boost, n.d. 2025; Redzuan et al., 2024).

Overview of Crowdfunding and Its Evolution

From a specialized financing tool, crowdfunding has evolved into a popular substitute using technology and social networks to gather capital. Traditionally, crowdfunding is the asking of modest donations from many individuals using internet platforms. Researchers like Belleflamme et al. (2014) have characterized the several types of crowdfunding including donation-based, reward-based, equity-based, and debt-based financing that function the mechanisms democratizing capital access. As these models developed, particular changes were needed for industries under rigorous ethical or legal rules, such Islamic finance. Primarily excluding interest-bearing transactions and enterprises with too much uncertainty, Islamic crowdfunding developed as an adaptation fitting Shariah values (Forward et al., 2022). Central to these principles are the prohibitions against *riba* and *gharar*. Numerous scholars have highlighted how these ethical tenets are designed to promote fairness and financial inclusion while ensuring that wealth circulation benefits society as a whole (Jatmiko et al., 2024). Secondly, The integration of Islamic finance and crowdfunding (Taha & Macias, 2014), holds the promise of extending access to financial resources without compromising religious tenets. This theoretical foundation is well supported by studies emphasizing that integrating *Maqasid al-Shariah* that main objectives of preserving faith, life, intellect, progeny, and wealth which can potentially maximize both economic and social welfare outcomes (Abdeldayem & Aldulaimi, 2023). Thirdly, Equity crowdfunding (ECF) offers Shariah-compliant partnership structures. Prior research (Kassim et al., 2020) emphasized the role of platform providers, social networks, and financial management practices in influencing the performance of ECF-funded firms in Malaysia.

Empirical Evidence and Case Studies

Empirical studies on conventional crowdfunding have illustrated how this model can bridge funding gaps in various sectors, especially for startups and SMEs that struggle to obtain traditional bank loans. The appeal of crowdfunding lies in its ability to lower entry barriers and empower niche markets with limited access to conventional financial sources (Muneeza et al., 2018). In the Islamic context, the role of crowdfunding extends further, as it becomes a tool for fostering financial inclusion in communities that traditionally adhere to Islamic finance principles. Literature in this area highlights that Islamic crowdfunding, by pooling small investments from the public, can offer much-needed capital to entrepreneurs and projects that align with ethical and social values. Websites such as Ethis, Global Sadaqah, and LaunchGood highlight how well Islamic crowdfunding supports business and charity initiatives. Case studies concentrating on platforms running in areas with significant Muslim populations, including Southeast Asia and the Middle East, have provided some of the earliest

empirical data on Islamic crowdfunding platforms. These studies indicate that Islamic crowdfunding platforms often seek to assist SMEs, charitable projects, and social projects in line with waqf (endowment) and zakat (obligatory charity) practices (Faudzi et al., 2021).

Studies by academics looking at crowdfunding platforms reveal encouraging trends in meeting financial inclusion goals and promoting entrepreneurship in underbanked areas (Mustafida et al., 2021). Furthermore, according to review papers, the technical infrastructure supporting these platforms is essential for guaranteeing accessibility and the quick flow of information among stakeholders. Such research offers a framework for comprehending the macroeconomic as well as microeconomic effects of digital transformation in Islamic finance (Hendratmi et al., 2019).

Among the gaps are insufficient empirical data on long-term performance and difficulties in striking a balance between regulatory requirements and technical innovation (Arzam et al., 2023). Though encouraging developments, the current research points out some deficiencies and issues. First, there is scant empirical data on the long-term sustainability and growth paths of Islamic crowdfunding platforms. Most studies have been exploratory (Halim, 2024; Muneeza et al 2018; Arzam et al., 2023; Redzuan et al., 2024), suggesting a need for longitudinal research to evaluate their performance over time. Second, while much has been said about the theoretical benefits of Islamic crowdfunding as a key innovation within financial technology, particularly its role in promoting financial inclusion, there remains limited consensus on how to best balance technological advancements with regulatory requirements. A critical area for further research is the interaction between emerging fintech solutions and established Shariah compliance frameworks. Moreover, although existing literature often highlights crowdfunding's potential to democratize finance, significant concerns persist regarding platform governance, transparency, and investor protection in an increasingly digital environment (Arzam et al., 2023; Redzuan et al., 2024).

Opportunities and Challenges of Islamic Crowdfunding

Islamic crowdfunding platforms are creating a significant change in how to promote financial inclusion especially for underprivileged micro, small, and medium businesses (MSMEs). These platforms not only bring financial services to those historically excluded from conventional banking systems, but they also enable small businesses and entrepreneurs to expand (Abdeldayem & Aldulaimi, 2023). Islamic crowdfunding is helping to create a more inclusive and fair financial landscape by opening doors to global markets, encouraging responsible and sustainable investments in line with Islamic ethical values (Abdullah & Oseni, 2017), and using technology to foster openness and confidence (Zaher & Hassan, 2020).

Rooted in the ethical values of Shariah and the larger objectives of Maqasid al-Shariah, Islamic crowdfunding platforms offer inclusive and open financial solutions that fit the needs of people usually excluded from conventional banking systems. They offer a way forward for many SMEs that struggle to access conventional funding, especially unbanked entrepreneurs, women-led businesses, and rural communities. What distinguishes these platforms is their dedication to justice and shared responsibility which replacing interest-based lending with profit-and-loss sharing models that fit Islamic values. This approach not only promotes financial inclusion but also ensures that ethical and religious principles are respected in the process (Arzam et al., 2023; Redzuan et al., 2024). Moreover, these platforms serve as critical

enablers of SME growth by linking ethical investors with promising businesses. In doing so, they contribute to job creation, innovation, and economic empowerment, which are the key components of inclusive development. Many platforms also support socially responsible and environmentally sustainable ventures, aligning their missions with both Islamic ethics and global development goals. Technology plays a pivotal role in amplifying these contributions. Digital crowdfunding platforms offer transparency through real-time data, open disclosures, and Shariah-compliant screening processes, thereby enhancing investor confidence and user engagement. Additionally, the online nature of these platforms allows SMEs to reach investors beyond local boundaries, facilitating cross-border funding and promoting regional collaboration in the Islamic economy. In summary, Islamic crowdfunding offers a promising pathway to promote financial inclusion by delivering accessible, ethical, and impact-driven finance tailored to the needs of underserved communities (Muneeza et al., 2018).

While Islamic crowdfunding platforms hold significant promise in promoting financial inclusion, several challenges persist that may limit their reach and impact if left unaddressed. These challenges span regulatory, operational, technological, and structural dimensions, particularly in markets where Islamic finance is still developing (Haruna et al., 2024). Although these platforms are designed to align with Islamic principles, the absence of standardized Shariah guidelines and qualified advisory oversight in some cases creates inconsistencies that can undermine investor trust and platform credibility. Inadequate governance mechanisms may also lead to disputes over fund utilization and ethical screening. Regulatory complexity adds another major hurdle. In many jurisdictions, crowdfunding regulations are either underdeveloped or do not specifically address the nuances of Islamic finance. This legal uncertainty poses risks for both platform operators and users and may deter wider adoption by SMEs and investors who seek assurance and protection under a clear legal framework. Investor trust and confidence remain fragile, especially in markets where crowdfunding is a relatively new concept. Concerns about the security of funds, legitimacy of listed projects, and accountability of platform operators may hinder participation. These concerns are heightened by the lack of robust risk mitigation mechanisms and limited regulatory enforcement (Alshater et al., 2022).

Managing risk and protecting investors also poses a challenge, particularly because crowdfunding often involves high-risk, early-stage ventures. Unlike traditional finance, there may be limited collateral or guarantees, making it crucial for platforms to adopt strong due diligence, risk scoring, and transparency practices. Finally, technological barriers and low digital literacy can restrict participation by SMEs, especially in rural or underserved areas. Many MSMEs may lack access to reliable internet or the skills to navigate digital funding platforms, creating an inclusion gap despite the platform's online availability. Considering these challenges, deliberate intervention is needed to build a secure, Shariah-compliant, and inclusive crowdfunding ecosystem that truly advances financial inclusion goals.

Investor trust and Financial Inclusion on Islamic Crowdfunding Platform

Investor trust is fundamental for the growth and sustainability of Islamic crowdfunding platforms. Trust influences investors' willingness to commit funds, especially in digital platforms where face-to-face interaction is limited. Factors contributing to trust include platform reputation, past performance, compliance assurance, and effectiveness in communication. Empirical studies have shown that trust significantly influences investment

decisions in online crowdfunding. Kim and Peterson (2017) assert that trust in the platform, project creators, and the crowdfunding model is pivotal. In Islamic finance, trust is further anchored by the perception of Shariah compliance, as noted by Ramli and Ishak (2022), who found that Shariah assurance mechanisms positively affect investor confidence.

There are 4 factors that influence investor trust and financial inclusion. First is Shariah Governance Quality, second is platform transparency, third is technology readiness, fourth is regulatory support. However, there are two another influencing factors, namely digital literacy and economic stability. Firstly, digital literacy, studies like those by Van Deursen and Van Dijk (2014) highlight that digital literacy directly impacts the usage and effectiveness of online financial services. In reward-based crowdfunding, Tahir, Shahid and Naheed (2025) found that improved digital literacy among SMEs and investors increases platform engagement and investment volumes. Secondly, economic stability, research by Claessens et al. (2018) indicates that platforms in stable economies enjoy higher investor confidence and lower default rates. Islamic finance studies, such as those by Iqbal and Mirakhor (2011), reinforce the notion that stable environments are conducive to ethical and long-term investments aligned with Islamic principles.

Previous studies have highlighted the importance of robust Shariah governance in Islamic financial institutions, including crowdfunding platforms. According to Rahman and Bukair (2015), effective Shariah governance positively influences investor confidence and financial performance. Studies by Haniffa and Hudaib (2007) and Mergaliyev, Asutay, Avdukic, & Karbhari (2021) emphasize the need for independence, competence, and transparency among Shariah board members. In the context of crowdfunding, research has shown that platforms with credible Shariah advisory boards are more likely to attract ethically concerned investors and ensure sustainable operations. Also, studies have consistently shown that platform transparency is a key determinant of investor participation in crowdfunding. Mollick (2014) found that clear disclosures increase campaign success rates and investor retention. Islamic finance literature emphasizes that transparency aligns with the Islamic principles of honesty and disclosure (*bayān*). For instance, Abdullah and Oseni (2017) argue that Islamic crowdfunding platforms must adopt rigorous transparency measures to uphold trust and fulfill *Maqasid al-Shariah*. Another the perspective of technological readiness and regulatory support, past research highlights the significant role of technology in the success of crowdfunding platforms. According to Davis (1989), the perceived ease of use and usefulness of a platform directly impact its adoption. Studies by Thaker et al. (2021) on Islamic crowdfunding stress the need for robust IT infrastructure to meet the expectations of tech-savvy investors and maintain operational excellence. The role of regulation in supporting financial innovation has been extensively documented. Zetzsche et al. (2020) and Muneez & Mustapha (2021) argue that clear and supportive regulations are essential for fintech development. In the Islamic finance context, Arzam, Fauzi, Efendi & Sulastri (2023), found that jurisdictions with well-defined regulatory environments for Islamic crowdfunding witness higher levels of investor participation and platform sustainability.

Fuzzy Logic Based Model Simulation

Previous study has emphasized the possibilities of FABS in modeling socio-technical systems. For example, Raoufi & Fayek (2018) and Luchici (2022), support its application in situations requiring the modeling socio-technical systems. Lamrani Alaoui, El Fakir, and Tkiouat (2024)

use FABS to investigate Qard Hasan and donation-based crowdfunding in connection to financial inclusion meanwhile. The results reveal the value of the crowdfunding-based method in increasing entrepreneurs' well-being, including protection against diseases and unplanned events, while also decreasing the hazards of moral hazard by assuring project success. Also, FABS has been practically employed in other sectors, including as public health, where Regis, Manicom and Doncescu (2023) deployed the technology to mimic the transmission of COVID-19. These contributions underline the usefulness and application of FABS in resolving uncertainty and capturing adaptive decision-making in complex systems. Previously, Luchici (2022) introduces fuzzy logic and uses python as a tool to model intelligent agent behavior, particularly in situations involving imprecise or ambiguous information. Even though the approach shows promise, it still needs to be tested and validated across a wider range of scenarios to confirm its effectiveness.

Research Methodology

The objective of this study is to explore the dynamics of financial inclusion within the Islamic crowdfunding ecosystem using Fuzzy Agent-based simulation (FABS). According to Hassan, Garmendia and Pavón (2010) and Luchici (2022), ABS models are effective for investigating unpredictable behaviour in social contexts. Previous agent models seem to be relatively basic, however there are societal difficulties that necessitate the study of some factors with ambiguity, much like human thought. These characteristics can be addressed by applying fuzzy sets theory to the specification of attributes that describe agents representing individuals, as well as functions that model the evolution of individual change of mind, relationships among individuals in a social network, inheritance, and individual similarity. Structured, rule-based logic encodes the behaviors and decision-making processes of important stakeholders; investors, platform operators, and regulatory authorities into the simulation. Agent-Based Simulation (ABS) is used to examine the emerging patterns produced by the interactions among these diverse agents.

Simulation Logic

Given the natural unpredictability and subjectivity in human assessments especially with views of platform transparency, Shariah governance quality, investor trust, and technology maturity. The simulation model combines a fuzzy logic inference mechanism. Fuzzy sets let one describe language factors like "high transparency," "moderate trust," and "low digital literacy," therefore enabling algorithmic assessment of qualitative judgments. Fuzzy Agent-Based Simulation (FABS), which combines fuzzy logic with agent-based modeling, allows for a sophisticated simulation of how these qualitative factors affect quantitative results like degrees of financial inclusion.

The simulation design allows one to manipulate independent variables such as the platform transparency, Shariah governance quality, technological readiness, regulatory support, and investors' trust with the moderating variables (digital literacy and economic stability). This study investigates their combined effect on the dependent variable, financial inclusion. This scientific approach is ideally suited to the study of complex socio-economic systems characterized by dynamic interactions, behavioral uncertainty, and feedback mechanisms.

The study uses an FABS framework to conceptually describe the interaction between Islamic crowdfunding platforms and financial inclusion. FABS successfully mixes fuzzy logic, which

captures human-like reasoning under ambiguity, with agent-based modeling, which models the behaviors and interactions of autonomous agents within a complex adaptive system. The hybrid method corresponds well with the peculiarities of Islamic crowdfunding environments, where stakeholders' activities are impacted by diverse concerns, including Shariah compliance, trust, and institutional frameworks. This simulation explain what is the agent definition and roles and what are the simulation variables used. The simulation comprises of three primary agent types:

Platform Operators	Entities managing the crowdfunding platforms, responsible for maintaining transparency, ensuring Shariah compliance, and implementing technological advancements.
Regulators	Authorities that establish and enforce regulations, influencing the operational environment of crowdfunding platforms.
Investors	Individuals who assess crowdfunding platforms based on various criteria and decide whether to invest or otherwise.

While Simulation Variables comprise of independent variables, moderating variable and dependent variable as shown in Table 1.0.

Table 1.0
Simulation Variables

Independent variables	Moderating Variables	Dependent Variable
Platform Transparency	Digital Literacy	Financial Inclusion
Shariah Governance Quality	Economic Stability	
Technological Readiness		
Regulatory Support		
Investor Trust		

Each variable is represented using linguistic fuzzy categories such as 'Low,' 'Medium,' and 'High' to capture qualitative assessments and uncertainties inherent in real-world scenarios. Then, investor decisions are modeled using a set of fuzzy logic rules that consider the interplay of various factors.

Rule 1	IF Platform Transparency is High AND Shariah Governance Quality is Strong AND Investor Trust is High, THEN Financial Inclusion is High.
Rule 2	IF Technological Readiness is Low OR Digital Literacy is Low, THEN Financial Inclusion is Moderate.
Rule 3	IF Regulatory Support is None AND Economic Stability is Unstable, THEN Investor Trust is Low.
Rule 4	IF Investor Trust is Low AND Platform Transparency is Low, THEN Financial Inclusion is Poor.

These rules facilitate the simulation of investor behavior under varying conditions, reflecting the complexity and uncertainty of real-world decision-making processes. Therefore, this simulation need simulation scenarios. The simulation explores multiple scenarios by adjusting the levels of input variables to observe their impact on financial inclusion as depicted in Table 2.0.

Table 2.0

Simulation Scenario and Outcomes

Scenario	Description	Expected Outcome
A	High Transparency, Strong Shariah Governance, High Technological Readiness, High Investor Trust (all independent variables high)	High Investor Trust, High Financial Inclusion
B	Medium Transparency, Weak Regulatory Support, Low Digital Literacy	Moderate to Low Financial Inclusion
C	Transparency and regulation low, Shariah governance and technology readiness high	Low investor trust, low financial inclusion

These scenarios help uncover crucial characteristics and their combinations that greatly affect financial inclusion through Islamic crowdfunding platforms. In this study, seven factors were represented as fuzzy sets: four platform features (transparency, Shariah governance, technological maturity, and regulation), two moderators (economic stability, digital literacy), and one mediator (investor trust). Finally, financial inclusion was chosen based on fuzzy logic principles connecting trust and contextual elements.

Python Simulation Code

```
# Import libraries
import numpy as np
import skfuzzy as fuzz
from skfuzzy import control as ctrl

# Define fuzzy input variables
transparency = ctrl.Antecedent(np.arange(0, 11, 1), 'transparency')
shariah = ctrl.Antecedent(np.arange(0, 11, 1), 'shariah')
tech = ctrl.Antecedent(np.arange(0, 11, 1), 'tech')
regulation = ctrl.Antecedent(np.arange(0, 11, 1), 'regulation')
econ_stability = ctrl.Antecedent(np.arange(0, 11, 1), 'econ_stability')
digital_literacy = ctrl.Antecedent(np.arange(0, 11, 1), 'digital_literacy')

# Define fuzzy intermediary and output
trust = ctrl.Consequent(np.arange(0, 11, 1), 'trust')
inclusion = ctrl.Consequent(np.arange(0, 11, 1), 'inclusion')

# Membership functions
for var in [transparency, shariah, tech, regulation, econ_stability, digital_literacy, trust,
inclusion]:
    var['low'] = fuzz.trimf(var.universe, [0, 0, 5])
    var['medium'] = fuzz.trimf(var.universe, [0, 5, 10])
    var['high'] = fuzz.trimf(var.universe, [5, 10, 10])

# Rule base for trust
rule1 = ctrl.Rule(transparency['high'] & shariah['high'], trust['high'])
rule2 = ctrl.Rule(tech['low'] | regulation['low'], trust['low'])
rule3 = ctrl.Rule(transparency['medium'] & shariah['medium'], trust['medium'])

# Rule base for financial inclusion
```

```
rule4 = ctrl.Rule(trust['high'] & digital_literacy['high'] & econ_stability['high'],
inclusion['high'])
rule5 = ctrl.Rule(trust['low'], inclusion['low'])

# Control system
trust_ctrl = ctrl.ControlSystem([rule1, rule2, rule3])
trust_sim = ctrl.ControlSystemSimulation(trust_ctrl)

inclusion_ctrl = ctrl.ControlSystem([rule4, rule5])
inclusion_sim = ctrl.ControlSystemSimulation(inclusion_ctrl)

# Set example input values
trust_sim.input['transparency'] = 8
trust_sim.input['shariah'] = 9
trust_sim.input['tech'] = 7
trust_sim.input['regulation'] = 8
trust_sim.compute()

# Get output for trust
calculated_trust = trust_sim.output['trust']

# Use trust to simulate financial inclusion
inclusion_sim.input['trust'] = calculated_trust
inclusion_sim.input['digital_literacy'] = 7
inclusion_sim.input['econ_stability'] = 6
inclusion_sim.compute()

# Output
print("Investor Trust:", round(calculated_trust, 2))
print("Financial Inclusion:", round(inclusion_sim.output['inclusion'], 2))
```

Implications and Use of Simulation

The FABS framework provides critical insights into the complex interdependence of factors influencing financial inclusion, especially in the context of Islamic crowdfunding platforms. By simulating the dynamic interplay of critical factors (platform transparency, regulatory support, digital literacy, and investor trust). The simulation can assist discover key leverage areas for increasing financial inclusion. Improving digital literacy or strengthening regulatory frameworks, for example, might provide large beneficial results when evaluated in a simulated context. Furthermore, FABS enables the evaluation of various policy actions and their expected benefits, promoting evidence-based decision-making. As such, our simulation is an important decision-support tool for policymakers, platform operators, and researchers looking to understand, analyze, and improve the role of Islamic crowdfunding in creating equitable financial systems.

Finding and Discussion

The FABS was designed to investigate the dynamic interactions between the important variables that influence financial inclusion via Islamic crowdfunding platforms. This

simulation was intended to recreate real-world interactions between SMEs, investors, platform providers, and regulators while taking into account issues such as Shariah governance quality, platform transparency, technology preparedness, and regulatory backing. The primary goal was to determine how these factors, together with moderators such as digital literacy and economic stability, affect investor trust and, eventually, financial inclusion. Investor trust is viewed as a mediator. A fuzzy inference system uses language principles to predict investor behavior. Higher platform transparency and Shariah governance quality resulted in higher investor trust. Investor trust had a considerable influence on financial inclusion levels, while digital literacy and economic stability moderated the benefits. Graphs and tables show simulation results under various settings. As illustrated in Figure 1.0, the simulation shows a positive relationship between platform transparency and investor trust. Higher levels of transparency—especially when paired with strong Shariah governance—significantly increase trust among investors. This finding supports the principle of bayān (honest disclosure) in Islamic finance, and highlights transparency as a foundational element for trust-building on crowdfunding platforms.

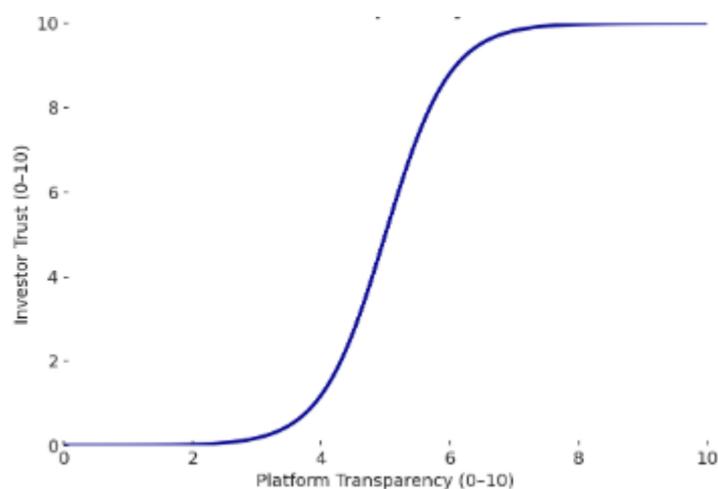


Figure 1.0: Simulation Output – Effect of Platform Transparency on Investor Trust

Figure 2.0 depicts a clear upward trend between investor trust and financial inclusion. As investor trust increases, so does the participation rate in crowdfunding platforms, leading to greater access to financing for SMEs and underserved communities. This validates the role of trust as a mediator in the relationship between platform features and inclusion outcomes, in line with prior Islamic fintech literature.

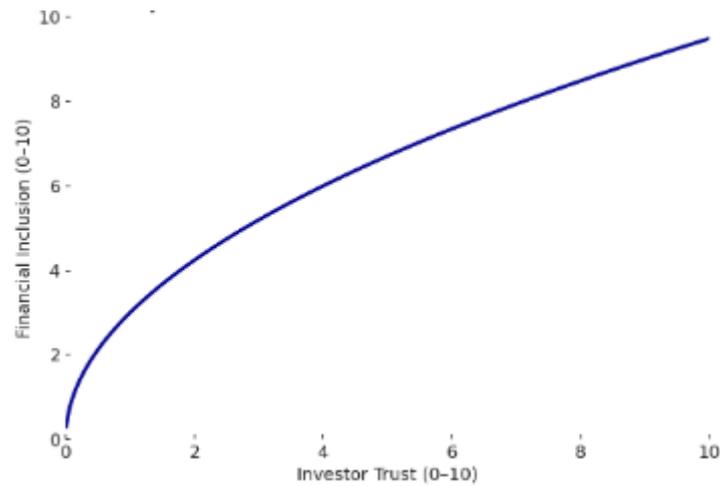


Figure 2.0: Simulation Output – Effect of Investor Trust on Financial Inclusion

These visual results affirm the fuzzy simulation's ability to model nonlinear behavioral patterns, particularly how qualitative platform attributes influence inclusion through the trust mechanism.

The fuzzy agent-based simulation demonstrated that investor trust rises significantly when platform transparency, Shariah governance quality, technology readiness, and regulatory support are strong. Investor trust, represented as a fuzzy mediator variable, has a considerable effect on perceived financial inclusion across agent activities.

The simulation also highlighted the significance of environmental elements. In areas with strong digital literacy and economic stability, the favorable benefits of investor trust on financial inclusion were greatly magnified. In contrast, in poor digital literacy and economically uncertain settings, even good platform performance yielded small financial inclusion effects. Overall, investor trust acted as a major mediator, and both moderators had a significant impact on how well crowdfunding platforms promote financial inclusion. The simulation revealed several important trends that can be mapped to previous studies:

Table 3.0

Variables	Trends	Previous studies
Shariah Governance Quality	Platforms with strong Shariah compliance frameworks consistently performed better in building investor confidence and encouraging SME participation	Abdullah & Oseni, 2017
Platform Transparency	High transparency fostered more robust investor participation and was especially effective when paired with high digital literacy	Thaker et al., 2021
Technological Readiness	Platforms with better technical infrastructure facilitated faster funding cycles and broader outreach, confirming findings from Davis (1989) and Claessens et al. (2018).	Davis, 1989 & Claessens et al., 2018
Regulatory Support	In unstable economic environments, strong regulatory frameworks significantly mitigated risks and supported platform resilience	Zetzsche et al., 2020
Digital Literacy	Digital literacy acted as a key enabler, amplifying the effects of transparency and technology adoption	van Deursen & van Dijk, 2014

Discussion

These findings support the conceptual framework provided in previous sections and are consistent with prior research showing the significance of governance, legislation, and technology in fintech adoption (Raml & Ishak, 2022, 2020; Haniffa & Hudaib, 2007). It is worth noting that, while all independent factors had varied degrees of beneficial effect on financial inclusion, the synergy between digital literacy and platform characteristics (such as transparency and technological readiness) was particularly important. This shows that regulatory supports focusing on SME education (Haruna et al., 2024) and awareness campaigns can considerably improve the efficacy of Islamic crowdfunding platforms. The agent-based modeling technique, when paired with fuzzy logic, successfully captured the nonlinear and interactive impacts of numerous drivers and moderators on financial inclusion. The simulation demonstrates how a hybrid system based on fuzzy logic and agent modeling may elucidate the dynamic relationships between Islamic crowdfunding features and financial inclusion. This model provides information for platform designers and regulators.

Limitations and Future Work

While this study provides valuable insights into the dynamics of Islamic crowdfunding using a fuzzy agent-based simulation (FABS), several limitations exist. First, the findings are based solely on simulation rather than empirical data. Although the model captures behavioral complexity well, it requires validation through real-world investor and platform data. Second, the model focuses on investor trust without considering the roles of fundraisers or other stakeholders, which could influence platform dynamics. Finally, the simulation assumes homogeneous agent behavior within defined fuzzy parameters, which may not fully reflect the diversity of investor motivations in practice.

Future research should expand the model to include additional agent types such as fundraisers or regulators and validate the simulation outcomes through surveys or platform-level datasets. Integrating machine learning or reinforcement learning agents could also enhance adaptive behavior modeling. Moreover, comparing Islamic crowdfunding platforms across multiple countries could help assess how regulatory and cultural differences shape trust and inclusion outcomes.

Conclusion

Islamic crowdfunding has proven to be a powerful tool for advancing financial inclusion, particularly for underserved communities and MSMEs. Grounded in the ethical framework of Maqasid al-Shariah, these platforms combine faith-driven principles with financial innovation to provide transparent, responsible, and socially conscious alternatives to traditional financing.

This study highlights the critical role of platform transparency, Shariah governance, technological readiness, regulatory support, and investor trust in shaping the success of Islamic crowdfunding. By employing fuzzy agent-based simulation, the research demonstrates how trust evolves in complex environments and how moderating factors such as digital literacy and economic stability significantly influence platform effectiveness.

To maximize the potential of Islamic crowdfunding, several strategic actions are essential. Strengthening Shariah governance and harmonizing standards will reinforce investor confidence and compliance. Clearer regulatory frameworks must be established to protect both investors and fundraisers, while education programs should raise awareness and improve financial literacy. Leveraging emerging technologies such as blockchain, artificial intelligence, and smart contracts can further enhance transparency, efficiency, and governance. Additionally, expanding cross-border collaboration and aligning platform objectives with the Sustainable Development Goals (SDGs) can ensure broader impact and long-term sustainability.

Although based on simulation rather than empirical data, this study demonstrates the value of computational modeling in exploring behavioral and institutional dynamics that are difficult to capture through surveys alone. The fuzzy agent-based approach provides a flexible, theory-building tool for policymakers, platform developers, and researchers to test scenarios and guide strategic decision-making.

In conclusion, Islamic crowdfunding represents more than just a financing mechanism—it is an avenue for reshaping inclusive finance through the integration of Islamic values, technological innovation, and sustainability. By addressing governance, regulation, and education, and by embracing forward-looking technologies, these platforms can redefine access to finance and contribute meaningfully to building a just, resilient, and empowered society.

Research Contribution

This study makes contributions on several levels: theoretical, methodological, practical, and policy.

Theoretical Contribution

The research adds to the ongoing discussion on Islamic fintech and financial inclusion by introducing the Fuzzy Agent-Based Simulation (FABS) model into the context of Islamic crowdfunding, something that has rarely been done before. Much of the existing work in this area has relied on traditional linear or survey-based. By focusing on behavioral and perceptual factors such as investor trust, Shariah governance, platform transparency, and technological readiness, this study fills an important gap where these dimensions have often been simplified or overlooked. The inclusion of digital literacy and economic stability as moderators also gives the analysis a stronger real-world grounding, especially for Muslim-majority economies where these issues are central to crowdfunding adoption (Wilson, 2012; World Bank, 2017). In this way, the study strengthens existing knowledge by offering a more holistic and context-sensitive perspective on how Islamic crowdfunding can enhance financial inclusion.

Methodological Contribution

The study also advances methodology by showing the potential of the FABS approach, which combines fuzzy logic with agent-based modeling. Unlike survey-based studies that provide useful but static insights, this method captures dynamic, non-linear relationships and allows us to see how people's perceptions and behaviors evolve in complex systems. By integrating linguistic and subjective variables into the model, the study provides a new computational tool for Islamic finance research. This offers a richer way of exploring "what-if" scenarios and testing the resilience of crowdfunding platforms under different behavioral and economic conditions.

Practical Contribution

For practitioners, the findings highlight what matters most in building successful Islamic crowdfunding platforms. The simulations show that greater transparency, strong Shariah governance, and solid technological infrastructure are key to strengthening investor trust and widening access. They also reveal how factors like digital literacy and the broader economy influence participation, meaning that strategies must be tailored to different communities. These insights give platform operators a clearer roadmap to designing crowdfunding ecosystems that are inclusive, trustworthy, and user-friendly.

Policy Contribution.

For regulators and policymakers, the FABS model serves as a decision-making aid. It enables them to simulate the effects of financial inclusion policies before rolling them out in practice. The findings stress the importance of regulatory support, digital infrastructure investment, and financial education in creating an inclusive Islamic crowdfunding environment (World Bank, 2017; Wilson, 2012). This shows the study's relevance to the real policy context, where governments aim to promote financial inclusion while staying true to Islamic ethical principles.

Future Research

Finally, this research lays a foundation for future work. It opens the door for empirical testing using real-world platform data, as well as extensions to other Islamic financial instruments such as waqf and takaful. It also points to the possibility of integrating artificial intelligence into the model to improve agent learning and prediction. Overall, the study provides a

scalable and contextually relevant framework for understanding how Islamic crowdfunding can support inclusive and ethical finance.

References

- AAOIFI. (2021). *Governance Standards For Islamic Financial Institutions*. Accounting and Auditing Organization for Islamic Financial Institutions. <https://aaoifi.com/shariaa-standards/?lang=en>.
- Abdeldayem, M., & Aldulaimi, S. (2023). Developing an Islamic crowdfunding model: a new innovative mechanism to finance SMEs in the Middle East. *International Journal of Organizational Analysis*, 31(6), 2623-2644.
- Abdullah, M., & Oseni, U. A. (2017). Towards Shariah-compliant equity-based crowdfunding for the halal industry in Malaysia. *International Journal of Business and Society*, 18(S1), 223–240.
- Ahmed, H., Mohieldin, M., Verbeek, J., & Aboulmagd, F. (2015). *On the sustainable development goals and the role of Islamic finance* (Policy Research Working Paper No. 7266). World Bank. <http://hdl.handle.net/10986/22000>
- Al Berto, M., Hamdun, N. G., & Abror, M. A. (2025). Empowerment of Women-Owned Businesses through Islamic Financial Inclusion Instruments: The Role of Crowdfunding. *Jurnal Ekonomi dan Bisnis Islam (JEBI)*, 5(1), 1-14.
- Alshater, Muneer M., Irum Saba, Indri Supriani, and Mustafa Raza Rabbani. "Fintech in islamic finance literature: A review." *Heliyon* 8, no. 9 (2022).
- Arzam, A., Fauzi, M., Efendi, F., & Sulastri, W. (2023). Islamic crowdfunding: a review literature. *Review of Islamic Economics and Finance*, 6(2), 171-186.
- Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the Right Crowd. *Journal of Business Venturing*, 29(5), 585–609.
- Claessens, S., Frost, J., Turner, G., & Zhu, F. (2018). Fintech credit markets around the world: size, drivers and policy issues. *BIS Quarterly Review September*.
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS quarterly*.
- Ethis.co. (2025). *Ethis: Ethical crowdfunding platform*. Ethis. <https://ethis.co/>
- Faudzi, M. S. M., Bakar, J. A., & Ahmad, S. (2021). The relevance of conventional and Islamic crowdfunding as financing instruments for SMEs. *Journal of Islamic Finance*, 10(1), 59-64.
- Forward, P., Hassan, M. K., & Rabbani, M. R. (2022). Islamic Fintech, Blockchain and Crowdfunding: Current Landscape. *FinTech in Islamic Financial Institutions: Scope, Challenges, and Implications in Islamic Finance*, 307.
- Gerber, E. M., & Hui, J. (2013). Crowdfunding: Motivations and deterrents for participation. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 20(6), 1-32.
- Global Sadaqah. (2023). *Global Sadaqah official website*. Global Sadaqah. <https://www.globalsadaqah.com/>
- Gundogdu, A. S. (2018). An inquiry into Islamic finance from the perspective of sustainable development goals. *European Journal of Sustainable Development*, 7(4), 381-381.
- Halim, M. A. (2024). Does crowdfunding contribute to digital financial inclusion? *Research in Globalization*, 9, 100238. <https://doi.org/10.1016/j.resglo.2024.100238>
- Haniffa, R., & Hudaib, M. (2007). Exploring the ethical identity of Islamic banks via communication in annual reports. *Journal of Business Ethics*, 76(1), 97–116. <https://doi.org/10.1007/s10551-006-9272-5>

- Haruna, A., Kountchou, A. M., Oumbé, H. T., & Wirajing, M. A. K. (2024). The adoption of Islamic finance by Cameroonian SME entrepreneurs: are there gender disparities?. *Journal of Islamic Monetary Economics and Finance*, 10(3), 521-550.
- Hassan, M. K., & Kayed, R. N. (2009). The global financial crisis, risk management and social justice in Islamic finance. *Risk Management and Social Justice in Islamic Finance*.
- Hendratmi, A., Sukmaningrum, P. S., Hadi, M. N., & Ratnasari, R. T. (2019). The role of Islamic crowdfunding mechanisms in business and business development. *Global J. Bus. Soc. Sci. Review*, 7(1), 1-7.
- Ishak, M. S. I., & Mohammad Nasir, N. S. (2024). The applicability of Islamic crowdfunding as an alternative funding for micro-entrepreneurs in Malaysia. *Qualitative Research in Financial Markets*, 16(3), 548-564.
- Iqbal, Z., & Mirakhor, A. (2011). *An Introduction to Islamic Finance: Theory and Practice*. John Wiley & Sons.
- Islamic Financial Services Board (IFSB). (2018). *Islamic Financial Services Industry Stability Report 2018*.
- Jatmiko, W., Iqbal, A., & Ebrahim, M. S. (2024). On the ethicality of Islamic banks' business model. *British Journal of Management*, 35(1), 115-136.
- Kapital Boost. (n.d.). *About us*. Kapital Boost. Retrieved May 9, 2025, from <https://kapitalboost.com/about>
- Kassim, S. F. M., Wahab, K. A., & Muhamed, N. A. (2020). Equity Crowdfunding: Factors Influencing the Performance of Firm in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 10(7), 717-737.
- Karakulah, M., & Muneeza, A. (2024). Exploring the Role of Donation-Based Crowdfunding in Islamic Social Finance. *International Journal of Islamic Economics and Finance Research*, 7(1 July), 42-58.
- Kholid, M. N., & Bachtiar, A. (2015). Good corporate governance dan kinerja maqasid syariah bank syariah di Indonesia. *Jurnal Akuntansi dan Auditing Indonesia*, 19(2), 126-136.
- Kim, K., & Peterson, R. A. (2017). A meta-analysis of online trust relationships in e-commerce. *Journal of Interactive Marketing*, 38, 44-54.
- Lamrani Alaoui, Y., El Fakir, A., & Tkiouat, M. (2024). A New Crowdfunding Model for Financial Inclusion Based on Donations and Interest-Free Debt: A Fuzzy Agent-Based Simulation Approach. *International Journal of Islamic Finance and Sustainable Development*, 16(4), 63-90.
- LaunchGood. (2025). *LaunchGood official website*. LaunchGood. Retrieved May 9, 2025, from <https://www.launchgood.com/>
- Luchici, A. (2022). Dealing With Vagueness In Agent-Based Models: A Python Fuzzy Logic Abm Framework. *Journal of Information Systems & Operations Management*, 16(2).
- Marzban, S., Asutay, M., & Boseli, A. (2014). *Shariah-compliant crowd funding: An efficient framework for entrepreneurship development in Islamic countries*. In Harvard Islamic Finance Forum 2014. Boston, USA.
- Mergaliyev, A., Asutay, M., Avdukic, A., & Karbhari, Y. (2021). Higher ethical objective (Maqasid al-Shari'ah) augmented framework for Islamic banks: Assessing ethical performance and exploring its determinants. *Journal of business ethics*, 170(4), 797-834.
- Mollick, E. (2014). The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*, 29(1), 1-16.

- Muneeza, A., Arshad, N. A., & Arifin, A. T. (2018). The application of blockchain technology in crowdfunding: Towards financial inclusion via technology. *International journal of management and applied research*, 5(2), 82-98.
- Muneeza, A., & Mustapha, Z. (2021). Islamic fintech and financial inclusion. In *Islamic FinTech: insights and solutions* (pp. 173-190). Cham: Springer International Publishing.
- Mustafida, R., Fauziah, N. N., & Kurnia, Z. N. (2021). The development of islamic crowdfunding in Indonesia and its impact towards SMEs. *Hasanuddin Economics and Business Review*, 4(3), 20-29.
- Naim, A. M. (2003). *Maqasid Syariah dan pemikiran pengurusan Islam*. UUM Press.
- Purwatiningsih, A., Purnamasari, S., Setyawati, H., Indriani, A., Prawitasari, D., & Fitria, S. (2024). Bibliometric analysis of Islamic crowdfunding: a literature review of its journey. *F1000Research*, 13, 531.
- Rahman, A. R., & Bukair, A. A. (2015). The influence of the Shariah supervisory board on corporate social responsibility disclosure by Islamic banks of Gulf Co-operation Council countries. *Asian Journal of Business and Accounting*, 8(1), 65–104.
- Ramli, H. S., Abdullah, M. F., & Alam, M. K. (2023). Islamic crowdfunding practices in Malaysia: a case study on Nusa Kapital. *Asian Journal of Accounting Research*, 8(2), 145-156.
- Ramli, H. S., & Ishak, M. S. I. (2022). Equity-crowdfunding in Malaysia: the needs for a comprehensive Shariah governance. *The Journal of Management Theory and Practice (JMTP)*, 3(1), 48-55.
- Raoufi, M., & Robinson Fayek, A. (2018). Fuzzy agent-based modeling of construction crew motivation and performance. *Journal of Computing in Civil Engineering*, 32(5), 04018035.
- Redzuan, N. H., Kassim, S., & Shaharuddin, S. S. (2024). Literature Review on Islamic Crowdfunding. *Islamic Sustainable Finance*, 170-184.
- Regis, S., Manicom, O., & Doncescu, A. (2023). An agent-based model of COVID-19 Pandemic And Its Variants Using Fuzzy Subsets and Real Data Applied in an Island Environment. *The Knowledge Engineering Review*, 38, e2.
- Securities Commission Malaysia. (2020). *Guidelines on recognized markets*. Securities Commission Malaysia. <https://www.sc.com.my/regulation/guidelines/recognizedmarkets>
- Taha, T., & Macias, I. (2014). Crowdfunding and Islamic Finance: A Good Match?. In *Social Impact Finance* (pp. 113-125). London: Palgrave Macmillan UK.
- Tahir, M. Y., Shahid, M. S., Naheed, K., & Jamal, M. N. (2025). Adoption Of Reward-Based Crowdfunding In The Digital Era: Examining The Roles Of User Perceptions, Technology Readiness, Trust, And Financial Literacy. *Kashf Journal of Multidisciplinary Research*, 2(07), 1-16.
- Thaker, M. A. M. T., Pitchay, A. A., & Azid, T. (2021). Factors influencing crowdfunding platform success: A Malaysian Islamic finance perspective. *International Journal of Islamic and Middle Eastern Finance and Management*, 14(2), 327–345.
- Van Deursen, A. J., & Van Dijk, J. A. (2014). The digital divide shifts to differences in usage. *New Media & Society*, 16(3), 507–526.
- World Bank. (2017). *Crowdfunding and financial inclusion*. Washington, DC: World Bank. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/260021500685246308/crowdfunding-and-financial-inclusion>

Zaher, T. S., & Hassan, M. K. (2001). A comparative literature survey of Islamic finance and banking. *Financial Markets, Institutions & Instruments*, 10(4), 155–199.
<https://doi.org/10.1111/1468-0416.00044>

Zetsche, D. A., Buckley, R. P., Arner, D. W., & Barberis, J. N. (2020). Regulating LIBRA: The transformative potential of Facebook’s cryptocurrency and possible regulatory responses. *Harvard International Law Journal*, 61(1), 133–176.