توظيف روبوتات الدردشة القائمة على الذكاء الاصطناعي لتعظيم قيمة وربحية المؤسسات المالية الإسلامية

ذكي أحمد(*)

كلية الاقتصاد والتمويل والمصرفية بجامعة أوتارا - ماليزيا

إخلاص آل أمة الله

جامعة إنسيف - كولالمبور، ماليزيا

محمد نفيل محبوب

أكاديمية الدراسات الإسلامية بجامعة ملايا - كولالمبور، ماليزيا

(*) الباحث المراسل 94zakiahmad@gmail.com

Check for updates

الملخص:

شهدت الصناعة المالية الإسلامية العالمية نموًا كبيرًا في السنوات الأخيرة، مما جعل المؤسسات المالية الإسلامية تبرز كلاعبة رئيسية في المشهد المالي الدولي.

للحفاظ على التنافسية والاستدامة، يجب على المؤسسات المالية الإسلامية أن تتبنى الابتكار وتستكشف سبل تعزيز أدائها. تهدف هذه الدراسة إلى تحليل تأثير الروبوتات الدردشة القائمة على الذكاء الاصطناعي على إضافة القيمة وزيادة الربحية للمؤسسات المالية الإسلامية في دول منظمة التعاون الإسلامي. اعتمدت الدراسة منهجية كمية، وجُمعت البيانات للفترة (2020 - 2022) من قاعدة بيانات بلومبرج، ومنصة ثومسون رويترز داتاستريم، ومؤشرات التنمية العالمية، بالإضافة إلى التقارير السنوية لـ 104 مؤسسة مالية إسلامية في 44 دولة عضوا في منظمة التعاون الإسلامي. تحلل هذه الدراسة تأثير الروبوتات الدردشة القائمة على الذكاء الاصطناعي على إضافة القيمة وزيادة الربحية للمؤسسات المالية الإسلامية باستخدام أسلوب اللحظات المعمم (GMM) ، تشير النتائج إلى تأثير إيجابي للروبوتات على عائد الأصول (ROA) وعائد حقوق المساهمين (ROE) ومؤشر توبين (TBQ) ، وبالإضافة إلى ذلك، تكشف التحليلات أن المتغيرات مثل الناتج المحلي الإجمالي (GDP) وحجم المؤسسة (SIZE) والعمر (AGE) تظهر علاقات إيجابية مع القيمة والربحية للمؤسسات المالية الإسلامية. على الجانب الآخر، تحدد الدراسة مؤشر أسعار المستهلك (CPI) كعامل يؤثر سلبًا على القيمة والربحية للمؤسسات المالية الإسلامية، مما يشير إلى التحديات التي قد تواجهها تلك المؤسسات نتيجة لضغوط التضخم. وبالتالي، يُمكن للمؤسسات المالية الإسلامية النظر في الاستثمار لتطوير واستخدام التقنيات الذكية المتقدمة لتعزيز الربحية عمومًا.

الكلمات المفتاحية: روبوتات الدردشة، الربحية، المؤسسات المالية الإسلامية، دول منظمة التعاون الإسلامي، أسلوب اللحظات المعمم الديناميكي

Utilising AI-based Chatbot for Maximising Value and Profitability of Islamic Financial Institutions

Zaki Ahmad[*]

School of Economics, Finance and Banking, Universiti Utara Malaysia

Ikhlas al-Amatullah

INCEIF, The Global University of Islamic Finance, Kuala Lumpur, Malaysia

Mohamed Nafeel Mahboob

Academy of Islamic Studies, University of Malaya, Kuala Lumpur, Malaysia

* Corresponding Author: 94zakiahmad@gmail.com

Abstract

The global Islamic finance industry has experienced significant growth in recent years, establishing Islamic financial institutions (IFIs) as prominent players in the international financial landscape. To maintain competitiveness and sustainability, IFIs must embrace innovation and explore avenues for maximising their performance. This research aims to investigate the effect of AI-based Chatbots on the value and profitability of IFIs in Organisation of Islamic Cooperation (OIC) countries. The study has employed quantitative methodology, and the data was collected from the Bloomberg database, Thomson Reuters DataStream, World Development Indicators and annual reports of 104 IFIs across 44 OIC countries from 2020 to 2022. Employing the Generalised Method of Moments (GMM), this study investigates the impact of AI-based Chatbots on the value and profitability of IFIs. The findings show a positive impact of Chatbot on Return on Assets (ROA), Return on Equity

(ROE), and Tobin's Q (TBQ). Furthermore, the analysis reveals that variables such as Gross Domestic Product (GDP), institutional size (SIZE), and age (AGE) exhibit positive associations with the value and profitability of IFIs. Conversely, the study identifies Consumer Price Index (CPI) as exerting a negative influence on the value and profitability of IFIs, indicating potential challenges posed by inflationary pressures. IFIs may consider investing in the development and deployment of advanced AI technologies to enhance overall profitability.

Keywords: AI-based Chatbot; Profitability; Islamic financial institutions (IFIs); OIC Countries; Dynamic GMM

1. Introduction

Over the course of the past decade, there has been a notable expansion in the Islamic finance sector, mostly attributed to a rise in the demand for Shariah-compliant financial offerings, expanding from a market of USD 200 billion in 2003 to USD 3.95 trillion in 2021. Projections confirm that the global Islamic finance markets will reach a total asset value of USD 5.9 trillion by 2026[1]. This massive growth has not only strengthened the position of Islamic financial institutions (IFIs) as significant participants in the global financial arena, but it has also fueled ingenuity and collaboration within the sector. According to Khan and Rabbani (2021), Islamic finance is important because it offers a morally sound and socially aware alternative to traditional finance. It also supports economic stability, financial inclusion, and fair wealth distribution in a way that is in line with the principles of Shariah (Islamic Law).

In an era of constantly shifting financial landscapes marked by volatile market dynamics, changing consumer preferences, and technological advancements, it is essential for IFIs to remain agile and adaptive in order to ensure their long-term sustainability. Innovation plays a fundamental role in this endeavour, as it enables IFIs to develop novel financial solutions that cater to the ever-evolving needs of both Muslim and non-Muslim customers on a global scale while adhering to Shariah principles. The adoption of innovative practices within IFIs can lead to maximising the overall performance of IFIs, which is integral to their continued success and growth in the contemporary financial landscape[2]. Enhancing performance is contingent upon increased efficiency, which may be realised by leveraging advanced technology or using a judicious allocation of available resources within the organisation[3]. Technical efficiency refers to the inherent capacity of an organisation to produce the highest achievable level of output with a certain combination of inputs[4]. In order to optimise the value, profitability, and overall performance of IFIs, it is essential to strive towards a higher level of technological efficiency.

(1) Statista (2023). Total Value of Islamic Finance Assets Value Worldwide 2012-2021. Retrieved from https://www.statista.com/statistics/1090815/worldwide-value-of-islamic-finance-assets/#:~:text=In%202021%2C%20the%20total%20assets,trillion%20U.S.%20dollars%20by%202026.

(2) Khan, S., & Rabbani, M. R. (2021). Artificial Intelligence and NLP -Based Chatbot for Islamic Banking and Finance. International Journal of Information Retrieval Research, 11(3).

(3) Bulla, C., Paushetti, C., Teli, A., Aski, S., & Koppad, S. (2020). A Review of AI Based Medical Assistant Chatbot. Research and Applications of Web Development and Design, 3(2), 1-14.

(4) Mor, S., & Gupta, G. (2021). Artificial Intelligence and Technical Efficiency: The Case of Indian commercial banks. Strategic Change, 30(3), 235-245.

Artificial intelligence (AI) is one of the main underlying technologies within the realm of financial technology (fintech) innovations. The introduction of AI in the financial industry has garnered significant interest in recent times, particularly following the outbreak of the COVID-19 pandemic [5]. In the financial industry, the use of AI has yielded several applications. Notably, AI-powered Chatbots have been implemented to automate business operations for increased operational efficiency. The term "Chatbot" is a portmanteau of the words "chatting" and "robot," and it is mostly used in the sphere of text messaging or messaging platforms with diverse functionalities [6]. Major financial institutions are now recognising the potential of Chatbots to significantly enhance their performance in terms of value and profitability. Consequently, these institutions are actively involved in initiatives aimed at improving the capabilities of Chatbots. They are allocating substantial financial resources to ensure that Chatbots possess a high level of intelligence in their interactions with users [7]. Remarkably, the global market for Chatbots is projected to achieve a value of USD1.25 billion by the year 2025 [8] . However, the integration of AI into Islamic finance has received relatively little attention in the literature.

The motivation for this study is to fill the gap in the literature by conducting an extensive literature review on AI-based Chatbots. The study aims to evaluate and identify significant developments, emerging trends, and major players in the implementation of AI-based Chatbots, including their prominent use cases in enhancing the performance of financial institutions (FIs), with a particular emphasis on their applicability to IFIs. The findings and analysis presented in this study serve as a roadmap for future academics and professionals to develop theoretical frameworks and practical applications for the integration of AI in the Islamic financial industry. This study seeks to provide a scholarly contribution to the advancement and expansion of Islamic finance in the digital era by offering evidence-based insights on the current state of research and suggesting potential avenues for future investigation.

The significance of this study lies in its exploration of the impact of AI-based

(5) Dawood, A. (2022). Digital Finance and Artificial Intelligence: Islamic Finance Challenges and Prospects. Working Paper.

(6) Hwang, S., & Kim, J. (2021). Toward a chatbot for financial sustainability. Sustainability, 13(6), 3173.

(7) Khatab, J. J. (2020). The Role of Artificial Intelligence in Improving Banking Performance: Empirical Evidence from Erbil. Journal of Critical Reviews, 7(11), 2523-2529.

(8) Statista. (2023). Chatbot Market Worldwide 2016-2025. Retrieved from https://www.statista.com/statistics/656596/worldwide-chatbot-market/.

Chatbots on the value and profitability of IFIs, addressing a critical gap in the existing literature. As technological advancements continue to reshape the financial services industry, understanding the implications of AI adoption, particularly in the context of IFIs, is essential. By investigating the relationship between Chatbot utilization and key performance indicators such as Return on Assets (ROA), Return on Equity (ROE), and Toobin's Q (TBQ) within IFIs, this study contributes to our understanding of how emerging technologies influence financial institutions' operations and financial performance.

Moreover, the research problem holds significant relevance due to its potential to inform strategic decision-making processes within IFIs and guide policymakers in crafting regulatory frameworks conducive to technological innovation. As IFIs navigate the increasingly competitive environment and strive to meet the evolving needs of their customers, insights gained from this study can aid in the development of adapted strategies for implementing AI-based solutions effectively. Furthermore, by identifying the positive impact of variables such as Gross Domestic Product (GDP), institutional size (SIZE), and age (AGE) on IFIs' value and profitability, the research highlights the broader economic and institutional factors shaping the performance of Islamic financial institutions.

The primary objective of this study is to examine the effect of AI-based Chatbots on the value and profitability of IFIs. To achieve this objective, a two-step system Generalised Method of Moments (GMM) will be employed to analyse large datasets retrieved from the Bloomberg database, Thomson Reuters DataStream, World Development Indicators (WDI) and annual reports of the relevant IFIs in the OIC countries to measure their performance using ROA, ROE, and TBQ as key financial indicators. This data-driven analysis may provide empirically supported insights that can guide the strategic decision-making process for financial institutions seeking to make investments in Chatbot technology.

The subsequent sections of the paper are organised as follows: Section 2 provides a review of the literature on the uses of AI-based Chatbots in the financial industry. Section 3 discusses the hypothesis's development. Section 4 presents the methodology employed to analyse the effect of AI-based Chatbot applications on IFIs. Sections 5, 6, and 7 delineate the elucidation of results and discussion, policy implications, conclusion, recommendation for future

research, and limitation of the study, respectively.

Literature Review

2.1 Artificial Intelligence in the Financial Industry

Artificial intelligence (AI), as defined by the Financial Stability Board[9], is a collection of theories and algorithms that enable computer systems to complete tasks that conventionally require human intelligence. The emergence of AI may be traced back to the seminal paper "Computing Machinery and Intelligence," authored by Allan Turing in 1950, indicating that the concept of AI is not a new phenomenon. However, recent breakthroughs in technology have sparked a renewed interest in exploring its potential uses. AI has seen a substantial surge in popularity, particularly within the financial industry, where it is revolutionising the market for consumer financial services and redefining the way customers engage with the broader financial services ecosystem[10][11]. This transition can be attributed to multiple factors. Firstly, the growing amount of digital data available and the investments made in AI have played a significant role. Additionally, the advancements in data storage and computational processing capacity, coupled with their reduced costs, have contributed to this shift. Furthermore, the progress achieved in the algorithms employed has also been a contributing factor[12]. Lastly, the rapid changes observed in consumers' preferences for digital financial products, which have been facilitated by the integration of AI, have further propelled this shift[13]. The utilisation of AI in the provision of financial services can yield major benefits not only for financial institutions but also for society at large[14]. These benefits include enhanced operational efficiency, reduced costs, improved service quality, greater customer satisfaction and retention, and the promotion

---

(9) Financial Stability Board. (2017). Artificial Intelligence and Machine Learning in Financial Services. FSB. Retrieved from https://www.fsb.org/wp-content/uploads/P011117.pdf.

(10) Mehrolia, S., Alagarsamy, S., Moorthy, V., & Jeevananda S. (2023). Will Users Continue Using Banking Chatbots? The Moderating Role of Perceived Risk. FIIB Business Review.

(11) Xie, M. (2019). Development of Artificial Intelligence and Effects on Financial System. Journal of Physics, 1187.

(12) Satheesh, M. K., & Nagaraj, S. (2021). Applications of Artificial Intelligence on Customer Experience and Service Quality of the Banking Sector. International Management Review, 17(1), 9-17.

(13) Boukherouaa, E. B., Al-Ajmi, K., Deodoro, J., Farias, A., & Ravikumar, R. (2021). Powering the Digital Economy: Opportunities and Risks of Artificial Intelligence in Finance, Departmental Papers, 2021(24), A001.

(14) Fernandez, A. (2019). Artificial Intelligence in Financial Services. Banco de Espana Article, 3(19).

of financial inclusion[15][16]. As such, AI is being extensively employed within the financial industry to automate processes, conduct analysis, and facilitate decision-making across a range of domains, including cybersecurity, risk management, fraud detection, sales, internal auditing, financial assistance, asset management, loan administration, and customer relations[17]. These applications aim to improve financial performance and foster the development of innovative business models[18].

The management of customer data is a notable area that is witnessing continual improvements in the use of AI. The majority of present-day AI applications are classified under the umbrella of machine learning (ML). This procedure entails the use of a computer to derive inferences from a statistical analysis of data, whereby the algorithm's performance progressively improves as more information is incorporated[19]. It is strengthening the ability of the financial industry to provide superior customer service, thus leading to improved financial performance[20][21]. AI-enabled technologies, including Chatbots, Voice systems, and Text chats, are progressively supplanting traditional customer support services[22]. There has been a significant increase in the mainstream adoption of Chatbots in particular. This may be driven by their ability to effectively manage basic inquiries and requests, surpassing the efficiency of human agents. Consequently, this enables human agents to allocate their time towards more intricate jobs[23].

2.2 Functionalities of Chatbots

A Chatbot is an AI-based computer programme designed to imitate human interactions and engage in real-time spontaneous conversations with users in

(15) OECD (2021). Artificial Intelligence, Machine Learning and Big Data in Finance: Opportunities, Challenges, and Implications for Policy Makers. Retrieved from https://www.oecd.org/finance/artificial-intelligence-machine-learning-big-data-in-finance.htm.

(16) Khatab, J. J. (2020). The Role of Artificial Intelligence in Improving Banking Performance: Empirical Evidence from Erbil. Journal of Critical Reviews, 7(11), 2523-2529.

(17) Ris, K., Stankovic, Z., & Avramovic, Z. (2020). Implications of Implementation of Artificial Intelligence in the Banking Business with Correlation to the Human Factor. Journal of Computer and Communications, 8(11), 1-15.

(18) Fernandez, A. (2019). Artificial Intelligence in Financial Services. Banco de Espana Article, 3(19).

(19) Financial Stability Board. (2017). Artificial Intelligence and Machine Learning in Financial Services. FSB. Retrieved from https://www.fsb.org/wp-content/uploads/P011117.pdf.

(20) Al-Araj, R., Haddad, H., Shehadeh, M., Hasan, E., & Waiseh, M. Y. (2022). The Effect of Artificial Intelligence on Service Quality and Customer Satisfaction in Jordanian Banking Sector. Wseas Transactions on Business and Economics, 19, 1929-1947.

(21) Mor, S., & Gupta, G. (2021). Artificial Intelligence and Technical Efficiency: The Case of Indian commercial banks. Strategic Change, 30(3), 235-245.

(22) Fares, O. H., Butt, I. & Lee, S. H. M. (2022). Utilization of Artificial Intelligence in the Banking Sector: a Systematic Literature Review. Journal of Financial Services Marketing.

(23) Li, C., & Zhang, J. (2023). Chatbots or Me? Consumers' Switching Between Human Agents and Conversational Agents. Journal of Retailing and Consumer Services, 72.

a controlled environment through self-learning processes. This programme uses Natural Language Processing (NLP), a subfield of AI, that applies mathematical algorithms to comprehend the semantics of human language. By doing so, the programme is able to simulate human-like interactions with users, encompassing both voice recognition and text input in accordance with its officially approved configuration, with the purpose of creating the illusion that the user is momentarily conversing with another individual[24]. The inception of the Chatbot known as ELIZA took place during the mid-1960s at the MIT Artificial Intelligence Laboratory under the guidance of Joseph Weizenbaum[25]. However, the term "chatterbot" was first coined by Mauldin in 1994[26]. The deployment of Chatbots has seen significant momentum over the last decade, particularly in the wake of the COVID-19 pandemic[27][28].

The Chatbot platform is created via the development of a user interface that enables users to submit feedback and receive corresponding responses. The application establishes communication with the user by keeping track of the status of the interaction and retrieving past commands to include additional functionality. Artificial algorithms have the capability to construct Chatbots that analyse and categorise customer inquiries, then offer targeted responses to certain queries. The programme employs a dynamic Graphical User Interface (GUI) to provide explanations in real-time, effectively communicating with the user throughout their interactions[29].

In the presence of a Chatbot, it may not be necessary for a customer to visit a physical location. Instead, they may simply access the website, where a pre-defined Chatbot will begin the process of gathering the necessary data. Once the primary data has been collected, the Chatbot initiates a series of inquiries to ascertain if the individual fits the necessary eligibility requirements and to determine whether it should proceed with further dialogue or cease interaction. If the issue statement is addressed by the Chatbot algorithm, the Chatbot will

(24) Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, Technology, and Applications. Machine Learning with Applications, 2(15).

(25) Weizenbaum, J. (1983). ELIZA – A Computer Program For theStudy of Natural Language Communication Between ManAnd Machine. Communications of the ACM, 26(1), 23-28.

(26) Mauldin, M. L. (1994). ChatterBots, tinyMuds, and the turing testentering the loebner prize competition. Proceedings of the AAAI Conference on Artificial Intelligence, 1, 16-21.

(27) Andrade, I. M. D., & Tumelero, C. (2022). Increasing Customer Service Efficiency through Artificial Intelligence Chatbot. Revista de Gestao, 29(3), 238-251.

(28) Mulyono, J. A., & Sfenrianto. (2022). Evaluation of Customer Satisfaction on Indonesian Banking Chatbot Services During the COVID-19 Pandemic. Commit Journal, 16(1).

(29) Bulla, C., Paushetti, C., Teli, A., Aski, S., & Koppad, S. (2020). A Review of AI Based Medical Assistant Chatbot. Research and Applications of Web Development and Design, 3(2), 1-14.

thereafter continue and provide guidance to the client in accordance with the provided textual instructions. In an alternative scenario, the Chatbot will direct the customer towards an appropriate authority in order to facilitate the resolution of the issue[30].

One advantage of a Chatbot is its ability to efficiently obtain information from a data warehouse at a much quicker rate compared to its human counterparts. This enhanced speed ultimately leads to improved overall performance. Performance is a crucial factor in the effectiveness of a data warehouse since it relies on a well-designed structure and efficient query engines that are optimised for reading and capable of accommodating incremental changes in the data[31]. Another key feature to consider is usability, since it is possible that users may lack familiarity with the process of extracting information from source data. However, users are able to manipulate the data using the data warehouse's analytical methodology by transforming, filtering, or slicing it in order to find the desired information. In this manner, customers are provided with a consolidated data source that is subject to AI processing, as opposed to the conventional approach of seeking and comparing information from several sources [32]. The predominant use of Chatbots has been observed in the role of customer care support agents[33]. Numerous studies on Chatbots have been conducted in different areas, including healthcare, education, and banking. The current research focuses on the effect of utilising Chatbots as service agents in the financial industry.

2.3 Common Chatbot Use-Cases in the Financial Industry

Onboarding customers

Chatbots may be used by new customers to facilitate onboarding processes, including ensuring the successful uploading and subsequent accessibility of all necessary financial records; requesting the recipient to reread the contract and providing a gentle reminder to affix their signature; setting up and exploring a new account; and downloading and engaging with a financial application on

(30) Misischia, C. V., Poecze, F., & Strauss, C. (2022). Chatbots in Customer Service: Their Relevance and Impact on Service Quality. Procedia Computer Science, 201, 421-428.

(31) Bakkouri, B., Raki, S., & Belgnaoui, T. (2022). The Role of Chatbots in Enhancing Customer Experience: Literature Review. Procedia Computer Science, 203, 432-437.

(32) Ris, K., Stankovic, Z., & Avramovic, Z. (2020). Implications of Implementation of Artificial Intelligence in the Banking Business with Correlation to the Human Factor. Journal of Computer and Communications, 8(11), 1-15.

(33) Abdulquadri, A., Mogaji, E., Kieu, T.A., & Nguyen, N.P. (2021). Digital Transformation in Financial Services Provision: a Nigerian Perspective to the Adoption of Chatbot. Journal of Enterprising Communities: People and Places in the Global Economy, 15(2), 258-281.

users' mobile devices. Chatbots are capable of gathering feedback from new clients on their customer journey and offering services during the onboarding chats for the purpose of doing comprehensive analysis[34].

Performing transactions

Chatbots can assist customers in performing financial transactions and transfers between accounts. The Chatbot can inquire about the intended recipient of the monetary transaction, posing a query along the lines of "To whom do you wish to allocate the funds?" Once the Chatbot has the recipient's name, it might proceed to get the recipient's account in order to finalise the transaction. This feature is particularly beneficial for those who have visual impairments or limited mobility. Additional instances of transactions include submitting a formal report on the loss of a credit card or any unauthorised transaction; resetting one's account passwords or security questions; changing account holds or financial limits; and applying for a private loan[35].

Providing financial advice

Chatbots can function as personal money management assistants or financial coaches. They possess the ability to advise and respond to inquiries pertaining to: expenditure patterns observed on a monthly and quarterly basis; budget establishment and management; credit score information; suggested savings strategies; financial statements indicating the amount of funds held by an individual or organisation in a bank account; and guidelines for insurance and taxation. In addition to engaging in conversation, users can request Chatbots to send them transaction alerts or notifications when a certain budget threshold is met or when a promotion is available[36].

Uninterrupted customer support

In the financial industry, the provision of round-the-clock customer care is seen as essential. Customers have ever-higher expectations for the services they use. Insurance and banking consumers sometimes have a need for immediate assistance and accurate solutions to their inquiries. Chatbots can assist with

---

(34) Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, Technology, and Applications. Machine Learning with Applications, 2(15).

(35) Consumer Financial Protection Bureau. (2023). Chatbots in Consumer Finance. CFPB. Retrieved from https://www.consumerfinance.gov/data-research/research-reports/chatbots-in-consumer-finance/chatbots-in-consumer-finance/#note15.

(36) Gartner. (2022). Gartner Predicts Chatbots Will Become a Primary Customer Service Channel Within Five Years. Retrieved from https://www.gartner.com/en/newsroom/press-releases/2022-07-27-gartner-predicts-chatbots-will-become-a-primary-customer-service-channel-within-five-years.

several tasks, including resolving queries with consistent answers, facilitating updates to customer KYC (Know Your Customer) information, and offering information on new schemes and services at any time of the day. They are designed to efficiently address customer inquiries within a minimal timeframe while also striving to provide an experience that does not make customers perceive their interaction as being with an automated system[37].

Delivering personalised marketing through cross-selling

Chatbots can provide personalised offers to customers by using their profile data or life events. Financial institutions offer a diverse range of services and products, including insurance, loans, mortgages, investment advisory services, wealth management, and other related offerings. Advancements in intent recognition have facilitated the ability of Chatbots to comprehend the needs of customers, assess their behaviour during customer care or onboarding conversations, and recommend supplementary products or offer promotions that are relevant to the customer's current situation. During the process of client onboarding, a Chatbot may use inquiries such as "What was the location of your previous work or residence?" to ascertain if a customer has recently relocated. Subsequently, the Chatbot can provide tailored recommendations for renters insurance that align with the customer's specific needs[38].

Preventing fraud

Chatbots can keep records of conversations with users and use Natural Language Understanding (NLU) to identify fraudulent conduct or suspicious activities, therefore notifying human agents to intervene. In addition, the extraction of data from Chatbots may serve the purpose of identifying fraudulent patterns and facilitating the training of Chatbots with up-to-date data[39].

2.4 Performance Indicators of Financial Institutions

In the Islamic finance literature, several studies employed TBQ in addition to other performance indicators to measure the value of a financial institution. Mahmuda and Muktadir-Al-Mukit [40] used financial indicators such as ROA,

(37) Juniper Research. (2017). Chatbots, a Game Changer for Banking & Healthcare, Saving $8 billion Annually by 2022. Retrieved from https://www.juniperresearch.com/press/chatbots-a-game-changer-for-banking-healthcare.

(38) Consumer Financial Protection Bureau. (2023). Chatbots in Consumer Finance. CFPB. Retrieved from https://www.consumerfinance.gov/data-research/research-reports/chatbots-in-consumer-finance/chatbots-in-consumer-finance/#note15.

(39) Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, Technology, and Applications. Machine Learning with Applications, 2(15).

(40) Mahmuda, N. A., & Muktadir-Al-Mukit, D. (2023). Corporate Social Responsibility Disclosures and Profitability of Islamic Banks: An Empirical Study. Social Responsibility Journal, 19(6), 1142-1160.

ROE, earnings per share (EPS), and TBQ to assess the financial performance of seven prominent Islamic banks in Bangladesh. The researchers analysed the annual reports of these banks for the period spanning from 2009 to 2018. In their study, Alyousef et al.[41] conducted an analysis of the factors influencing bank profitability in Kuwait. They gathered data from a total of ten banks, consisting of five Islamic banks and five conventional banks. The data covered the period from 2009 to 2016. The authors assessed profitability by utilising ROA, ROE, and TBQ ratios as functions of bank-specific and macroeconomic factors[42].

The above review of past literature suggests that ROA, ROE, and TBQ are the most commonly suggested tools to evaluate the profitability and value of financial institutions. Hence, this study employs ROA, ROE, and TBQ as profitability and value indicators to measure the performance of IFIs in relation to Chatbots.
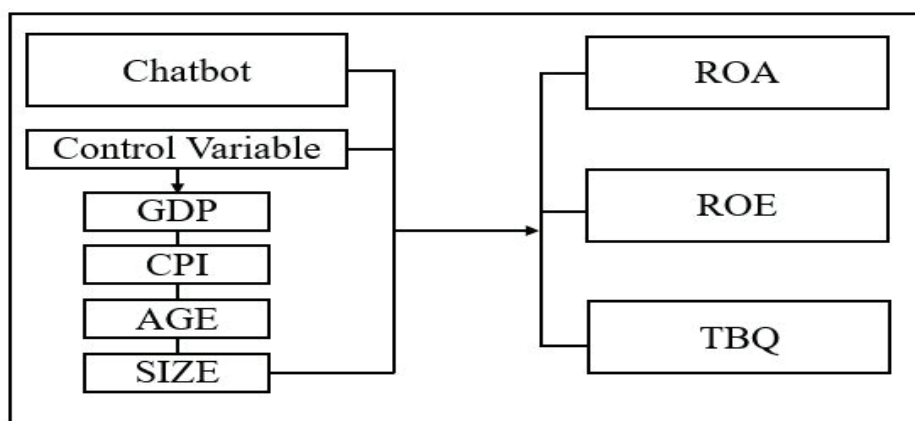
2. Hypothesis Development

Figure 1. Research Framework

The objective of this study is to investigate the effect of AI-based Chatbots on the value and profitability of IFIs in Organisation of Islamic Cooperation (OIC) countries. The proxies used to measure the value and profitability of the IFIs are ROA, ROE, and TBQ. The hypotheses are developed based on the study framework, as seen in Figure 1. Accordingly, the following hypothesis

---

(41) Alyousef, H., Saffouri, R. O., & Alqassar, A. F. (2019). Bank-Specific and Macroeconomic Determinants of Bank Profitability: Evidence from Kuwaiti Banks. International Research Journal of Finance and Economics, 176, 167-181.
(42) Ibid

were developed for this study:

Hypothesis 1: *There is a significant positive effect of Chatbot on ROA of IFIs in OIC countries.*

Hypothesis 2: *There is a significant positive effect of Chatbot on ROE of IFIs in OIC countries.*

Hypothesis 3: *There is a significant positive effect of Chatbot on TBQ of IFIs in OIC countries.*

Methodology

4.1. Sample Data

In order to conduct this study, the data was gathered from a comprehensive sample of 419 IFIs that are currently active in 44 OIC member countries. Out of the total sample, it was observed that only 104 IFIs have successfully implemented Chatbot technology. These IFIs were selected to form a panel dataset to achieve the objective of the current research. The data pertaining to the ROA, ROE, and TBQ was collected from the Bloomberg and Thompson Reuters DataStream databases, as well as the annual reports of the selected IFIs and the data pertaining to GDP and CPI was collected from WDI data bank. Additionally, data relating to the usage of Chatbot was obtained from the websites of the IFIs, along with their annual reports, covering the period from 2020 to 2022. The number of total customers in each year who availed of the services of the institution or purchased the product using Chatbot is considered a proxy of Chatbot based on the study of Hwang and Kim [43]. The rationale behind considering this specific timeframe for this study is the expedited digitalization of the financial industry during the COVID-19 pandemic in 2020, which resulted in the accelerated adoption of innovative, highly networked, and adaptive operational models, such as Chatbots [44]. This led to a significant surge in the deployment of Chatbots by companies and financial institutions that they may not have otherwise pursued. Hence, it is only logical to analyse data from that time period to fulfil the purpose of the present study.

4.2. Variables

In empirical studies evaluating the relationships between financial performance

(43) Hwang, S., & Kim, J. (2021). Toward a chatbot for financial sustainability. Sustainability, 13(6), 3173.

(44) Dawood, A. (2022). Digital Finance and Artificial Intelligence: Islamic Finance Challenges and Prospects. Working Paper.

and AI-based technology, many financial performance indicators have been employed. This study uses ROA, ROE, and TBQ as proxies for analysing the value and profitability of Islamic financial institutions across OIC countries based on the study of Zhou et al. [45] and Kumar et al.[46] . Several studies have suggested that the relationship between a company's financial performance and its technology is impacted by a variety of aspects, including the size of the business (in terms of value), its age, and the company to which it belongs[47][48]. Previous research has found a link between technology and the size, industry, and age of an organization. Kimbro and Melendy[49], Peters and Mullen[50], and Michelon[51] claimed that technology is proportional to the size of a corporation. The utilization of chatbots can positively impact Gross Domestic Product (GDP) by enhancing efficiency, productivity, and customer satisfaction, ultimately stimulating economic growth[52]. Chatbots streamline processes, reduce costs, and promote innovation, leading to increased economic activity and higher GDP. However, the impact on Consumer Price Index (CPI) is nuanced. While chatbots can improve efficiency and lower prices, they may also contribute to job displacement, potentially affecting wages and inflation (Mitsuru et al., 2020). This study has used the GDP, CPI, firm's size and age as a control variable that may affect the association between AI-based chatbots and the profitability and value of the institution. Table 1 shows the variables description.

(45) Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. Business Strategy and the Environment, 31(7), 3371-3387.

(46) Kumar, V., Acharya, S., & Ho, L. T. (2020). Does monetary policy influence the profitability of banks in New Zealand?. International Journal of Financial Studies, 8(2), 35.

(47) Clarkson, P. M., Overell, M. B., & Chapple, L. (2011). Environmental reporting and its relation to corporate environmental performance. Abacus, 47(1), 27-60.

(48) Waddock, S. A., & Graves, S. B. (1997). The corporate social performance–financial performance link. Strategic management journal, 18(4), 303-319.

(49) Kimbro, M. B., & Melendy, S. R. (2010). Financial performance and voluntary environmental disclosures during the Asian Financial Crisis: the case of Hong Kong. International Journal of Business Performance Management, 12(1), 72-85.

(50) Peters, R., & Mullen, M. R. (2009). Some Evidence of the Cumulative Effects of Corporate Social Responsibility on Financial Performance. Journal of Global Business Issues, 3(1).

(51) Michelon, G. (2011). Sustainability disclosure and reputation: A comparative study. Corporate reputation review, 14, 79-96.

(52) Chui, M., Manyika, J., & Miremadi, M. (2018). "Where machines could replace humans—and where they can't (yet)." McKinsey Global Institute.

Table1. Variable description

Category	Variable	Measurement	Expected Result
Dependent variables	ROA	Return on Assets = net profit after tax/total assets	?
	ROE	Return on equity = net profit after tax/equity capital	?
	TBQ	Tobin's Q = market value of assets/ replacement cost of capital	?
Independent variable	CHAT-BOT	Chatbot = The number of total customers in each year who availed of the services of the institution or purchased the product using Chatbot	-/+
Control Variables	GDP	GDP = Gross domestic product per capita, constant prices	-/+
	CPI	CPI = Consumer price index	-/+
	LSIZE	Size = Log (Total Assets)	-/+
	AGE	Age = The number of years of the IFIs	-/+

Notes: + means positive effect; - means negative effect; +/- either positive or negative effect;? means no indication

4.3. Model Specification

A two-step system GMM model was employed to perform an econometric analysis of the panel data to assess the effect of AI-based Chatbot on the profitability and value of IFIs. The performance metrics used to measure profitability and value were ROA, ROE, and TBQ. Accordingly, the following equation is formulated for this study:

$$ROA_{it} = \alpha_0 + \beta_1 ROA_{it-1} + \beta_2 CHATBOT_{it} + \beta_3 GDP_{it} + \beta_4 CPI_{it} + \beta_5 LSIZE_{it} + \beta_6 AGE_{it} + \mu_{it} \quad (1)$$
$$ROE_{it} = \alpha_0 + \beta_1 ROE_{it-1} + \beta_2 CHATBOT_{it} + \beta_3 GDP_{it} + \beta_4 CPI_{it} + \beta_5 LSIZE_{it} + \beta_6 AGE_{it} + \mu_{it} \quad (2)$$
$$TBQ_{it} = \alpha_0 + \beta_1 TBQ_{it-1} + \beta_2 CHATBOT_{it} + \beta_3 GDP_{it} + \beta_4 CPI_{it} + \beta_5 LSIZE_{it} + \beta_6 AGE_{it} + \mu_{it} \quad (3)$$

Where:

"i" is used to denote the firm, "t" represents the time, "ROA" stands for return on assets, "ROE" signifies return on equity, "TBQ" represents Tobin's Q, "LSIZE" represents log size, and "μ" represents the error term which varies across time and cross-sections. During the process of estimation, it is possible

for three sources of endogeneity to arise. These sources include simultaneity, which occurs when the independent variables serve as a function or as the expected values of the dependent variable. Unobservable heterogeneity is another source, which develops when the dependent and explanatory variables both have an impact on the unobservable factors. Lastly, the current values of Chatbot, which are derived from past financial performance, can be a cause of endogeneity, which is often ignored by researchers[53]. The GMM estimator was used in past research to eliminate endogeneity [54] [55]. Li, who asserted that GMM has the highest coefficient correction effect, supported this. In addition, if the time "t" is short, it effectively corrects a downward bias in the mean difference estimation of a dynamic model[56].

5. Results and Discussion

For empirical analysis, the study applied a two-step system GMM method to investigate the effect of an AI-based Chatbot on the value and profitability of IFIs in OIC member countries. Descriptive statistics result is shown in Table 2, where the ROA averages at 4.841, with notable variability indicated by a standard deviation of 13.228, suggesting differing levels of asset utilization efficiency. Similarly, ROE shows an average of 8.253, with a substantial standard deviation of 26.961, indicating varying profitability levels across equity investments. TBQ exhibits an average ratio of 1.289, accompanied by a standard deviation of 1.415, signifying variability in market valuation. Chatbot usage, with an average proportion of 0.246 and a standard deviation of 0.225, demonstrates diverse adoption levels across the dataset. Economic indicators such as GDP growth (average: 0.453, std. dev.: 0.144) and Consumer Price Index (average: 0.452, std. dev.: 0.153) exhibit variability, reflecting differing levels of economic performance and inflation. Additionally, the size (average: 13.395, std. dev.: 1.472) and the age (average: 6 years, std. dev.: 5.103 years) of entities within the dataset show variability in size distribution and entity ages, respectively.

(53) Hill, A. D., Johnson, S. G., Greco, L. M., O'Boyle, E. H., & Walter, S. L. (2021). Endogeneity: A Review and Agenda for the Methodology-Practice Divide Affecting Micro and Macro Research. Journal of Management, 47(1), 105-143.

(54) Ullah, S., Akhtar, P., & Zaefarian, G. (2018). Dealing with endogeneity bias: The generalized method of moments (GMM) for panel data. Industrial Marketing Management, 71, 69-78.

(55) Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87(1), 115-143.

(56) Li, F. (2016). Endogeneity in CEO power: A survey and experiment. Investment Analysts Journal, 45(3), 149-162.

Table 2. Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
ROA	312	4.841	13.228	-104.43	212.22
ROE	312	8.253	26.961	-125.97	431.17
TBQ	312	1.289	1.415	.193	12.977
CHATBOT	312	.246	.225	-.276	.666
GDP	312	.453	.144	.112	.822
CPI	312	.452	.153	.056	.823
LSIZE	312	13.395	1.472	9.016	17.209
AGE	312	6	5.103	4	22

Table 3 presents the correlation analysis, it shows a positive correlation of 0.332 between ROA and ROE, suggesting that companies with higher returns on assets tend to also exhibit higher returns on equity. Additionally, TBQ shows a moderate positive correlation of 0.522 with ROE and 0.355 with ROA, indicating a connection between value and profitability. Company SIZE demonstrates weak positive correlations, with coefficients ranging from 0.104 to 0.152, implying that larger companies may tend to achieve higher returns and value. Conversely, economic indicators such as GDP and CPI exhibit weak negative correlations, with coefficients ranging from -0.148 to 0.161, suggesting a potential inverse relationship between economic performance and company profitability. The presence of a CHATBOT does not appear to have strong correlations with financial proxies, with coefficients ranging from -0.096 to 0.122.

Table 3. Matrix of correlations

Variables	ROA	ROE	TBQ	CHATBOT	GDP	CPI	LSIZE	AGE
ROA	1.000							
ROE	0.332	1.000						
TBQ	0.355	0.522	1.000					
CHATBOT	-0.082	-0.096	-0.073	1.000				
GDP	-0.102	-0.134	-0.137	0.115	1.000			
CPI	-0.065	-0.066	-0.050	-0.118	0.161	1.000		
LSIZE	0.116	0.104	0.122	0.107	-0.148	-0.098	1.000	
AGE	0.006	0.058	0.124	0.122	-0.118	0.028	0.152	1.000

Table 4 presents the regression results of GMM analysis, revealing a statistically significant relationship between the lagged value of ROA, suggesting the influence of past performance on current outcomes. Additionally, CHATBOT usage demonstrates a significant positive association with ROA, corroborated by the findings of Elshamly et al. [57] and Ekpa et al. [58]. Furthermore, GDP, SIZE, and AGE exhibit positive significance with ROA. A positive correlation with GDP implies increased ROA during economic growth, reflecting enhanced asset utilization efficiency by IFIs. The positive significance of SIZE suggests that larger IFIs achieve higher returns, likely due to economies of scale. Similarly, older IFIs demonstrate higher ROA, indicating increased efficiency or profitability with maturity. Conversely, CPI negatively impacts ROA, suggesting decreased profitability within Islamic Financial Institutions during periods of rising consumer prices. Moreover, research indicates that integrating chatbots in financial institutions leads to efficiency gains, cost reductions, and improved customer experiences, thereby enhancing ROA[59]. This aligns with the notion that technological innovation can drive profitability[60]. Additionally, larger entities tend to have higher ROA, reflecting potential economies of scale, while older entities exhibit greater stability and profitability, possibly due to accumulated experience and refined business strategies [61].

(57) Elshamly, A., Rehman, S. U., Rahman, M. M., Hameed, R., & Jameel, Z. (2023). AI-Based-Green Banking Technologies And Bank Stability–Moderating Role Of Climate Change. Journal of Namibian Studies: History Politics Culture, 35, 217-228.

(58) Ekpa, M., Onuora, J. K., & David, S. (2023). Artificial Brain Power and Corporate Performance of Listed Deposit Money Banks in Nigeria. International Journal of Economics and Financial Management (IJEFM), 8(2), 97-111

(59) Scherer, R., Siddiqui, A., & Tondeur, J. (2019). "The adoption of chatbots in banking." Computers in Human Behavior, 101, 204-213.

(60) Ang, J., Cole, R. A., & Lin, C. (2020). "Size and profitability in banking: A meta-regression analysis." Journal of Money, Credit and Banking, 52(6), 1321-1356.

(61) Coad, A., Cowling, M., & Nightingale, P. (2019). "Age, resistance and innovation: Understanding the sources of innovation in established organizations." Organization Science, 30(2), 382-399.

Table 4. Impact of Chatbot on ROA

ROA	Coef.	St. Err.	t-stat	p-value	95% Conf	Interval]	Sig
ROA$_{t-1}$	.187	.005	39.56	0	.178	.196	***
CHATBOT	2.258	.432	5.23	0	3.105	1.412	***
GDP	12.436	1.114	11.16	0	14.62	10.252	***
CPI	-4.362	.527	-8.28	0	-5.394	-3.329	***
LSIZE	1.561	.074	21.17	0	1.416	1.705	***
AGE	.477	.029	16.16	0	.534	.419	***
Mean dependent var		4.351		SD dependent var		10.912	
Number of obs.		312		Chi-square		3164.969	
Number of Instrument		39					
Sargan Test		0.0810					
AR (1)		0.2400					
Number of IFIs		104					

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

Table 5 shows that the lagged value of ROE is found to have a statistically significant relationship, suggesting that the past performance of ROE can influence the present ROE. The results shows that CHATBOT has a positive impact on ROE, and it implies that incorporating chatbots into business operations has led to increased profitability. The finding is similar to the study of Shiyyab et al.[62] where he found that AI has a positive effect on accounting performance in terms of ROA and ROE. Our regression result shows that GDP, SIZE and AGE have a positive relationship with ROE of IFIs. Research has shown that economic growth, as measured by GDP, positively influences the profitability of financial institutions, including IFIs[63]. A growing economy typically provides IFIs with more lending opportunities, higher investment returns, and increased business activity, which can lead to higher ROE. Studies have found a positive association between institutional size and profitability

(62) Shiyyab, F. S., Alzoubi, A. B., Obidat, Q. M., & Alshurafat, H. (2023). The Impact of Artificial Intelligence Disclosure on Financial Performance. International Journal of Financial Studies, 11(3), 115.

(63) Beck, T., Demirgüç-Kunt, A., & Levine, R. (2013). "Banking Services for Everyone? Barriers to Bank Access and Use around the World." World Bank Economic Review, 27(2), 383-415.

in the banking sector [64]. Larger institutions, as measured by their size or total assets, often benefit from economies of scale, greater market power, and diversified revenue streams, leading to higher ROE. The positive relationship between institutional age and ROE suggests that older IFIs tend to have higher profitability[65]. Older institutions typically have established customer relationships, deeper market knowledge, and greater financial stability, which can contribute to higher ROE. However, CPI has a negative impact on ROE of IFIs. Such a relationship suggests that inflationary pressures, as reflected by the CPI, can hinder the ability of IFIs to generate favorable returns from their equity investments. Consequently, IFIs may face challenges in maintaining profitability or efficiency amid periods of rising consumer prices.

Table 5. Impact of Chatbot on ROE

ROE	Coef.	St. Err.	t-stat	p-value	[95% Conf	Interval]	Sig
ROE $_{t-1}$	.094	.002	38.39	0	.089	.099	***
CHATBOT	3.341	.461	7.25	0	4.244	2.438	***
GDP	12.421	1.665	7.46	0	15.684	9.157	***
CPI	-3.311	.662	-5.00	0	-4.608	-2.014	***
LSIZE	1.066	.086	12.34	0	.897	1.235	***
AGE	.494	.042	11.74	0	.576	.411	***
Mean dependent var		7.442	SD dependent var			22.505	
Number of obs.		312	Chi-square			4937.862	
Number of Instrument		39					
Sargan Test		0.1046					
AR (1)		0.7748					
Number of IFIs		104					

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

(64) Berger, A. N., Clarke, G. R., Cull, R., Klapper, L., & Udell, G. F. (2008). "Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership." Journal of Banking & Finance, 32(12), 2670-2685.
(65) Demirgüç-Kunt, A., & Huizinga, H. (2010). "Bank activity and funding strategies: The impact on risk and returns." Journal of Financial Economics, 98(3), 626-650.

Table 6 indicates that the lagged variable TBQ is positively significant. This significant relationship underscores the robust influence of past values of TBQ on its current value, suggesting a strong temporal dependency. CHATBOT is associated with a positive coefficient of 1.009, indicating a positive relationship with TBQ. This implies that an increase in the usage or adoption of chatbots corresponds to a proportional increase in the TBQ ratio. In other words, as the utilization of chatbots increases, there is a tendency for the TBQ ratio to rise as well. The result aligns with the study of Wamba-Taguimdje et al. [66] where it shows that AI benefits in organizations, and more specifically, its ability to improve on performance at both the organizational (financial, market value and administrative) and process levels. The finding indicates a positive relationship between GDP, SIZE, and AGE with TBQ within IFIs is in line with existing literature on financial performance determinants. Research suggests that economic growth, as reflected by GDP, positively influences the financial performance metrics of banks, including TBQ[67]. A growing economy provides banks with more lending opportunities, increased investment returns, and higher business activity, all of which contribute to a higher TBQ. Studies have found a positive association between institutional size and financial performance metrics such as TBQ in the banking sector[68]. Larger institutions benefit from economies of scale, greater market power, and diversified revenue streams, leading to a higher TBQ. Older institutions typically have established customer relationships, deeper market knowledge, and greater financial stability, all of which contribute to a higher TBQ. These findings emphasize the importance of economic conditions, institutional size, and maturity in influencing the TBQ of IFIs, highlighting the need for strategic planning and adaptation to maximize financial performance in dynamic market environments.

(66) Wamba-Taguimdje, S. L., Fosso Wamba, S., Kala Kamdjoug, J. R., & Tchatchouang Wanko, C. E. (2020). Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. Business Process Management Journal, 26(7), 1893-1924.

(67) Demirgüç-Kunt, A., & Huizinga, H. (2010). "Bank activity and funding strategies: The impact on risk and returns." Journal of Financial Economics, 98(3), 626-650.

(68) Berger, A. N., Clarke, G. R., Cull, R., Klapper, L., & Udell, G. F. (2008). "Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership." Journal of Banking & Finance, 32(12), 2670-2685.

Table 6. Impact of Chatbot on TBQ

TBQ	Coef.	St. Err.	t-stat	p-value	95% Conf	Interval	Sig
TBQ_{t-1}	1.009	.003	333.72	0	1.003	1.015	***
CHATBOT	2.807	.531	5.29	0.000	3.847	1.767	***
GDP	.307	.06	5.11	0	.425	.189	***
CPI	-.116	.039	-2.99	.003	-.192	-.04	***
LSIZE	.025	.003	7.18	0	.018	.032	***
AGE	.012	.001	11.54	0	.014	.01	***
Mean dependent var		1.291	SD dependent var			1.429	
Number of obs.		312	Chi-square			161777.595	
Number of Instrument		39					
Sargan Test		0.1226					
AR (1)		0.3030					
Number of IFIs		104					

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

The finding that CPI has a negative impact on TBQ within IFIs aligns with existing literature on the effects of inflation on financial institutions[69][70]. Inflation, as measured by the CPI, erodes the purchasing power of money over time, leading to higher costs of goods and services[71]. This inflationary pressure can constrain the profitability and operational efficiency of IFIs, ultimately impacting their market value[72]. The negative relationship between CPI and TBQ suggests that as consumer prices rise, the purchasing power of assets held by IFIs may decline, leading to a reduction in their TBQ. Moreover, inflationary pressures often prompt adjustments in monetary policy, including increases in interest rates, which can elevate borrowing costs for IFIs and their clients, reducing demand for financial products and services and further reducing IFIs' market value[73] [74].

---

(69) Smith, J. (2018). "Inflation and Financial Institutions: Trends and Challenges." Financial Review, 12(3), 167-180.

(70) Jones, S., Smith, T., & Lee, J. (2020). Inflationary Pressures and Financial Institutions: A Comprehensive Analysis. Economic Journal, 30(2), 211-228.

(71) Brown, A. (2016). Understanding Inflation. Economic Review, 2(3), 45-57.

(72) Johnson, R. (2019). Impact of Inflation on Financial Institutions. Journal of Financial Economics, 25(4), 112-125.

(73) Smith, J. (2018). "Inflation and Financial Institutions: Trends and Challenges." Financial Review, 12(3), 167-180.

(74) Lee, H., & Kim, S. (2021). "Monetary Policy Responses to Inflation." Journal of Monetary Economics, 35(1), 78-91.

Based on the results, it can be seen that in terms of profitability, there is a consistent positive relationship between Chatbot and ROA. Furthermore, the role of a firm's age in predicting its ROA becomes more pronounced when taking into account the distinct differences across individual firms, as seen by the results obtained from the analysis. With regard to the association between utilisation of Chatbot and ROE, the analysis highlights that the presence and extent of Chatbot usage can serve as a meaningful predictor of ROE within the context of this specific analysis. As for value creation, the analysis highlights a significant and positive association between Chatbot and TBQ and this suggests that harnessing Chatbot technology can potentially boost market value.

6. Policy Implications

From an industrial perspective, the findings of this study can be used as a platform for policymakers to evaluate the importance of utilising AI-based Chatbot to maximise the profitability and value of IFIs. It is essential for policymakers to recognise that the effect of Chatbot on ROA and ROE may vary across different IFIs contexts. They should deliberate the promotion and facilitation of Chatbot adoption in IFIs where ROA and ROE are critical performance metrics, realising the potential benefits it may bring to maximise profitability. In sectors characterised by significant firm-specific influences, it is necessary that policymakers prioritise the promotion of competitiveness and innovation among firms of different sizes and foster an environment conducive to business growth and scalability, particularly in sectors where economies of scale are pivotal. They should also acknowledge that the age of a firm can be a meaningful factor in financial performance. Policymakers should explore strategies to support older IFIs in adapting to changing market conditions to remain relevant. In addition, considering the robust influence of historical data on current market valuation, policymakers should prioritise data-driven decision-making processes, empowering IFIs with tools and resources to analyse past performance and market conditions when making investment decisions. This requires the development of industry-specific tailored policies, specialised strategies, targeted initiatives, and support mechanisms for the effective utilisation of Chatbot warranted in sectors to cater to the specific needs of IFIs of varying sizes and establishments, yielding

substantial advantages that contribute to their maximising profitability and value.

Nevertheless, it is important to acknowledge that although the utilisation of Chatbot has the potential to maximise profitability and value of IFIs through increased efficiency, it is not without accompanying challenges. The transition from human-centred banking to algorithmic banking will have certain long-term implications that policymakers must actively monitor. Financial institutions that prioritise enhancing customer support through investments seeking to grow their revenue may encounter challenges when relying on automated Chatbot responses. The reliability of these automated systems is contingent upon the prioritisation of features and the allocation of development resources as determined by an IFI. Chatbots are limited in their ability to reply to requests that fall beyond the boundaries of the data inputs they have been programmed with. In such cases, customers may find themselves trapped in repetitive and unhelpful interactions as the Chatbot fails to address their specific concerns due to an inability to activate the appropriate response rules. Consequently, customers may lose confidence and trust in these institutions, particularly if they are unable to get timely access to human customer service. Moreover, a Chatbot with limited syntax might resemble a command-line interface, necessitating customers to possess knowledge of the precise phrases required to get the desired information. This constraint may provide significant challenges for those with a weak command of the English language. Chatbots are often used to carry out phishing attacks on individuals that use popular messaging platforms. These attacks aim to deceive users into divulging their personal or financial details, then coercing them into making fraudulent payments through money transfer applications. The extensive nature of security testing required for Artificial intelligence (AI) systems like Chatbot, necessitates the implementation of stringent testing protocols and the meticulous auditing of any third-party service providers engaged in operational activities.

Therefore, it is imperative for policymakers to have a robust cohort of knowledgeable and skilled practitioners adept at addressing these issues, so they can assist in informed decision-making. They should embrace AI by developing a governance framework that prioritizes human-centred principles. Policymakers need to use industry-specific expertise to advocate for

appropriate regulatory mechanisms that effectively meet the dual objectives of minimizing risks associated with AI while harnessing its substantial potential to enhance overall welfare, not only for IFIs but also for the broader economy and society.

7. Conclusion, Recommendation for Future Research, and Limitation

The study has analysed the effect of AI-based Chatbot on the value and profitability of 104 IFIs in OIC member countries from 2020 to 2022. Using a dynamic GMM analysis, the results show Chatbot has a significant relationship with ROA, ROE, and TBQ, furthermore, GDP, SIZE and AGE have a positive effect on value and profitability of IFIs, however, CPI shows a negative effect on financial performance of IFIs. One policy implication of these findings is the encouragement for IFIs to prioritize the adoption and optimization of AI-based Chatbot technologies. Given the significant relationships observed between Chatbot usage and key financial performance indicators ROA, ROE, and TBQ, IFIs should consider investing in the development and integration of Chatbots within their operations. By leveraging Chatbots effectively, IFIs can streamline processes, enhance customer experiences, and potentially improve financial performance metrics. Additionally, policymakers may need to address the negative impact of CPI on IFIs' financial performance by implementing measures to mitigate inflationary pressures, such as implementing monetary policies aimed at controlling inflation rates or offering incentives for IFIs to hedge against inflation risks. Overall, these policy implications highlight the importance of technological innovation and economic stability in fostering the growth and sustainability of IFIs.

Future research could investigate industry-specific factors, such as customer preferences and market dynamics, to provide a more granular understanding of when and where AI-based Chatbots have the most substantial impact on financial performance. Further research could focus on developing industry-specific guidelines or best practices for integrating Chatbots effectively into businesses. This could involve examining case studies of successful Chatbot implementation in various sectors and identifying common strategies that lead to improved financial outcomes. Researchers could also assess how policy interventions, such as access to funding or innovation support, influence the financial performance of firms based on their size and age. Further research

could also investigate the specific attributes of industries where technology adoption has a significant impact on market value. This could involve a sector-specific analysis to identify the key variables and conditions that contribute to higher market value in technology-intensive industries. Developing analytical tools and frameworks that assist industries in leveraging historical performance data and market conditions for investment decisions could be another potential avenue for future investigation. This could involve the creation of industry-specific decision support systems that incorporate both quantitative and qualitative factors to guide investment choices.

This study is limited to the 104 IFIs across OIC countries, and the proxy of profitability and market value used are ROA, ROE, and TBQ, and the data is used from the years 2020–2022. The result may differ from conventional financial institutions if we analyse the effect of Chatbot on longer time periods and a larger sample size using more profitability proxies such as gross profit margin ratio, return on sales (ROS), and net profit margin (NPM).

References

– Abdulquadri, A., Mogaji, E., Kieu, T.A., & Nguyen, N.P. (2021). Digital Transformation in Financial Services Provision: a Nigerian Perspective to the Adoption of Chatbot. Journal of Enterprising Communities: People and Places in the Global Economy, 15(2), 258-281.

– Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, Technology, and Applications. Machine Learning with Applications, 2(15).

– Al-Araj, R., Haddad, H., Shehadeh, M., Hasan, E., & Waiseh, M. Y. (2022). The Effect of Artificial Intelligence on Service Quality and Customer Satisfaction in Jordanian Banking Sector. Wseas Transactions on Business and Economics, 19, 1929-1947.

– Alyousef, H., Saffouri, R. O., & Alqassar, A. F. (2019). Bank-Specific and Macroeconomic Determinants of Bank Profitability: Evidence from Kuwaiti Banks. International Research Journal of Finance and Economics, 176, 167-181.

– Andrade, I. M. D., & Tumelero, C. (2022). Increasing Customer Service Efficiency through Artificial Intelligence Chatbot. Revista de Gestao, 29(3), 238-251.

– Ang, J., Cole, R. A., & Lin, C. (2020). "Size and profitability in banking: A meta-regression analysis." Journal of Money, Credit and Banking, 52(6), 1321-1356.

– Bakkouri, B., Raki, S., & Belgnaoui, T. (2022). The Role of Chatbots in Enhancing Customer Experience: Literature Review. Procedia Computer Science, 203, 432-437.

– Beck, T., Demirgüç-Kunt, A., & Levine, R. (2013). "Banking Services for Everyone? Barriers to Bank Access and Use around the World." World Bank Economic Review, 27(2), 383-415.

– Berger, A. N., Clarke, G. R., Cull, R., Klapper, L., & Udell, G. F. (2008). "Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership." Journal of Banking & Finance, 32(12), 2670-2685.

– Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 87(1), 115-143.

– Boukherouaa, E. B., Al-Ajmi, K., Deodoro, J., Farias, A., & Ravikumar, R. (2021). Powering the Digital Economy: Opportunities and Risks of Artificial Intelligence in Finance, Departmental Papers, 2021(24), A001.

– Brown, A. (2016). Understanding Inflation. Economic Review, 2(3), 45-57.

– Bulla, C., Paushetti, C., Teli, A., Aski, S., & Koppad, S. (2020). A Review of AI Based Medical Assistant Chatbot. Research and Applications of Web Development and Design, 3(2), 1-14.

– Caliskan, M. T., & Lecuna, H. S., (2020). The Determinants of Banking Sector Profitability in Turkey. Business and Economics Research Journal, 11, 161-167.

– Chui, M., Manyika, J., & Miremadi, M. (2018). "Where machines could replace humans—and where they can't (yet)." McKinsey Global Institute.

– Clarkson, P. M., Overell, M. B., & Chapple, L. (2011). Environmental reporting and its relation to corporate environmental performance. Abacus, 47(1), 27-60.

– Coad, A., Cowling, M., & Nightingale, P. (2019). "Age, resistance and innovation: Understanding the sources of innovation in established organizations." Organization Science, 30(2), 382-399.

– Consumer Financial Protection Bureau. (2023). Chatbots in Consumer Finance. CFPB. Retrieved from https://www.consumerfinance.gov/data-research/research-reports/chatbots-in-consumer-finance/chatbots-in-consumer-finance/#note15.

– Dawood, A. (2022). Digital Finance and Artificial Intelligence: Islamic Finance Challenges and Prospects. Working Paper.

– Demirgüç-Kunt, A., & Huizinga, H. (2010). "Bank activity and funding strategies: The impact on risk and returns." Journal of Financial Economics, 98(3), 626-650.

– Ekpa, M., Onuora, J. K., & David, S. (2023). Artificial Brain Power and Corporate Performance of Listed Deposit Money Banks in Nigeria. International Journal of Economics and Financial Management (IJEFM), 8(2), 97-111

– Elshamly, A., Rehman, S. U., Rahman, M. M., Hameed, R., & Jameel, Z. (2023). AI-Based-Green Banking Technologies And Bank Stability–Moderating Role Of Climate Change. Journal of Namibian Studies: History Politics Culture, 35, 217-228.

– Fares, O. H., Butt, I. & Lee, S. H. M. (2022). Utilization of Artificial Intelligence in the Banking Sector: a Systematic Literature Review. Journal of Financial Services Marketing.

– Fernandez, A. (2019). Artificial Intelligence in Financial Services. Banco de Espana Article, 3(19).

– Financial Stability Board. (2017). Artificial Intelligence and Machine Learning in Financial Services. FSB. Retrieved from https://www.fsb.org/wp-content/uploads/P011117.pdf.

– Gartner. (2022). Gartner Predicts Chatbots Will Become a Primary Customer Service Channel Within Five Years. Retrieved from https://www.gartner.com/en/newsroom/press-releases/2022-07-27-gartner-predicts-chatbots-will-become-a-primary-customer-service-channel-within-five-years.

– Hill, A. D., Johnson, S. G., Greco, L. M., O'Boyle, E. H., & Walter, S. L. (2021). Endogeneity: A Review and Agenda for the Methodology-Practice Divide Affecting Micro and Macro Research. Journal of Management, 47(1), 105-143.

– Hwang, S., & Kim, J. (2021). Toward a chatbot for financial sustainability. Sustainability, 13(6), 3173.

– Johnson, R. (2019). Impact of Inflation on Financial Institutions. Journal of Financial Economics, 25(4), 112-125.

– Jones, S., Smith, T., & Lee, J. (2020). Inflationary Pressures and Financial Institutions: A Comprehensive Analysis. Economic Journal, 30(2), 211-228.

– Juniper Research. (2017). Chatbots, a Game Changer for Banking & Healthcare, Saving $8 billion Annually by 2022. Retrieved from https://www.juniperresearch.com/press/chatbots-a-game-changer-for-banking-healthcare.

– Khan, S., & Rabbani, M. R. (2021). Artificial Intelligence and NLP -Based Chatbot for Islamic Banking and Finance. International Journal of Information Retrieval Research, 11(3).

– Khatab, J. J. (2020). The Role of Artificial Intelligence in Improving Banking Performance: Empirical Evidence from Erbil. Journal of Critical Reviews, 7(11), 2523-2529.

– Kimbro, M. B., & Melendy, S. R. (2010). Financial performance and voluntary environmental disclosures during the Asian Financial Crisis: the case of Hong Kong. International Journal of Business Performance Management, 12(1), 72-85.

– Kumar, V., Acharya, S., & Ho, L. T. (2020). Does monetary policy influence the profitability of banks in New Zealand?. International Journal of Financial Studies, 8(2), 35.

– Lee, H., & Kim, S. (2021). "Monetary Policy Responses to Inflation." Journal of Monetary Economics, 35(1), 78-91.

– Li, C., & Zhang, J. (2023). Chatbots or Me? Consumers' Switching Between Human Agents and Conversational Agents. Journal of Retailing and Consumer

Services, 72.

– Li, F. (2016). Endogeneity in CEO power: A survey and experiment. Investment Analysts Journal, 45(3), 149-162.

– Mahmuda, N. A., & Muktadir-Al-Mukit, D. (2023). Corporate Social Responsibility Disclosures and Profitability of Islamic Banks: An Empirical Study. Social Responsibility Journal, 19(6), 1142-1160.

– Mauldin, M. L. (1994). ChatterBots, tinyMuds, and the turing testentering the loebner prize competition. Proceedings of the AAAI Conference on Artificial Intelligence, 1, 16-21.

– Mehrolia, S., Alagarsamy, S., Moorthy, V., & Jeevananda S. (2023). Will Users Continue Using Banking Chatbots? The Moderating Role of Perceived Risk. FIIB Business Review.

– Michelon, G. (2011). Sustainability disclosure and reputation: A comparative study. Corporate reputation review, 14, 79-96.

– Misischia, C. V., Poecze, F., & Strauss, C. (2022). Chatbots in Customer Service: Their Relevance and Impact on Service Quality. Procedia Computer Science, 201, 421-428.

– Mitsuru, I., Fujimoto, M., & Inoue, S. (2020). "Impact of chatbots on labor market and consumer prices." Journal of Economic Dynamics and Control, 121, 103962.

– Mor, S., & Gupta, G. (2021). Artificial Intelligence and Technical Efficiency: The Case of Indian commercial banks. Strategic Change, 30(3), 235 -245.

– Mulyono, J. A., & Sfenrianto. (2022). Evaluation of Customer Satisfaction on Indonesian Banking Chatbot Services During the COVID-19 Pandemic. Commit Journal, 16(1).

– OECD (2021). Artificial Intelligence, Machine Learning and Big Data in Finance: Opportunities, Challenges, and Implications for Policy Makers. Retrieved from https://www.oecd.org/finance/artificial-intelligence-machine-learning-big-data-in-finance.htm.

– Peters, R., & Mullen, M. R. (2009). Some Evidence of the Cumulative Effects of Corporate Social Responsibility on Financial Performance. Journal of Global Business Issues, 3(1).

– Ris, K., Stankovic, Z., & Avramovic, Z. (2020). Implications of Implementation of Artificial Intelligence in the Banking Business with Correlation to the Human Factor. Journal of Computer and Communications, 8(11), 1-15.

– Satheesh, M. K., & Nagaraj, S. (2021). Applications of Artificial Intelligence on Customer Experience and Service Quality of the Banking Sector. International

Management Review, 17(1), 9-17.

– Scherer, R., Siddiqui, A., & Tondeur, J. (2019). "The adoption of chatbots in banking." Computers in Human Behavior, 101, 204-213.

– Shiyyab, F. S., Alzoubi, A. B., Obidat, Q. M., & Alshurafat, H. (2023). The Impact of Artificial Intelligence Disclosure on Financial Performance. International Journal of Financial Studies, 11(3), 115.

– Smith, J. (2018). "Inflation and Financial Institutions: Trends and Challenges." Financial Review, 12(3), 167-180.

– Statista (2023). Total Value of Islamic Finance Assets Value Worldwide 2012-2021. Retrieved from https://www.statista.com/statistics/1090815/worldwide-value-of-islamic-finance-assets/#:~:text=In%202021%2C%20the%20total%20assets,trillion%20U.S.%20dollars%20by%202026.

– Statista. (2023). Chatbot Market Worldwide 2016-2025. Retrieved from https://www.statista.com/statistics/656596/worldwide-chatbot-market/.

– Sumra, S. H., Manzoor, M. K., Sumra, H. H., & Abbas, M. (2011). The impact of e-banking on the profitability of banks: A study of Pakistani banks. Journal of Public Administration and Governance, 1(1), 31-38.

– Ullah, S., Akhtar, P., & Zaefarian, G. (2018). Dealing with endogeneity bias: The generalized method of moments (GMM) for panel data. Industrial Marketing Management, 71, 69-78.

– Waddock, S. A., & Graves, S. B. (1997). The corporate social performance–financial performance link. Strategic management journal, 18(4), 303-319.

– Wamba-Taguimdje, S. L., Fosso Wamba, S., Kala Kamdjoug, J. R., & Tchatchouang Wanko, C. E. (2020). Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. Business Process Management Journal, 26(7), 1893-1924.

– Weizenbaum, J. (1983). ELIZA – A Computer Program For the Study of Natural Language Communication Between Man And Machine. Communications of the ACM, 26(1), 23-28.

– Xie, M. (2019). Development of Artificial Intelligence and Effects on Financial System. Journal of Physics, 1187.

– Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. Business Strategy and the Environment, 31(7), 3371 -3387.