Economic Growth and Islamic Financial Inclusion in OIC Countries: Evidence with Spline Approach

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Abstract

Keywords:
Economic Growth; Islamic Financial Inclusion; OIC Countries; Spline Approach

JEL Classifications:
O47; G21; E44; O16; C14

Background: Digital financial inclusion is presently one of the most acknowledged domains of international development. Financial inclusion is pertains to the accessibility of inexpensive financial services for individuals and enterprises to fulfill their requirements.

Objectives: This study aims to analyze the effect of Islamic financial inclusion on economic growth in Organization of Islamic Cooperation (OIC) member countries, focusing on the importance of financial infrastructure and digital adoption in Muslim-majority nations.

Novelty: This study presents a novel methodology by analyzing the correlation between economic growth and Islamic financial inclusion in the context of OIC (Organization of Islamic Cooperation) nations with a Spline regression model. This research explicitly examines Islamic financial inclusion, a neglected aspect that adheres to the norms and practices of Sharia law, in contrast to traditional studies that address financial inclusion in a general sense.

Research Methodology / Design: The research employs the Spline regression approach to capture the non-linear relationship between Islamic financial inclusion and economic growth. The dependent variable is economic growth represented by GDP per capita, while the independent variables consist of the number of ATMs, Islamic bank branches, mobile phone usage, and internet access. The study uses data from 47 OIC member countries, with independent variables from 2022 and the dependent variable from 2023.

Findings: The results indicate that the maturity level of financial infrastructure and the adoption of technology significantly contribute to economic growth. The separation of indicators based on their influence provides valuable insights for policymakers to design more targeted financial inclusion strategies. Furthermore, the findings highlight that access to financial services, digital adoption, and Islamic financial practices play a transformative role in improving GDP per capita across OIC countries.

Implication: The findings provide both theoretical and practical implications by demonstrating that tailored financial inclusion policies are needed to accommodate diverse national contexts and stages of economic development in OIC member states.

A. Introduction

Digital financial inclusion is presently one of the most acknowledged domains of international development (Duvendack & Mader, 2020). It has recently garnered global attention from policymakers and enterprises (Lai et al. (2020); Gabor & Brooks (2017)). Digital financial inclusion refers to initiatives aimed at delivering affordable digital access to financial services, especially for financially underserved populations (X. . Zhang et al., 2019). It provides digital methods for capital production, savings, and investment prospects for enterprises (Ozili, 2018). Digitalization and technology advancements have markedly improved financial services (Vives, 2019).

Financial inclusion is pertains to the accessibility of inexpensive financial services for individuals and enterprises to fulfill their requirements (Word Bank, 2025); (Le et al., 2019); (Mhlanga, 2022). The advancement of fintech has given rise to the notion of digital financial inclusion, which entails utilizing digital technologies to provide accessible formal financial services to unbanked persons and enterprises (Lyman & K, 2015). Although financial inclusion is not expressly designated as a sustainable development target (SDG), it is acknowledged as a crucial facilitator of eight of the seventeen SDGs (Klapper et al., 2016). This highlights the crucial importance of financial inclusion in advancing development goals, leading many developing countries to strive for elevated levels of financial inclusion.

A robust financial system is a crucial factor that promotes economic progress (A. . Umar, 2017). The intermediation function of financial institutions is crucial for attaining financial system stability, income equality, and economic progress (Adzimatinur & Manalu, 2021). Thus, the fundamental principles of Islam emphasize social justice, inclusion, and the fair distribution of resources between the affluent and the impoverished. Islamic finance addresses "financial inclusion" or "access to finance" through two lenses: firstly, by advocating risk-sharing contracts as a feasible substitute for conventional debt financing, and secondly, by endorsing particular mechanisms for wealth redistribution within society (Rahmah, 2023). A defining feature of Sharia-compliant corporations, including Sharia banks, is their utilization of risk-sharing financing instruments to provide funding for small and medium-sized enterprises and microinsurance, thereby improving access to capital. Additionally, redistributive mechanisms like as Zakat, Sadaqat, Waqf, and Qard-al-hassan complement risk-sharing tools to address vulnerable segments of society, so forming a comprehensive plan for poverty alleviation and the establishment of a robust and dynamic economy. Consequently, it possesses the capacity to mitigate disparities and poverty within the economy (Mohieldin, Rostom, et al., 2011).

Given these issues, Islamic finance, which complies with Shariah law principles, presents a viable answer for meeting the requirements of these marginalized groups. The concepts of Islamic finance stress equality, social responsibility, and risk-sharing, setting it apart from traditional finance (Ameziane, 2024).

The World Bank and Islamic Development Bank Group (2016) assert that Islamic financing can incorporate 40 million individuals into formal financial institutions, and enhanced access to Islamic finance can positively influence economic growth (Imam & Kpodar, 2016). Moreover, the OECD (2020) emphasizes the capacity of Islamic finance to foster a more stable and equitable financial system in accordance with the Sustainable Development Goals (SDGs). The substantiates this concept, proposing that Islamic finance can advance Sustainable Development Goals by enabling investments in sustainable infrastructure (Ahmed, 2017).

Notwithstanding the established presence and expansion of Islamic finance in the region, access remains constrained, as indicated by the Global Findex 2021, underscoring a deficiency in financial inclusion attributable to religious factors in Islamic Nations (Demirgüç-Kunt et al., 2022). Even prominent markets such as Malaysia, Indonesia, Saudi Arabia, and the UAE necessitate additional enhancement. These countries are diligently enhancing their Islamic financial sectors, emphasizing FinTech innovation, regulatory frameworks, and sustainability (Refinitiv, 2022).

This study presents a novel methodology by analyzing the correlation between economic growth and Islamic financial inclusion in the context of OIC (Organization of Islamic Cooperation) nations with a Spline regression model. This research explicitly examines Islamic financial inclusion, a neglected aspect that adheres to the norms and practices of Sharia law, in contrast to traditional studies that address financial inclusion in a general sense. However, beyond methodological considerations, the relationship between Islamic financial inclusion and economic growth is inherently dynamic and may not follow a linear pattern. Countries at different stages of Islamic financial development may experience varying marginal effects of inclusion on growth, reflecting threshold effects, saturation patterns, or diminishing returns. These economic mechanisms justify the use of spline regression as a more appropriate tool to capture structural changes in slope across different levels of Islamic financial inclusion.

The study employs spline modeling to elucidate the non-linearities and threshold effects in this connection, providing detailed insights into the impact of differing levels of Islamic financial inclusion on economic growth across different OIC economies. Incorporating these economic rationales strengthens the argument that spline regression is not merely a technical choice but represents the underlying economic behavior of financial deepening in Islamic economies.

A notable innovation pertains to the dataset and geographical emphasis. The study specifically examines OIC member nations, which frequently exhibit varied stages of economic development and degrees of financial inclusion, so offering a substantial background for analysis. It also highlights statistics specific to Islamic finance, like the adoption of Islamic banking services, the magnitude of Islamic financial assets, and involvement in Sukuk markets. These customized measurements provide a more accurate comprehension of the contribution of Islamic finance institutions to economic growth, especially in mostly Muslim countries.

The current research primarily examines financial inclusion broadly, frequently overlooking the unique attributes and principles of Islamic finance. Moreover, research on Islamic financial inclusion is scarce and seldom examines its effects on economic growth, particularly in OIC member nations. Most previous studies utilize linear models that do not consider possible threshold effects or non-linear interactions, resulting in deficiencies in comprehending the intricate dynamics involved. Such limitations further highlight the importance of adopting a non-linear econometric approach capable of identifying structural breaks in the relationship, which aligns with theoretical expectations of varying growth impacts at different financial inclusion stages. This work addresses these gaps by incorporating Islamic financial inclusion measures with spline modeling, offering a thorough and context-specific analysis of their effects on economic growth.

This study aims to examine the effect of Islamic financial inclusion on economic growth in OIC member nations through the Spline regression method. This research seeks to elucidate the intricate and non-linear linkages between Islamic financial inclusion and economic growth by concentrating on indicators particular to Islamic finance. The study aims to furnish empirical evidence regarding the impact of differing levels of Islamic financial inclusion on economic performance in various economic contexts, thereby addressing gaps in the literature and aiding in the formulation of targeted policies to promote economic growth in predominantly Muslim countries.

B. Literature Review

Financial inclusion refers to the provision of financial access to low-income groups of society at a reasonable cost (Ali et al., 2019). The designation low-income segment encompasses terms such as "non-banked," "non-bankable," "unbanked individuals," or impoverished populations (Allen et al., 2012); (Kunt & Klapper, 2013); (Mohieldin, Iqbal, et al., 2011). Kimutai (2015) defines financial inclusion as the delivery of banking services to the unbanked population by diverse financial institutions, including banks and microfinance entities. Financial inclusion encompasses four dimensions: accessible finance for all households and enterprises, robust financial institutions, sustainable financial and institutional practices, and vigorous competition among service providers to enhance customer options.

This study's theoretical framework is grounded in the Finance-Growth Nexus theory, which posits that financial intermediaries can enhance economic growth by facilitating funding for entrepreneurial endeavors. King and Levine (1993) assert that financial markets and institutions can enhance economic development by mobilizing savings and facilitating transactions (King & Levine, 1993). Nevertheless, access to financial services is frequently constrained by numerous obstacles. In Islamic nations, religious considerations impede access to money because Shariah law prohibits interest, leading to a substantial share of financial resources being excluded from the economic process. According to Al-Jarhi (2017), Islamic finance, governed by Shariah law, improves resource mobilization for those dedicated to ethical investments and abstaining from interest, therefore fostering economic progress (Al-Jahri, 2017).

While the Finance–Growth Nexus provides the foundation for understanding how financial systems stimulate economic development, it also implies that the effect of financial access on growth may vary depending on the level of financial development. This opens space for potential non-linearities. For instance, initial increases in access may yield large growth benefits in economies with underdeveloped Islamic financial sectors, whereas more advanced economies may experience diminishing marginal returns. Such theoretical expectations strengthen the rationale for employing spline regression to capture threshold-dependent dynamics

Multiple studies underscore the beneficial influence of Islamic finance on economic growth. Boukhatem and Ben Moussa (2018) investigate the dynamic relationships between Islamic banking and economic growth by employing pooled FMOLS regressions on data from selected MENA countries spanning 2000 to 2014. Islamic financial development is found to enhance economic growth (Boukhatem & Ben Moussa, 2018). Muhammad et al. (2019) examine the effects of Islamic finance compared to conventional finance on economic growth in Pakistan. The application of GMM to quarterly data from 2006Q3 to 2017Q4 demonstrates that Islamic finance fosters economic growth and meets certain demands unmet by conventional finance (Muhammadd et al., 2019). Ledhem & Mekidiche (2020) enhance this comprehension by employing system GMM to evaluate the influence of Islamic financial performance on economic growth, utilizing data from 2014 to 2018. The findings demonstrate that the profitability of Islamic finance positively influences economic growth (Ledhem & Mekidiche, 2020). Likewise, Shah et al. (2020) examine the relationship between Islamic financial instruments and economic growth in Pakistan during the period from 2005 to 2015. The study employs unit root tests, OLS, and Granger causality tests to substantiate the causal association between Islamic funding and economic growth (Shah et al., 2020). Tabash and Dhankar (2014) examine the influence of Islamic banking on the economic growth of three chosen MENA countries: Qatar, Bahrain, and the UAE. The research utilizes cointegration testing on quarterly data spanning from 1990 to 2010. The findings indicate a sustained favorable correlation between Islamic banking and economic growth (Tabash & Dhankar, 2014).

Moreover, the results of the causality test demonstrate that Islamic bank financing favorably influences economic growth in the short term. This underscores the crucial significance of Islamic banking in the economic development of these three countries, both in the short term and long term. Derradj et al. (2024) examine the influence of Islamic financing on the expansion of the Malaysian economy, utilizing the ARDL model on quarterly data from Q1 2018 to Q4 2022. The results indicate that Islamic banking is a significant catalyst for Malaysia's economic expansion (Derradj et al., 2024). These studies comprehensively delineate the role of Islamic finance in fostering economic growth across many regions and nations, demonstrating its potential as a crucial vehicle for economic development.

The increasing importance of financial inclusion has stimulated scholars' interest in assessing its effects on economic development and growth in various contexts, utilizing a range of approaches. Chinoda and Mashamba (2021) perform thorough research employing the panel ARDL model for 23 African nations from 2004 to 2018. The study emphasizes the significance of financial inclusion as a driver of long-term economic progress in African Nations (Chinoda & Mashamba, 2021). Emara and El Said (2021) utilize GMM estimate techniques on a panel of MENA nations spanning from 1965 to 2016. The outcome underscores the capacity of inclusive financial institutions to foster prosperity throughout MENA Nations (Emara & El Said, 2021). Similarly, Nkwede (2015) examines data from Nigeria spanning the years 1981 to 2013, employing the OLS approach. The findings indicate that financial inclusion positively impacts economic growth in Nigeria (Nkwede, 2015). Ozturk and Ullah (2022) analyze data from 42 economies inside the OBRI for the period from 2007 to 2019, employing OLS, 2SLS, and GMM methodologies. The results underscore the potential of digital financial inclusion in fostering inclusive economic growth (Ozturk & Ullah, 2022). Oanh (2024) use Panel Vector Autoregressive models to examine data from 45 nations. The study indicates varying impacts of digital financial inclusion in the context of low financial development levels (Oanh, 2024). Liu et al. (2021) utilize a Bayesian panel VAR model for specific Chinese provinces from 2011 to 2019. The findings indicate that digital financial inclusion fosters economic growth. Exhibiting a beneficial influence in nations with elevated financial development levels and an adverse effect in other countries (Liu et al., 2021).

Additionally, geographical approaches utilized by Shen et al. (2021) demonstrate a beneficial impact of digital financial inclusion on economic development. The findings emphasize the significance of incorporating geographical dynamics in the analysis of the relationship between financial inclusion and economic growth (Shen et al., 2021). Khera et al. (2021) employ cross-sectional analysis to investigate data from 52 developing nations spanning the period from 2011 to 2018. The findings demonstrate that digital financial inclusion fosters inclusive economic growth across many countries and contexts (Khera et al., 2021). Demir et al. (2022) employ quantile regressions to analyze data from 140 chosen countries, revealing that financial inclusion mediates the effect of fintech on diminishing income disparity (Demir et al., 2022). Daud & Ahmad (2023) contribute to the literature by employing dynamic panel analysis on data from 84 countries in the post-financial crisis period, illustrating that financial inclusion promotes economic growth, with digital technology mediating this relationship (Daud & Ahmad, 2023). Thaddeus et al. (2020) employ the VECM to examine data from 22 African nations between 2011 and 2017, demonstrating a positive long-term effect of digital financial inclusion on economic growth (Thaddeus et al., 2020).

Although there is a substantial body of literature on Islamic finance and economic growth, as well as on financial inclusion and economic growth, research explicitly focusing on Islamic financial inclusion and its effects on economic growth is limited. To the author's knowledge, the sole study in this field is conducted by Novreska & Arundina (2024), which investigates the influence of Islamic financial inclusion on human development. Utilizing panel data from 33 Indonesian provinces spanning 2014 to 2022, the findings demonstrate that Islamic financial inclusion substantially improves human development in Indonesia (Novreska & Arundina, 2024).

However, the existing literature has not extensively examined whether the relationship between Islamic financial inclusion and economic growth follows a linear or non-linear pattern. Given differences in market maturity, regulatory environments, and cultural preferences across OIC countries, it is plausible that the marginal effect of Islamic financial inclusion on growth changes at certain thresholds. This theoretical gap further justifies the adoption of econometric techniques capable of detecting heterogeneous impacts across levels of inclusion, such as spline regression.

Sarma (2012) proposed a methodology for calculating an Index of Financial Inclusion (IFI) to assess the degrees of financial inclusion among states or provinces within countries over a certain timeframe. The method satisfies the assumptions of comparability, mathematical qualities, and three dimensions: accessibility, availability, and utilization of financial services. The accessibility indicator reflects the extent of formal financial institution penetration, quantified by the total amount of third-party deposits. The availability variable is represented by the number of banking branches, whereas the utilization dimension encompasses the volume of credit/financing relative to the overall household sector. A comparable study was conducted by Sanjaya and Nursechafia (2016), who assessed the impact of conventional banking on financial inclusion and the degree of inclusive growth in Indonesia, whereas Umar (2017) computed an Islamic financial inclusion index for Islamic rural banks (BPRS) in Indonesia.

The objective is to address the deficiency in current research by assessing the Islamic financial inclusion index in Indonesia for Islamic commercial banks (BUS) and Islamic business units (UUS) across three dimensions: accessibility, availability, and utilization of Islamic banking goods and services (Sarma, 2012). Exclusively utilized Islamic rural banks as the sample for assessing Islamic financial inclusion in Indonesia and assessed the financial inclusion index based on traditional banks (Sanjaya & Nursechafia, 2016; A. Umar, 2017).

Research related to Islamic Financial Inclusion and Economic Growth in OIC Countries has been conducted by Massinissa Ameziane (2024). The study analyzes the impact of Islamic financial inclusion on economic growth across various quantiles in OIC countries with Sarma's methodology is employed to develop a new index of Islamic financial inclusion (IIFI) and to conduct a quantile regression with fixed effects and applied to data covering the years 2015 to 2020 from 25 OIC nations. The results indicate that Islamic financial inclusion positively influences economic growth in OIC nations across all GDP per capita sectors, with the effect being uniform across all segments. Policymakers should leverage the transformative potential of Islamic finance to foster sustainable economic growth and development in OIC nations by increasing the network of Islamic banks and improving the technology infrastructure for financial access (Ameziane, 2024).

Despite this contribution, previous studies predominantly rely on linear frameworks, overlooking the possibility that Islamic financial inclusion may exert differential effects across stages of financial deepening. This gap further reinforces the need for methodologies such as spline regression that can empirically capture threshold-dependent behavior consistent with economic theory.

C. Research Methodology

This study uses one dependent variable as a representative of economic growth measured by GDP per capita in the OIC countries studied and uses four independent variables related to Financial Inclusion including Numbers of ATMs, Islamic Bank Branches, Mobile Cellular and Using Internet. Due to data shortages in some OIC member countries that are difficult to interpolate, this study only focuses on 47 countries with data in 2022 for independent variables and data in 2023 for dependent variables. The research variables used can be seen in Table 1 below.

Table 1. Used of Variables

Variable	Symbol	Measurement	Source
Economic Growth	GDP	The level of economic growth, Measured of Real Gross Domestic Product (GDP) per Capita (USD)	World Bank
Numbers of ATM	ATM	Numbers of ATM for 100 Adults in each country	World Bank
Bank Branches Islamic	BBI	Number of Bank Branches for 100.000 Adults in each country	World Bank
Mobile Cellular	MC	Mobile cellular subscriptions for 100 People	World Bank
Using Internet	UI	Individuals using internet (Percentage of Population)	World Bank

This research uses the Spline approach. Spline is defined as a flexible segment of polynomial pieces that can effectively adapt to the characteristics of the data used. These polynomial segments play a significant role due to their flexibility and efficiency in processing attributes or data (Eubank, 1998). One of the most critical polynomial segments is the Spline, which originates from an optimization problem. Estimation in Spline depends on the knot points, which are the points where the pattern of a function changes within different intervals (Eiilers & Marx, 2010). Spline excels in handling data patterns with sharp fluctuations by utilizing knot points, resulting in a well-fitted curve. The Spline estimator can independently estimate its parameters, thereby producing a model that conforms to the data's structure, even for dynamic data (Brugnano et al., 2024). For instance, given data $(x_{1i}, x_{2i}, \dots, x_{pi}, y_i)$, where $(x_{1i}, x_{2i}, \dots, x_{pi})$ are predictors and y_i is the response, the nonparametric regression model can be expressed as follows (Hardle, 1990).

In addition to its statistical advantages, the use of Spline regression in this study is also supported by strong economic reasoning. The relationship between Islamic financial inclusion and economic growth is widely recognized as non-linear due to several macroeconomic mechanisms. First, improvements in financial inclusion typically generate substantial economic benefits at early stages—particularly in countries where access to financial services is low—leading to large marginal gains in productivity and capital mobilization. However, after reaching certain levels, the economic impact tends to diminish, reflecting diminishing marginal returns. Second, many OIC countries experience threshold effects: economic growth responds differently at lower versus higher levels of financial infrastructure development, including digital finance, Islamic banking penetration, and ATM availability. Therefore, the Spline approach is appropriate because it captures these structural shifts in the relationship, allowing different slopes before and after key threshold points. By incorporating spline knots, the model reflects the dynamic and heterogeneous nature of financial inclusion processes across OIC economies.

$$y_i = \sum_{j=i}^{p} f(x_{ji}) + \varepsilon_i \tag{1}$$

Where:

$$y_i = \sum_{h=0}^{q} \beta_{hj} x_{ji}^h + \sum_{i=0}^{m} \beta_{(q+1)j}(x_{ji} - k_{ij})_+^q + \varepsilon_i \tag{2}$$

The truncated function is defined as

$$(x_{ji} - k_{ij})_+^q = \begin{cases} (x_{ji} - k_{ij})_j^q, & x_{ji} \geq k_{ij} \\ 0, & x_{ji} \leq k_{ij} \end{cases} \tag{3}$$

Where $k_{ij}, k_{2j}, \dots, k_{mj}$ are the knot points indicating changes in the function at specific intervals, and q represents the polynomial degree. The equation can be expanded as (W. Zhang & Goh, 2013).

$$y_i = \beta_{01} + \beta_{11}x_{1i} + \cdots + \beta_{q1}x_{1i}^q + a_{11}(x_{1i} - k_{11})_+^q \ldots a_{m1}(x_{1i} - k_{m1})_+^q + \beta_{02} + \beta_{12}x_{2i} + \cdots + \beta_{q2}x_{2i}^q + a_{12}(x_{2i} - k_{12})_+^q \ldots a_{m2}(x_{2i} - k_{m2})_+^q + \beta_{0p} + \beta_{p1}x_{pi} + \cdots + \beta_{qp}x_{pi}^q + a_{1p}(x_{pi} - k_{1p})_+^q \ldots a_{mp}(x_{pi} - k_{mp})_+^q + \varepsilon_i \tag{4}$$

Optimal knot points are critical in nonparametric spline regression. Data behavior changes at certain intervals, and the best Spline estimator is determined based on the minimum Generalized Cross Validation (GCV) criterion (Prenter, 2008). he selection of optimal knot points in this context also has economic relevance. Each knot may represent a change in the marginal impact of financial inclusion on growth — for example, when a country transitions from limited access to moderate access, or from traditional banking to digital financial services. Thus, knot determination is not only a statistical operation but also an empirical identification of economic thresholds within OIC countries.

$$GCV\left(k_1, k_2, \ldots, k_j\right) = \frac{MSE(k_1, k_2, \ldots, k_j)}{\left(n^{-1}Trace\left[I - A(k_1, k_2, \ldots, k_j)\right]\right)^2} \tag{5}$$

The coefficient of determination R^2 measures the model's explanatory power

$$R^2 = \frac{\hat{\beta}^T X^T y - n\bar{y}^2}{y^T y - n\bar{y}^2} \; x \; 100\% \tag{6}$$

D. Result & Discussion

The characteristics of economic growth represented by the value of GDP Per Capita along with independent variables related to Financial Inclusion can be seen in Table 2. Financial Inclusion indicators used include Numbers of ATMs, Islamic Bank Branches, Mobile Cellular and Using Internet.

Table 2. Descriptive Statistics

Variable	Mean	Variance	Std Dev.	Minimum	Maximum
GDP	8502.2	160966996.8	12687.27696	540.58	63428.36
ATM	27.34	579.0206	24.06285	1.9	92.46
BBI	9.64	73.16252	8.553509	0.85	54.28
MC	113.99	1341.7882	36.630427	42.07	212.22
IU	63.64	823.50546	28.696785	10.00	100.00

Source: Author's Processed Data, 2025

The first thing to do in analysing the potential for economic growth based on the Financial Inclusion indicator in IOC countries using the Spline approach is to select the most optimal knot point. The selection of the most optimal knot point is done by looking at the lowest GCV value produced by each knot point. Table 3 shows the results of the GCV value of each knot point obtained.

Table 3. GCV Value Generated by Each Knot Point

No	Knot Point	GCV Value Generated
1	Knot Point 1	61745287
2	Knot Point 2	61745287
3	Knot Point 3	36827089

Source: Author's Processed Data, 2025

Table 3 shows that the smallest GCV value generated by knot point 3 with the resulting value is 36827089. Therefore, modelling of the rate of economic growth value based on the Financial Inclusion indicator will use knot point 3 which is shown in the following model equation:

$$\hat{y} = 689.8166 + 173.7462ATM_1 + 184.4278(ATM_2 + 72.1302)$$
$$+ 2353.3867(ATM_3 + 73.97837) + 2083.3677(ATM_4 + 75.82653)$$
$$+ 20803.5473BBI_1 + 41427.4534(BBI_2 + 42.28263)$$
$$+ 24090.5367(BBI_3 + 43.37309) + 3732.916(BBI_4 + 44.46355)$$
$$+ 2609.7161MC_1 + 2181.1596(MC_2 + 174.0241)$$
$$+ 1111.3878(MC_3 + 177.4965) + 1693.9029(MC_4 + 180.9689) + 9040.9698IU_1$$
$$+ 10288.5657(IU_2 + 79.79592) + 5354.4855(IU_3 + 81.63265)$$
$$+ 6842.2919(IU_4 + 83.46939)$$

Furthermore, parameter tests were conducted using two types of tests, namely simultaneous parameter tests and individual tests. The results of the simultaneous estimation test are shown in Table 4.

Table 4. Simultaneous Parameter Test

Source of Variance	Df	SS	MS	F	P-Value
Regression	16	4244414554	265275910		
Error	30	3160067260	105335575	2.518389	0.01409632
Total	46	7404481815			

Source: Author's Processed Data, 2025

The statistical value produces a p-value of 0.01409632. When compared to the significance level of $\alpha = 0,05$. Then the decision taken is Reject H_0. This value gives the conclusion that there is at least one variable that has a significant influence on the model formed. The occurrence H_0 indicates that it is necessary to test individually to find out which variables have a significant effect on the model formed. The individual test results can be seen in Table 5.

Table 5. Individual Test

Variable	Parameter	Estimator	P-Value	Noted
Constant	β_0	689.8166	0.0176299	Significant
	β_1	173.7462	0.0273989	Significant
ATM	β_2	184.4278	0.09309	Not Significant
	β_3	2533.3867	0.075175	Not Significant
	β_4	2083.3677	0.0382666	Significant
	β_5	20803.5473	0.0956602	Not Significant
BBI	β_6	41427.4534	0.0463844	Significant
	β_7	24090.5367	0.0010372	Significant
	β_8	3732.916	0.0422663	Significant
	β_9	2609.7161	0.0139976	Significant
MC	β_{10}	2181.1596	0.0865482	Not Significant
	β_{11}	1111.3878	0.0952727	Not Significant
	β_{12}	1693.9092	0.083529	Not Significant
	β_{13}	9040.9698	0.0102339	Significant
IU	β_{14}	10288.5657	0.0853495	Not Significant
	β_{15}	5354.4855	0.0485364	Significant
	β_{16}	6842.2919	0.0261228	Significant

Source: Author's Processed Data, 2025

The final stage in this analysis is to determine the coefficient of determination to show how good the model is in explaining the value of economic growth in IOC member countries based on the Financial Inclusion indicator used.

$$R^2 = \frac{SS_{Regresi}}{SS_{Total}} x100\% = \frac{4244414554}{7404481815} x100\% = 57.32\%$$

Based on the results of these calculations, a value R^2 of 57.32 percent was obtained. This means that the Financial Inclusion Indicator used can explain 57.32 percent of the variation in the value of economic growth in IOC member countries. While the rest is explained by other variables not yet studied. After the results of the analysis have been carried out using the Spline approach, and the residual assumptions have been met, the results show that the indicators of Financial Inclusion used have a significant influence on economic growth in IOC member countries. Next, we will look at the potential for increasing the economic growth of each country studied in the IOC member countries based on the Financial Inclusion indicators used. If the Islamic Bank Branches, Mobile Cellular and Using Internet variables are considered constant, the effect of the Numbers of ATMs variable on the potential economic growth of IOC Member countries is as follows:

$$\hat{y} = 173.7462 ATM_1 + 184.4278(ATM_2 + 72.1302) + 2353.3867(ATM_3 + 73.97837)$$
$$+ 2083.3677(ATM_4 + 75.82653)$$

$$\hat{y} = \begin{cases} 173.7462; \ ATM_1 < 72.1302 \\ 358.174; 72.1302 \ \leq ATM_2 < 73.97837 \\ 2711.5607; 73.97837 \ \leq ATM_3 < 75.82653 \\ 4794.9284; ATM_4 > 75.82653 \end{cases}$$

Based on the equation model, it is known that there are three country clusters formed based on the Numbers of ATM variables that have an influence on the value of economic growth in OIC member countries according to the Spline cuts formed. The clusters of countries formed can be seen in Figure 1 below.

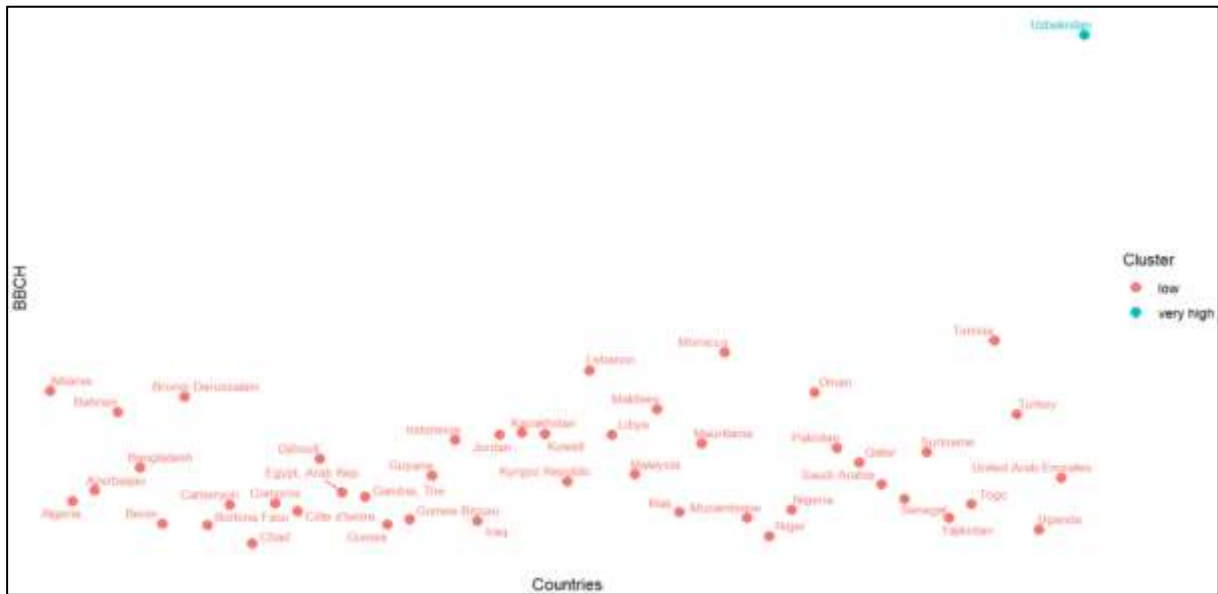*Source: Author's Processed Data, 2025*

Figure 1. Cluster of IOC Countries based On Spline Segments Formed for Numbers of ATM Variables

Interpretation: If a country has a number of ATMs less than 72.1302 per 100,00 Adults, then the potential increase in GDP Per Capita in that country will increase by 173.7462 USD, where these countries fall into the low category. If a country has a number of ATMs between 72.1302 and 73.97837 per 100,00 Adults, then the potential increase in GDP per capita in the country will increase by 358.174 USD, which is in the medium category. If a country has Numbers of ATM between 73.1302 to 75.82653 per 100,00 Adults, then the potential increase in GDP per capita in that country will increase by 2711.5607 USD, which is in the high category. If a country has Numbers of ATMs more than 75.82653 per 100,00 Adults, then the potential increase in GDP Per Capita in the country will increase by 4794.9284, where this country is included in the very high category. If the Numbers of ATMs, Mobile Cellular and Using Internet variables are considered constant, then the effect of the Islamic Bank Branches variable on the potential for economic growth in IOC Member countries is as follows:

$$\hat{y} = 20803.5473 BBI_1 + 41427.4534(BBI_2 + 42.28263) + 24090.5367(BBI_3 + 43.37309) + 3732.916(BBI_4 + 44.46355)$$

$$\hat{y} = \begin{cases} 20803.5473; & BBI_1 < 42.28263 \\ 62231.0007; & 42.28263 \leq BBI_2 < 43.37309 \\ 86321.5374; & 43.37309 \leq BBI_3 < 44.46355 \\ 90054.4534; & BBI_4 > 44.46355 \end{cases}$$

Based on the equation model, it is known that there are two clusters of countries formed based on the Islamic Bank Branches variable that has an influence on the value of economic growth in OIC member countries according to the Spline cuts formed. The clusters of countries formed can be seen in Figure 2 below.

Source: Author's Processed Data, 2024

Figure 2. Cluster of IOC Countries based On Spline Segments Formed for Islamic Bank Branches Variables
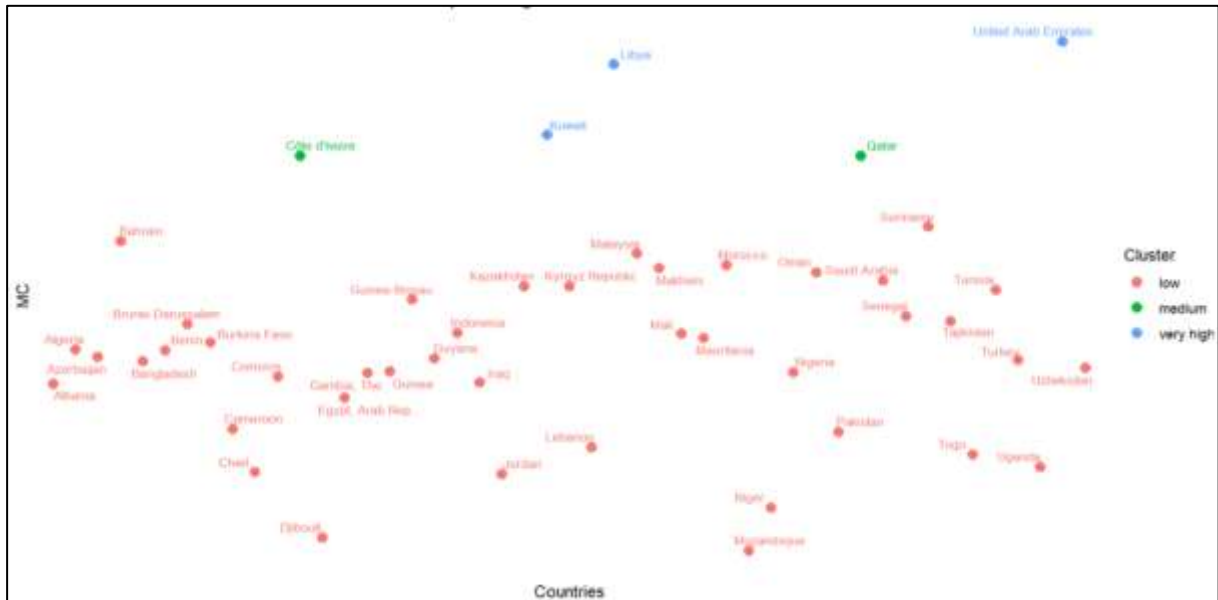
Interpretation: If a country has less than 42.28263 Islamic Bank Branches per 100,000 Adults, then the potential increase in GDP per capita in that country will increase by 20803.5473 USD, where these countries fall into the low category. If a country has Islamic Bank Branches between 42.28263 and 43.37309 per 100,000 adults, then the potential increase in GDP per capita in that country will increase by 62231.0007 USD, which falls into the medium category. If a country has Islamic Bank Branches between 43.37309 and 44.46355 per 100,000 adults, then the potential increase in GDP per capita in that country will increase by 86321.5374 USD, which is in the high category. If a country has more than 44.46355 Islamic Bank Branches per 100,000 Adults, then the potential increase in GDP Per Capita in that country will increase by 90054.4534, which is in the very high category.

If the Numbers of ATMs, Islamic Bank Branches and Using Internet variables are considered constant, then the effect of Mobile Cellular variables on the potential for economic growth in IOC Member countries is as follows:

$$\hat{y} = 2609.7161MC_1 + 2181.1596(MC_2 + 174.0241) + 1111.3878(MC_3 + 177.4965) + 1693.9029(MC_4 + 180.9689)$$

$$\hat{y} = \begin{cases} 2609.7161; & MC_1 < 174.0241 \\ 4790.8757; & 174.0241 \leq MC_2 < 177.4965 \\ 5902.2653; & 177.4965 \leq MC_3 < 180.9689 \\ 7596.1664; & MC_4 > 180.9689 \end{cases}$$

Based on the equation model, it is known that there are three clusters of countries formed based on Mobile Cellular variables that have an influence on the value of economic growth in OIC member countries according to the Spline pieces formed. The clusters of countries formed can be seen in Figure 3 below.

Source: Author's Processed Data, 2025

Figure 3. Cluster of IOC Countries based On Spline Segments Formed for Mobile Cellular Variables
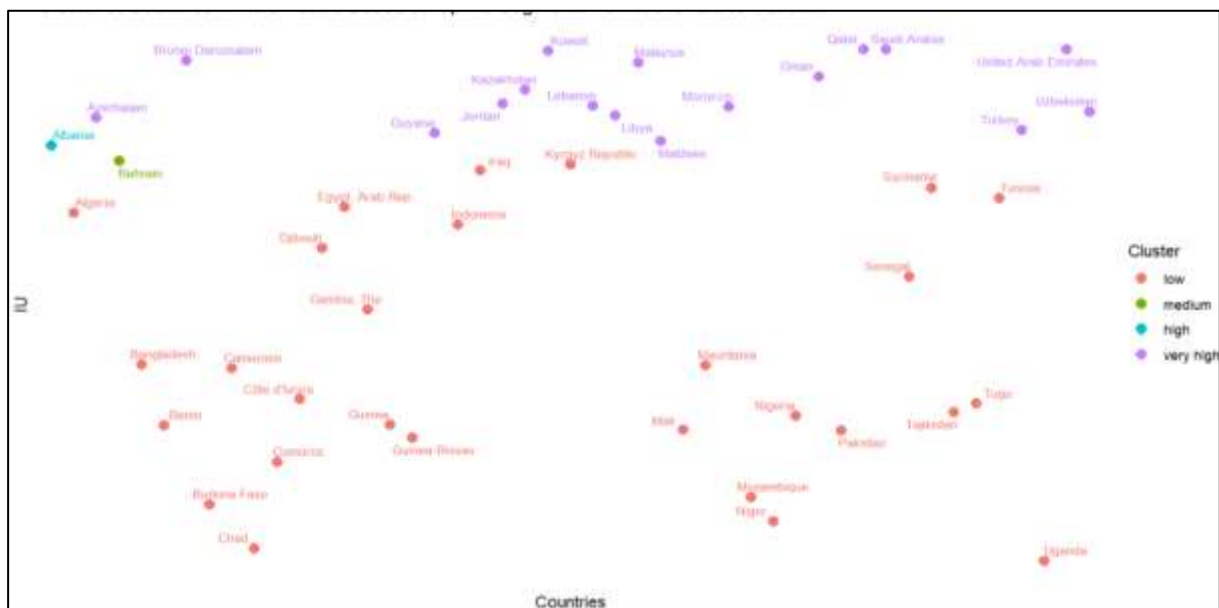
Interpretation: If the people of a country use Mobile Cellular less than 174.0241 per 100 Peoples, then the potential increase in GDP Per Capita in the country will increase by 2609.7161 USD, where these countries are in the low category. If the people of a country use Mobile Cellular between 174.0241 to 177.4965 per 100 peoples, then the potential increase in GDP per capita in the country will increase by 4790.8757 USD, where this country is included in the medium category. If people of a country use Mobile Cellular between 177.4965 to 180.9689 per 100 Peoples, then the potential increase in GDP Per Capita in the country will increase by 5902.2653 USD, where this country is included in the high category. If the people of a country use Mobile Cellular more than 180.9689 per 100 Peoples, then the potential increase in GDP Per Capita in the country will increase by 7596.1664, where this country is included in the very high category.

If the variable Numbers of ATMs, Islamic Bank Branches and Mobile Cellular are considered constant, then the effect of the Using Internet variable on the potential for economic growth in IOC Member countries is as follows:

$$\hat{y} = 9040.9698 IU_1 + 10288.5657(IU_2 + 79.79592) + 5354.4855(IU_3 + 81.63265) + 6842.2919(IU_4 + 83.46939)$$

$$\hat{y} = \begin{cases} 9040.9698; \ UI_1 < 79.79592 \\ 19329.5355; 79.796592 \ \leq UI_2 < 81.63265 \\ 24684.021; 81.63265 \ \leq UI_3 < 83.46939 \\ 31526.3129; UI_4 > 83.46939 \end{cases}$$

Based on the equation model, it is known that there are four country clusters formed based on the Using Internet variable that has an influence on the value of economic growth in OIC member countries according to the Spline cuts formed. The clusters of countries formed can be seen in Figure 4 below.

Source: Author's Processed Data, 2025

Figure 4. Cluster of IOC Countries based On Spline Segments Formed for Using Internet Variables

Interpretation: If the percentage of a country's population using the internet is less than 79.79592 per cent, then the potential increase in GDP per capita in that country will increase by 9040.9698 USD, where these countries fall into the low category. If the percentage of a country's population using the internet is between 79.796592 to 81.63265 Percent, then the potential increase in GDP per capita in that country will increase by 19329.5355 USD, where this country is included in the medium category. If the percentage of a country's population using the internet is between 81.63265 to 83.46939 Percent, then the potential increase in GDP per capita in that country will increase by 24684.021 USD, where this country is included in the high category. If the percentage of a country's population using the internet is more than 83.46939 Percent, then the potential increase in GDP Per Capita in that country will increase by 31526.3129 USD, where this country is included in the very high category.

This study elucidates the intricate relationship between economic growth and Islamic financial inclusion in OIC nations, highlighting the essential significance of financial infrastructure and technological adoption. The categorization of indicators into different levels of influence underscores the heterogeneous financial environment across these nations and the varying levels of maturity in financial inclusion programs. This differentiated methodology provides useful data for policymakers and stakeholders seeking to enhance economic growth via focused financial inclusion programs.

A significant observation is the considerable influence of access to financial services, indicated by the quantity of ATMs and Islamic bank branches, on GDP per capita. The results indicate that enhancing physical access to financial facilities can substantially aid economic development. The message for OIC nations is unequivocal: prioritizing investment in the expansion of financial networks, especially Islamic banks that conform to cultural and religious principles, is essential. Policymakers must pinpoint disadvantaged areas and invest resources judiciously to guarantee equitable financial access.

The importance of technological adoption is equally significant, as evidenced by the impact of mobile cellular usage and internet prevalence. Digital change in financial services can surpass conventional obstacles linked to physical banking infrastructure. This highlights the significance of advancing digital financial literacy and investing in strong technology infrastructure. OIC nations exhibiting diminished technological adoption rates may gain advantages from collaborations with private sector organizations to improve digital connection and create user-centric platforms suited to their populations' requirements.

The findings highlight the differing levels of financial inclusion maturity among OIC members. This diversity requires a customized approach to policy development. Countries exhibiting poor financial inclusion metrics may prioritize basic infrastructure, whilst those with more advanced metrics should emphasize the integration of modern technology and the optimization of service delivery. Cooperative initiatives among OIC nations, exchanging exemplary practices and resources, could expedite collective advancement.

These results underscore the necessity for data-driven policymaking. Governments and financial organizations ought to utilize data analytics to assess progress and pinpoint deficiencies in financial inclusion. Regular assessments and adjustments of plans based on factual data help guarantee that projects stay effective and pertinent. Furthermore, cultivating a culture of accountability and openness in financial inclusion initiatives will enhance trust among stakeholders and promote increased public participation.

The robust association between internet utilization and economic expansion highlights the significance of digital inclusion as an adjunct to financial inclusion. Policymakers must strive to enhance internet accessibility while simultaneously guaranteeing that digital ecosystems are inclusive, secure, and conducive to economic activities. Promoting the advancement of fintech solutions tailored for small and medium firms (SMEs) might be especially significant, as SMEs frequently provide the foundation of economic growth in OIC nations.

Islamic financial institutions possess a distinctive function in this environment. By adhering to principles of risk-sharing and ethical investments, they can meet the financial requirements of marginalized populations while fostering sustainable economic development. Increasing public knowledge of the advantages of Islamic finance and establishing conducive regulatory frameworks might further enhance its beneficial effects on economic growth.

Ultimately, the study's results advocate for a holistic and inclusive strategy for financial inclusion. Increasing the number of ATMs or internet users is insufficient; attention must also be directed towards making these services accessible, inexpensive, and pertinent to the requirements of varied populations. Customized financial products, focused outreach initiatives, and collaborations with community organizations can assist in closing the gap for underrepresented populations, particularly women and rural communities.

This research highlights the transformative potential of financial inclusion in fostering economic growth in OIC countries. By tackling the distinct problems and possibilities highlighted in this study, stakeholders may cultivate an atmosphere in which financial services empower individuals and communities, thereby promoting sustainable and inclusive economic development.

E. Conclusions & Policy Recommendations

E.1. Conclusion

The findings of this study provide a nuanced understanding of the relationship between economic growth and Islamic financial inclusion in OIC countries, emphasizing the critical role of financial infrastructure and technological adoption. The segmentation of the indicators into varying levels of influence highlights the diverse financial ecosystem present across these countries and the varying degrees of maturity in financial inclusion strategies. Such a differentiated approach offers valuable insights for policymakers and stakeholders aiming to strengthen economic growth through targeted financial inclusion initiatives.

This study highlights the transformative capacity of financial inclusion in fostering economic growth in OIC nations. The findings indicate that access to financial services, digital adoption, and Islamic financial practices substantially enhance GDP per capita. The varied effects of financial inclusion indicators underscore the necessity for customized strategies to tackle distinct country circumstances and developmental phases.

E.2. Recommendations

1. Enhance Banking Infrastructure. Policymakers must to prioritize investments in both physical and digital financial infrastructures, especially Islamic banks, to conform to cultural and religious inclinations. Recognizing underprivileged areas and distributing resources fairly will guarantee wider accessibility.
2. Advocate for Digital Financial Inclusion. Governments ought to partner with the business sector to augment technological infrastructure, elevate digital financial literacy, and create user-friendly platforms. Utilizing mobile and internet technology can facilitate the removal of conventional banking obstacles.

3. Customized Policy Development. Due to the disparity in financial inclusion maturity, solutions must be tailored. Countries with inferior inclusion metrics should prioritize establishing fundamental financial infrastructure, whereas developed economies may incorporate cutting-edge financial innovations.
4. Empirical Monitoring. Systematic assessment and adjustment of financial inclusion programs based on empirical evidence are essential. This entails promoting accountability and openness in the execution of financial efforts to cultivate confidence among stakeholders.
5. Promote Islamic Finance. Public awareness initiatives and conducive regulatory frameworks ought to advocate for Islamic financial principles that correspond with ethical investment and risk-sharing methodologies. These concepts can foster sustainable economic development.
6. Comprehensive Financial Services. Initiatives must guarantee that financial services are accessible, economical, and customized to the requirements of marginalized populations, especially women and rural areas. Collaborations with local organizations can effectively address these disparities.

While this study provides valuable insights, it is not without limitations. The analysis was restricted to 47 OIC countries due to data unavailability, and the reliance on single-year data (2022 for independent variables and 2023 for GDP per capita) may not capture temporal variations or long-term trends. Future research should consider longitudinal data to validate these findings and explore additional variables that influence financial inclusion and economic growth.

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