

Islamic Financial Inclusion and Human Development in Indonesia: Constructing an Islamic Financial Inclusion Index and Evidence from Long-Run Time Series Analysis

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Abstract

This study analyzes the effect of the Islamic Financial Inclusion Index (IFII) on the Human Development Index (HDI) in Indonesia from January 2013 to December 2024 using a time series econometric approach. The IFII was constructed using the Sarma (2008) method, integrating the dimensions of availability, penetration/accessibility, and Islamic financial services availability. Two estimation methods were employed: Ordinary Least Squares (OLS) as the baseline model and Fully Modified Ordinary Least Squares (FMOLS) as the main estimator for long-run relationships, controlling for Trade Openness, Inflation, Gini Ratio, Regulatory Quality, and a COVID-19 dummy. The Augmented Dickey-Fuller test confirmed that all variables are integrated at order I(1), while the Johansen cointegration test identified seven long-run cointegrating equations. The OLS model exhibited heteroskedasticity and autocorrelation, reinforcing the suitability of FMOLS. The FMOLS results show that IFII has a positive and significant effect on HDI, as do Regulatory Quality and the COVID-19 dummy (negative effect), while Trade Openness and Inflation are not significant. These findings suggest that Islamic financial inclusion should be integrated into national human development policy.

Keywords: Islamic Financial Inclusion Index, Human Development Index, FMOLS, Time Series, Indonesia

Abstrak

Penelitian ini bertujuan menganalisis pengaruh Islamic Financial Inclusion Index (IFII) terhadap Human Development Index (HDI) di Indonesia periode Januari 2013–Desember 2024 menggunakan pendekatan ekonometrika time series. IFII dikonstruksi dengan metode Sarma (2008) yang mengintegrasikan dimensi *availability*, *penetration/accessibility*, dan ketersediaan layanan keuangan syariah. Estimasi dilakukan melalui Ordinary Least Squares (OLS) sebagai model dasar dan Fully Modified Ordinary Least Squares (FMOLS) sebagai estimator utama hubungan jangka panjang, dengan lima variabel kontrol yaitu Trade Openness, inflasi, Gini

Ratio, Regulatory Quality, dan dummy COVID-19. Uji Augmented Dickey-Fuller menunjukkan seluruh variabel terintegrasi pada derajat I(1), sementara uji kointegrasi Johansen mengonfirmasi tujuh persamaan kointegrasi jangka panjang. Model OLS menunjukkan gejala heteroskedastisitas dan autokorelasi sehingga FMOLS lebih layak digunakan. Hasil estimasi FMOLS menunjukkan IFII berpengaruh positif dan signifikan terhadap HDI, demikian pula Regulatory Quality dan dummy COVID-19 (negatif), sedangkan Trade Openness dan inflasi tidak signifikan. Temuan ini mengimplikasikan perlunya integrasi inklusi keuangan syariah ke dalam kebijakan pembangunan manusia nasional.

Kata Kunci: *Islamic Financial Inclusion Index, Human Development Index, FMOLS, Time Series, Indonesia*

A. Introduction

The development of Islamic finance at both global and national levels over the past two decades has demonstrated an increasingly significant trajectory, particularly in its contribution to the agenda of equitable and sustainable financial inclusion. Indonesia, as the country with the largest Muslim population in the world, possesses extraordinary strategic potential in optimizing the Islamic financial system as an instrument of inclusive economic development (BPS, 2023). In this context, Islamic financial inclusion is not merely understood as the expansion of access to Sharia-compliant products and services, but rather as a structural mechanism capable of driving resource redistribution, poverty alleviation, and comprehensive improvement of societal welfare (OJK, 2023; World Bank, 2022).

In contemporary development discourse, national progress is no longer measured solely through conventional economic indicators such as Gross Domestic Product. The United Nations Development Programme (UNDP) introduced the Human Development Index (HDI) as a more comprehensive and multidimensional framework for measuring welfare, constructed from three core dimensions: health, education, and decent standard of living (UNDP, 2023). HDI's superiority over purely economic indicators lies in its ability to capture human capability conditions holistically, extending beyond material dimensions to touch upon fundamental aspects of quality of life (Sen, 1999). Despite Indonesia recording a consistent upward trend in HDI, the country remains relatively behind several neighboring Southeast Asian nations, indicating that significant room exists for more sustainable and inclusive human development improvement (UNDP, 2023).

A critical challenge underlying this condition is the absence of a comprehensive, context-specific, and periodically measurable instrument to capture the actual level of Islamic financial inclusion in Indonesia. Existing financial inclusion indices, including those published by the World Bank Global Findex and the IMF Financial Access Survey, are constructed using conventional frameworks that do not accommodate the distinctive dimensions of Islamic finance, namely the availability of Sharia-compliant products, the role of social finance instruments such as zakat, infaq, shadaqah, and waqf (ZISWAF), and compliance with Islamic principles in financial service delivery (Mohieldin et al., 2011; Demirguc-Kunt et al., 2022). These conventional indices therefore systematically underrepresent the actual state of Islamic financial inclusion and cannot serve as reliable proxies for measuring the depth of Islamic finance penetration in Muslim-majority countries such as Indonesia.

Attempts to construct an Islamic Financial Inclusion Index (IFI) have primarily been conducted through cross-country panel data approaches, predominantly covering Organisation of Islamic Cooperation (OIC) member states (Imam and Kpodar, 2016; Mohieldin et al., 2011). While these studies provide valuable cross-national comparative insights, they carry fundamental limitations when applied to single-country analysis. First, panel-based IFI construction reflects averaged cross-country effects that may not accurately represent the institutional, regulatory, and structural specificities of individual countries, including Indonesia (Zulhibri, 2016). Second, the indicators used in cross-country IFI construction are often constrained by data availability across multiple countries, forcing researchers to sacrifice indicator depth and Islamic-finance specificity for the sake of cross-national comparability. Third, and most critically, no study has yet constructed an IFI for Indonesia using time series data at monthly frequency, which would allow for a more granular analysis of how Islamic financial inclusion has evolved dynamically over time and how it relates to human development outcomes at the national level.

This gap is particularly consequential given that Indonesia's Islamic financial ecosystem has undergone substantial structural transformation since 2013, including the consolidation of state-owned Islamic banks into Bank Syariah Indonesia, the acceleration of digital Islamic financial services, and progressive regulatory reforms by the Financial Services Authority (OJK). A cross-country index constructed from annual panel

data cannot adequately capture these dynamic shifts, nor can it provide the periodically precise estimates needed for robust long-run econometric analysis. The Sarma (2008) method, which integrates multiple dimensions through Euclidean distance calculation into a standardized composite index, offers a methodologically rigorous and replicable framework for constructing such a country-specific IFII. However, its application to Indonesian monthly time series data incorporating the three dimensions of Availability, Penetration/Accessibility, and Islamic Financial Services Availability remains absent from the existing literature.

Against this backdrop, this study makes two interrelated contributions. First, it constructs an IFII for Indonesia using monthly time series data from January 2013 to December 2024, applying the Sarma (2008) method to integrate five indicators across three Islamic financial inclusion dimensions into a single composite index that is both methodologically sound and contextually relevant to Indonesia. Second, it analyzes the long-run association between the constructed IFII and HDI using Ordinary Least Squares (OLS) as a baseline model and Fully Modified Ordinary Least Squares (FMOLS) as the primary estimator, controlling for Trade Openness, Inflation, Gini Ratio, Regulatory Quality, and a COVID-19 dummy variable. The logical connection between these two contributions is direct: only by first constructing a valid, multidimensional, and Indonesia-specific IFII can the subsequent time-series analysis yield reliable and meaningful estimates of the relationship between Islamic financial inclusion and human development.

Building upon the identified gaps, this study addresses three specific research questions. First, how has the Islamic Financial Inclusion Index (IFII) developed in Indonesia over the period 2013 to 2024 when measured through a multidimensional composite index constructed specifically for the Indonesian context? Second, is there a long-run cointegrating relationship between IFII and HDI in Indonesia? Third, what is the magnitude and direction of the effect of IFII on HDI after controlling for Trade Openness, Inflation, Gini Ratio, Regulatory Quality, and the COVID-19 dummy variable, estimated through both OLS and FMOLS?

The novelty of this study is threefold and distinguishes it explicitly from prior research. First, while existing IFII studies predominantly rely on cross-country OIC panel data with annual frequency, this study constructs an IFII using monthly time series data specific to Indonesia across 144 observations, allowing for a more granular and institutionally

grounded measurement of Islamic financial inclusion dynamics. Second, this study operationalizes IFII through three dimensions, namely Availability, Penetration/Accessibility, and Islamic Financial Services Availability, using five indicators sourced from OJK and World Bank datasets, thereby incorporating the distinctive infrastructure of Indonesia's Islamic banking ecosystem rather than relying on generic cross-country proxies. Third, the application of FMOLS as the primary estimator addresses the econometric limitations of OLS in the presence of non-stationary cointegrated data, a methodological rigor that remains underutilized in the Islamic financial inclusion literature focused on Indonesia.

Regarding the index construction, this study adopts the composite index methodology originally developed by Sarma (2008) in the context of conventional financial inclusion measurement. Sarma (2008) proposed a multidimensional index based on Euclidean distance that integrates normalized sub-indices across dimensions into a single composite score ranging from 0 to 1, where higher values indicate greater financial inclusion. Subsequent studies have adapted and extended this framework to the Islamic finance context by substituting or supplementing conventional indicators with Sharia-specific proxies, most notably indicators of Islamic banking penetration and digital financial access (Mohieldin et al., 2011; Zulkhibri, 2016). This study applies and adapts that framework to construct an Indonesia-specific IFII, making it methodologically traceable to Sarma (2008) while remaining substantively grounded in the institutional realities of Indonesia's Islamic financial sector.

B. Research Methods

This study employs a quantitative approach using time series econometric methods, with monthly data from January 2013 to December 2024 (144 observations).

Table 1.
Research Data Sources

Variable	Symbol	Operational Definition	Unit	Source
HDI	HDI_{it}	Composite index of health, education, and per capita income (GNI PPP)	Index (0-1)	UNDP HDR
IFII	$IFII_{it}$	Composite index of: (1) Number of ATMs and Number of Islamic Banks (2) Number of Bank Branch Offices (3) Number of Network Users and Internet Users.	Index (0-1)	IFSB; World Bank FDD
Inflation	INF_{it}	Annual inflation rate based on the Consumer Price Index (CPI)	%	World Bank WDI
Trade Openness	TRD_{it}	$(\text{Exports} + \text{Imports}) / \text{GDP} \times 100$	% of GDP	World Bank WDI
Reg. Quality	REG_{it}	Perception score of government capacity to formulate and implement regulations conducive to the private sector	Score (-2.5 to +2.5)	World Bank WGI
Gini Ratio	$GINI_{it}$	Gini coefficient of income distribution; a value close to 1 indicates very high inequality	Index (0-1)	World Bank WDI; SWIID
COVID-19	$COVID_{it}$	Dummy variable: 1 for the years 2020 and 2021 (active pandemic period), 0 for other years	0 / 1	WHO; UNDP

HDI, the Gini Ratio, and Trade Openness are originally published on an annual basis. To align them with the monthly frequency of the IFII indicators (most of which are derived from banking/OJK and IFSB operational data available monthly), the annual values were interpolated into monthly series. This interpolation should be understood as a linear smoothing between known annual data points, rather than as genuinely

measured monthly observations. Consequently, month-to-month variation in the interpolated variables is artificial and tends to produce very high serial correlation—a point that should be kept in mind when interpreting the autocorrelation test results for the OLS model discussed in the following section.

The IFII was constructed using the Sarma (2008) method, based on Euclidean distance across three dimensions: Availability (mobile cellular subscriptions per 100 population and the percentage of internet users), Penetration/Accessibility (the number of bank branches per 100,000 population), and Islamic Financial Services Availability (the number of ATMs and Islamic banks/business units per 100,000 population).

STEP 1: Normalization of Each Indicator. Each dimension is normalized to a 0-1 scale using the following formula:

$$d_i = w_i \times \frac{A_i - m_i}{M_i - m_i}$$

d_i :Normalized value of the i-th dimension

w_i :Weight

A_i :Original data value

m_i :Minimum value

M_i :Maximum value

STEP 2: Euclidean Distance Calculation. After all dimensions are normalized, two distance measures are calculated: the distance from the zero point (X_1) and the distance to the ideal condition (X_2)

$$X_1 = \sqrt{\frac{d_1^2 + d_2^2 + \dots + d_n^2}{n}}$$

$$X_2 = \sqrt{\frac{(w_1 - d_1)^2 + (w_2 - d_2)^2 + \dots + (w_n - d_n)^2}{n}}$$

STEP 3: Final IFII Calculation. The final IFII value is obtained by aggregating X_1 and X_2 using the following formula:

$$IFII = \frac{X_1 + (1 - X_2)}{2}$$

If the IFII approaches 1, this indicates a high level of Islamic financial inclusion, meaning the country is close to the ideal condition and

far from the zero point. If the IFII approaches 0, this indicates a low level of Islamic financial inclusion, meaning the country is far from the ideal condition.

The baseline model uses OLS:

$$HDI_t = \alpha + \beta_1 IFII_t + \beta_2 TO_t + \beta_3 INF_t + \beta_4 GINI_t + \beta_5 RQ_t + \beta_6 COVID_t + \varepsilon_t$$

The main model uses Fully Modified Ordinary Least Squares (FMOLS), developed by Phillips and Hansen (1990) to correct for endogeneity bias and serial correlation in I(1) cointegrated data through semi-parametric correction.

C. Results and Discussion

1. Results

The empirical analysis begins by examining the time-series properties of the variables to ensure that the estimation results are statistically meaningful and to identify the appropriate framework for assessing their long-run relationships. The analysis proceeds through several stages, including the Augmented Dickey-Fuller (ADF) stationarity test, the Johansen cointegration test, baseline OLS estimation, classical diagnostic tests, and finally the Fully Modified Ordinary Least Squares (FMOLS) estimation as the main estimator. This sequential procedure is particularly important because the study employs a monthly analytical series in which several annual variables have been interpolated into monthly observations. The results of each stage are presented and discussed below to establish the robustness of the estimated long-run relationship between Islamic Financial Inclusion and Human Development in Indonesia.

Table 2.
Stationarity Test

Variable	Testing Level	Prob.	Remarks
HDI	<i>1st Difference</i>	0,0271	Stationary I(1)
IFII	<i>1st Difference</i>	0,0000	Stationary I(1)
TRD	<i>1st Difference</i>	0,0005	Stationary I(1)
REG	<i>1st Difference</i>	0,0000	Stationary I(1)
INF	<i>1st Difference</i>	0,0015	Stationary I(1)
GINI	<i>1st Difference</i>	0,0000	Stationary I(1)
COVID	<i>1st Difference</i>	0,0001	Stationary I(1)

Source: EViews 12 output, processed (2026).

The ADF test shows that all variables (HDI, IFIL, TRD, REG, INF, GINI, COVID) are non-stationary at level but become stationary at first difference I(1), with probabilities below 5% (Dickey & Fuller, 1981). Since all variables are integrated of the same order, the Johansen cointegration test can be performed.

Table 3.
Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.228449	169.6629	125.6154	0.0000
At most 1 *	0.200801	133.6129	95.75366	0.0000
At most 2 *	0.187534	102.4567	69.81889	0.0000
At most 3 *	0.177579	73.58905	47.85613	0.0000
At most 4 *	0.158954	46.41411	29.79707	0.0003
At most 5 *	0.092602	22.35201	15.49471	0.0040
At most 6 *	0.061650	8.844841	3.841465	0.0029

Source: EViews 12 output, processed (2026).

The trace test rejects all seven null hypotheses of no cointegration at the 5% level, indicating seven cointegrating equations—ranging from a trace statistic of 169.66 for the ‘None’ hypothesis (critical value 125.62) to 8.84 for ‘At most 6’ (critical value 3.84). This finding justifies the use of FMOLS as the primary estimator for the long-run relationship (Johansen, 1991).

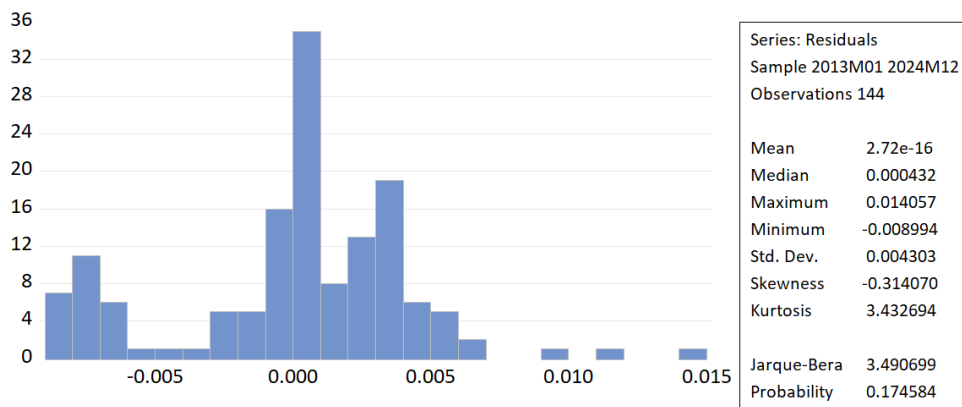
Table 4.
OLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.497134	0.022175	22.41851	0.0000
IFIL	0.192921	0.025613	7.532228	0.0000
TRD	4.61E-05	0.000146	0.315029	0.7532
REG	0.020055	0.005089	3.941138	0.0001
INF	-0.000667	0.000607	-1.099175	0.2736
GINI	0.282408	0.025188	11.21222	0.0000
COVID	-0.019827	0.001486	-13.34585	0.0000

Source: EViews 12 output, processed (2026).

The OLS estimation shows an R^2 of 0.90 (Adjusted R^2 0.896) with an F-statistic of 205.27 ($p < 0.001$), so H7 is accepted at the simultaneous level. Partially, IFII has a significant positive effect ($\beta = 0.193$; $p < 0.001$), as do Regulatory Quality ($\beta = 0.020$; $p < 0.001$) and the Gini Ratio ($\beta = 0.282$; $p < 0.001$), while COVID-19 has a significant negative effect ($\beta = -0.020$; $p < 0.001$). Trade Openness and Inflation are not significant.

Table 5.
Normality Test



Source: EViews 12 output, processed (2026).

Table 6.
Heteroskedasticity Test

Statistic	Value	Probability	Distribution Remarks
F-statistic	18.70339	0.0000	Prob. F(6,137)
Obs*R-squared	64.84114	0.0000	Prob. Chi-Square(6)
Scaled explained SS	71.38785	0.0000	Prob. Chi-Square(6)

Source: EViews 12 output, processed (2026).

Table 7.
Autocorrelation Test

Statistic	Value	Probability	Prob Value
F-statistic	515.9614	Prob. F(2,135)	0.0000
Obs*R-squared	127.3408	Prob. Chi-Square(2)	0.0000

Source: EViews 12 output, processed (2026).

However, this OLS model violates the classical assumptions: the Breusch-Pagan-Godfrey test indicates heteroskedasticity ($F = 18.70$;

$p < 0.001$), and the Breusch-Godfrey LM test indicates very strong autocorrelation ($F = 515.96$; $p < 0.001$), consistent with a Durbin-Watson statistic of 0.05, far from its ideal value. The Jarque-Bera normality test (3.49; $p = 0.175$) does not reject the assumption of normally distributed residuals. This combination of heteroskedasticity and extreme autocorrelation confirms that OLS is inefficient for long-run inference—as noted above, this is consistent with the expectation that interpolating annual data into monthly data produces a residual pattern that is highly correlated over time.

Table 8.
Goodness of Fit

Description	Value
R-squared	0.899900
Adjusted R-squared	0.895516
F-statistic	205.2721
Prob(F-statistic)	0.000000

Source: EViews 12 output, processed (2026).

Table 9.
FMOLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IFII	0.211849	0.042864	4.942393	0.0000
TRD	-6.56E-05	0.000237	-0.276278	0.7828
REG	0.018087	0.008274	2.185901	0.0305
INF	-0.000201	0.000993	-0.202810	0.8396
GINI	0.325690	0.041076	7.929001	0.0000
COVID	-0.021322	0.002416	-8.826964	0.0000
C	0.470322	0.036493	12.88788	0.0000

Source: EViews 12 output, processed (2026).

The FMOLS estimation (Phillips & Hansen, 1990) produces an R^2 of 0.903 (Adjusted R^2 0.899), slightly higher than OLS. IFII has a positive and significant effect on HDI ($\beta = 0.212$; $p < 0.001$), so H1 is accepted—this coefficient is slightly larger than that of OLS (0.193), indicating that OLS slightly underestimated the effect due to bias that FMOLS successfully corrected. Regulatory Quality has a significant positive effect ($\beta = 0.018$; $p = 0.031$; H5 accepted). The Gini Ratio has a significant positive effect ($\beta = 0.326$; $p < 0.001$)—however, its direction

contradicts hypothesis H4, which assumed a negative effect, so H4 is rejected. COVID-19 has a significant negative effect ($\beta = -0.021$; $p < 0.001$; H6 accepted). Trade Openness ($\beta = -0.00007$; $p = 0.783$) and Inflation ($\beta = -0.0002$; $p = 0.840$) are not significant, so H2 and H3 are rejected.

2. Discussion

The FMOLS estimate yields a long-run coefficient of 0.2118 for IFII, which is marginally larger than the OLS estimate of 0.1929. The consistency in direction across both estimators suggests that the positive association between IFII and HDI is not an artifact of the estimation method. Economically, a one-unit increase in IFII is associated with an increase of approximately 0.21 points in HDI in the long run, holding other variables constant. Given that HDI in Indonesia typically moves by 0.005 to 0.010 points annually under normal conditions, this coefficient magnitude is substantively meaningful, though it should be interpreted as reflecting a long-run equilibrium association rather than a direct causal effect, since the model does not include an instrument or experimental variation that would allow causal identification (Phillips and Hansen, 1990).

The theoretical channels through which this association may operate are multiple and consistent with the Capability Approach (Sen, 1999). Expansion in Islamic financial access, penetration, and service availability may facilitate productive financing for low-income households, support redistribution through ZISWAF instruments, and reduce household vulnerability to financial shocks. However, it must be acknowledged that these transmission mechanisms are not directly tested within the present model. The FMOLS estimator identifies the long-run cointegrating vector between IFII and HDI after correcting for endogeneity bias and serial correlation, but it does not decompose the effect through specific channels. The theoretical narratives drawn from Beck et al. (2007), Kahf (1997), and Mohieldin et al. (2011) therefore serve as plausible interpretive frameworks consistent with the empirical finding, not as confirmed causal pathways. This finding is empirically consistent with Imam and Kpodar (2016) at the cross-country level and Abduh and Omar (2012) in the Indonesian context, both of which document positive associations between Islamic financial development and economic welfare outcomes, albeit using different methodological approaches.

Neither Trade Openness nor Inflation produced statistically significant coefficients in the FMOLS estimation, leading to the rejection of H2 and H3. For Trade Openness, the result is plausible given the commodity-intensive structure of Indonesia's export base during this period, which may limit the distributional transmission of trade gains to human development outcomes (Sachs and Warner, 1995; Stiglitz et al., 2009). For Inflation, Indonesia maintained relatively controlled inflation throughout 2013–2024, which may explain the absence of a detectable long-run effect on HDI (Bank Indonesia, 2023; Fischer, 1993). It should be noted, however, that non-significance in a cointegrating regression does not confirm the absence of a relationship; it may reflect insufficient variation in the variable during the sample period, or the effect may operate through channels absorbed by other regressors in the model.

The positive and statistically significant coefficient on Gini Ratio in both OLS and FMOLS is the most methodologically sensitive finding of this study and warrants explicit critical treatment rather than straightforward interpretation. At face value, this result indicates that in the national aggregate data for Indonesia between 2013 and 2024, periods of higher measured inequality are associated with higher HDI values. What can be stated on purely statistical grounds is that Gini Ratio and HDI exhibit co-movement in the same direction over the sample period.

Two important methodological caveats must be stated explicitly. First, the Gini Ratio is among the variables interpolated from annual to monthly frequency, as is HDI. When two annually observed variables are converted to monthly series through linear interpolation, both series inherit a smooth upward or downward trend by construction. If both variables share a common long-run trend, their high comovement may partly reflect this shared interpolation trend rather than a genuine structural relationship. Although the Johansen cointegration test formally addresses non-stationarity, it cannot fully rule out spurious correlation driven by common deterministic trends embedded in the interpolated series. Second, the positive direction contradicts the theoretical prediction of H4, which was grounded in arguments by Beck et al. (2007) and Atkinson (2015). Post-hoc explanations such as the middle-class income hypothesis or a modified Kuznets argument, while theoretically conceivable, were not tested within this model and

should not be presented as confirmed explanations. Future research employing non-interpolated disaggregated data or province-level panel analysis would be better positioned to resolve this ambiguity.

The positive and significant FMOLS coefficient for Regulatory Quality is consistent with Kaufmann et al. (2010) and Zulkhibri (2016), who document that institutional quality and regulatory environment are enabling conditions for Islamic financial sector development. The relatively small coefficient magnitude is interpretively consistent with the understanding that regulatory quality operates indirectly on HDI, creating an ecosystem within which financial intermediation can expand, rather than transmitting directly to health, education, or income outcomes. The OJK's branchless banking initiatives and progressive Islamic banking regulatory reforms during this period constitute plausible contextual evidence, though they are not directly tested as mechanisms within the model (OJK, 2023).

The negative and highly significant coefficient for the COVID-19 dummy is the most straightforward finding in terms of interpretive confidence, as the variable is binary and exogenously determined. A coefficient of -0.021 indicates that HDI during the 2020–2021 pandemic period was on average 0.021 points lower than in non-pandemic periods, after controlling for all other variables. This magnitude is substantively large relative to Indonesia's normal annual HDI increment of 0.005 to 0.010 points, and is consistent with the documented simultaneous shock to all three HDI dimensions: excess mortality compressing life expectancy, school closures disrupting educational attainment, and income contraction reducing real per capita income (IMF, 2020; World Bank, 2022). The exogenous nature of the COVID-19 shock provides the strongest ground in this study for a directional causal interpretation, as the pandemic's timing was not determined by any of the economic variables in the model.

Across all variables, the discussion in this study distinguishes between statistical associations established through the FMOLS cointegrating regression and causal mechanisms drawn from theory and prior empirical literature. The FMOLS estimator provides efficient and asymptotically normal estimates of long-run equilibrium relationships in the presence of cointegrated $I(1)$ variables, correcting for endogeneity and serial correlation (Phillips and Hansen, 1990). However, it does not resolve issues of omitted variable bias, nor does

it validate the specific theoretical transmission channels invoked in interpretation. The use of interpolated data for annually observed variables introduces additional uncertainty into the monthly-frequency estimates that cannot be fully corrected by the cointegration framework. These limitations should be borne in mind when translating the statistical findings of this study into policy recommendations.

D. Conclusion

This study constructs an Islamic Financial Inclusion Index (IFII) for Indonesia using monthly time series data from January 2013 to December 2024, integrating three dimensions, namely availability, penetration/accessibility, and Islamic Financial Services Availability, through the Sarma (2008) composite index methodology. The confirmed presence of cointegrating relationships among all $I(1)$ variables provides the primary justification for using FMOLS as the main estimator, which corrects for endogeneity bias and serial correlation inherent in long-run cointegrating regressions. The FMOLS results, interpreted as long-run statistical associations rather than established causal relationships, indicate that IFII, Regulatory Quality, and the COVID-19 dummy are significantly associated with HDI in their hypothesized directions, while Trade Openness and Inflation show no significant long-run association. The Gini Ratio, although statistically significant, moves in a direction contrary to the theoretical expectation and should be interpreted cautiously, as both Gini Ratio and HDI were subject to annual-to-monthly interpolation that may inflate their apparent co-movement through shared deterministic trends.

Two structural limitations must be stated explicitly. First, the interpolation of annually observed variables introduces smoothing that the Johansen cointegration framework cannot fully correct. Second, FMOLS identifies equilibrium associations but does not validate the specific transmission mechanisms proposed theoretically. Future research employing non-interpolated provincial panel data or explicit causal identification strategies would substantially strengthen the inferential foundation of this line of inquiry.

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