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EFFECT OF ISLAMIC FINANCIAL SYSTEM STABILITY ON ECONOMIC PERFORMANCE IN INDONESIA

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ABSTRACT

This study constructs a financial stability index for the Islamic financial system of Indonesia using the dynamic factor model and then links it to economic performance employing a nonlinear autoregressive distributed lag (NARDL) model. The financial stability index constructed from a broad range of macrofinancial variables captures well the 2008-2009 global financial crisis and the 2020-2021 COVID 19 pandemic crisis periods. The most significant results suggest that positive and negative shocks in Islamic financial stability in the long run increase and decrease economic performance, respectively. The quantile regression results also demonstrate that Islamic financial stability is statistically significant throughout all quantiles in promoting economic performance, although it plays a greater role at lower quantiles and diminishes when the economic performance is at a high level. Our results highlight that the stability of the Islamic financial system deepening would positively enhance economic performance.

Keywords: Financial stability indexes, Islamic and conventional banks, Economic performance, NARDL, Time series econometrics.
JEL classification: G2; G21; C32.

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I. INTRODUCTION

The issue of financial instability of the conventional financial system from different angles and perspectives have received attention before the 2007-2009 global financial crisis. The crisis' immense scope and ramifications have highlighted the long-standing and difficult problem of "the hunt for financial stability". If the financial system is unstable, are there any "effective solutions" or "greatly moderated structural reforms" that may be pursued? With respect to this question, Islamic financial institutions (IFIs) and the principles that guide their operations have attracted a lot of attention throughout this contentious debate. However, most of the pre-crisis studies, if not all of them, are theoretical and based on an "abstract model." They note that Islamic financial system is primarily centred on equity and participatory forms of funding. The crisis's explosion has sparked empirical investigations to capture the actuality of these institutions in practice. While Islamic finance and conventional finance both serve a similar purpose, there are significant variations between the two systems. Osei and Kim (2020) argue that although the financial sector benefits economic growth, the impact of additional financial development on growth becomes minimal. As a result, the nonlinear relationship exists, and achieving an ideal degree of financial development is critical for economic growth.[1]

Social justice, inclusivity, and resource sharing between the rich and the poor are at the heart of Islamic Finance Sharia Law. There are two ways that Islamic finance handles the issue of "financial inclusion" or "access to financing." The first channel encourages risk-sharing agreements as a feasible substitute for traditional debt-based funding. To increase financial inclusion, the risk-sharing financial instruments can provide microfinance and microinsurance that adhere to Islamic law. The second channel is redistribution of wealth in society via Zakah, Sadaqah, and Waqf, which are risk-sharing tools for eradicating poverty and enhancing social welfare. Financial development is more likely to occur if everyone has access to financing, the law encourages greater risk sharing, and income is distributed equally. Sharia Law thereby protects citizens from reckless behaviour and supports financial stability and economic growth. According to the Islamic Finance Development Report (2020), the top five countries in relation to Islamic Finance are Malaysia, Indonesia, Bahrain, United Arab Emirates and Saudi Arabia. Indonesia has displayed one of the most notable improvements in the Islamic Finance Development Indicator (IFDI) in 2020, moving into second place for the first time due to its high knowledge and awareness ranking.[2]

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1 Ghlamallah et al. (2021) provide the topics of Islamic economics and finance research, which can be well-described by 11 topics. Khan et al. (2021) present a survey of Islamic finance research in the literature.

2 Islamic financial institutions (IFIs) had a robust resurgence as economies recovered from a challenging 2020 brought on by the worldwide pandemic and decreased oil prices. IFIs were extremely cautious when setting aside money for financing loss in 2020. Charges were significantly lower in 2021, and several institutions released reserves, which improved outcomes. Islamic banks' net profits increased by more than 50% in 2021, with banks in the Gulf recording especially impressive performance. Customer deposits kept growing, fuelling the expansion of finance portfolios. IFIs also recognised the value of technical and digital initiatives that reduced operating costs. Nevertheless, the IFIs stability issue remains an important question to be addressed.

This study examines the effect of Islamic financial stability on economic performance in Indonesia, a country that has the highest Islamic population in the world. Islamic financial system is getting popular and improving since the last few years. The stability of the Islamic financial system is crucial, especially in channelling funds from surplus units to deficit units, consequently, promoting economic performance and reducing poverty. Indonesia is an interesting case to analyse the effect of Islamic finance issue on economic development.[3] Figure 1 depicts the bank Z-score of Indonesia, which captures the probability of default of a country's banking system. Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns. The score ranges 2.0 – 4.5 that is lower than other emerging markets.[4] A higher z-score indicates a lower probability of insolvency. As such, it is important to analyse the financial stability in Indonesia. Given the complexity of contemporary financial systems and current worldwide trends, financial stability has been linked to a variety of issues that are generally related to the smooth operation of financial systems. The most complete conceptual framework for characterising financial stability is provided by Allen & Wood (2006). They contend that any policy meant to create financial stability must have the general welfare as one of its primary goals. They also emphasise how crucial it is for financial stability to be quantifiable and how it must be governed by a certain governmental body. This makes it possible for competent policymakers to respond quickly to the first indications of economic distress and loss of stability. The organisation in charge of preserving financial stability must have sufficient power to address problems related to it.

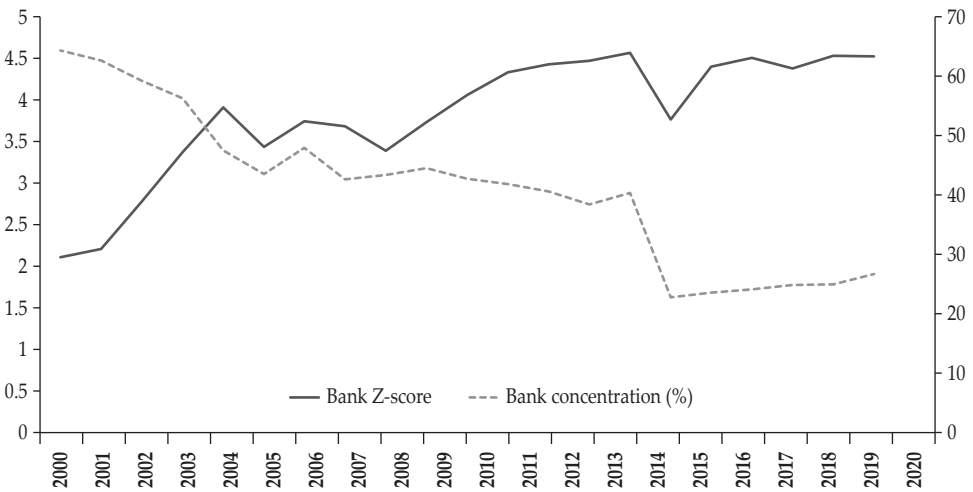


Figure 1.
Bank Z-score and Bank Concentration of Indonesia, 2000 – 2020

3 See, for example, Ridhwan et al. (2014).

4 Vietnam 17.09 Score; Turkey 12.33 Score; Thailand 6.8 Score; Pakistan 11.39 Score; Malaysia 31.18 Score; Jordan 52.39 Score; United Arab Emirates 22.36 Score; Saudi Arabia 21.54 Score.

In the case of Indonesia, the share of Islamic finance is increasing based on the Fitch Rating (2020). With a growth rate of 7.5% in September 2021, Islamic banks' gross financing increased faster than that of their conventional counterparts (conventional banks: 1.8 percent). The proposed conversion of three regional Indonesian lenders to Sharia banks in 2022 is expected to boost the market share of Sharia banks. According to Fitch Rating projections, these conversions will increase the proportion of Sharia financing in the banking sector from 7.1 percent at end of September 2021 to around 9 percent. The financial profiles of the Islamic Sharia banks increasingly more closely resemble those of their conventional competitors. They were able to keep their non-performing financing ratio at 3.1 percent at the end of September 2021 (conventional banks' non-performing loan ratio was 3.2 percent), thanks to their focus on consumer financing (September 2021: 50 percent of total financing; conventional: 26 percent), which fared better during the pandemic. At the end of September 2021, their average capital adequacy ratio of 25% indicated that their capitalization was comparable to that of their traditional peers, and their average return on assets of 1.6% did the same.

Another issue is related to the interest rate sensitivity in Indonesia where Islamic banks' equivalent rates are lower than conventional banks' interest rates.[5] As shown in Figure 2, the conventional banks have higher interest rates compared to Islamic banks especially for deposit rate, although the credit rates of both banks tend to be equal. However, from the creditee' side, they tend to go to Islamic banks because the credit agreement is clearer from the beginning, and the Islamic banks is basically a flat rate.[6] In contrast, the interest rate of bank credits from conventional banks is floating, and hence maybe quite volatile or risky especially for the long run period. However, since conventional banks are dominant players with extensive networks and services compared to the Islamic ones, no wonder if the latter banks face funding constraint issue. Therefore, the sensitivity of the interest rate changes between conventional and Islamic banks pose some challenges to Indonesian financial markets and institutions. If the central bank namely Bank Indonesia implements low interest rate policy, the conventional banks will charge low interest rate too. Nevertheless, for the Islamic banks, they give higher equivalent rate (performance from profit and loss). Therefore, this condition is heterogeneity across the financial system whereby some can provide higher, and others can provide lower interest rates.

Furthermore, the public has different perception towards the interest rate, whether the depositors are willing or prefer to save in conventional or Islamic banks. Conventional banks are more towards profit-oriented objectives, and hence may optimize their funds invested in money markets in a very short term. And, as consequence, they may also expose to higher default risks, or at least more volatile returns. While shariah banks are more focused on underlying transactions namely credit disbursement, as well as limited options for financial market products notably Islamic bonds and stocks, while investing in derivative products

5 In the concept of Islamic banking, there is no such interest rate relationship, and they mainly use the profit and lost sharing principle as instead. Commonly it is called as an equivalent rate, instead of interest rate (see, interalia, https://en.wikipedia.org/wiki/Islamic_banking_and_finance)

6 Mudarabah principle is basically buying and selling relationship, and for the financing, bank simply charge a flat rate over the duration of credit given by banks.

are strictly prohibited. In addition, to increase public trust in the national banking system, the Indonesian Deposit Insurance Corporation (IDIC) is established as an independent institution functioning to insure customer's deposits and play an active role in maintaining banking system stability in accordance with its authority.[7] The IDIC is a safeguard to insure the depositors' money in the banks. In case something happens, the IDIC can back up the loss and increase public trust in the national banking system. The massive insurance programme must be replaced with limited coverage deposit insurance to increase customer confidence and protect the stability of the banking system in Indonesia.

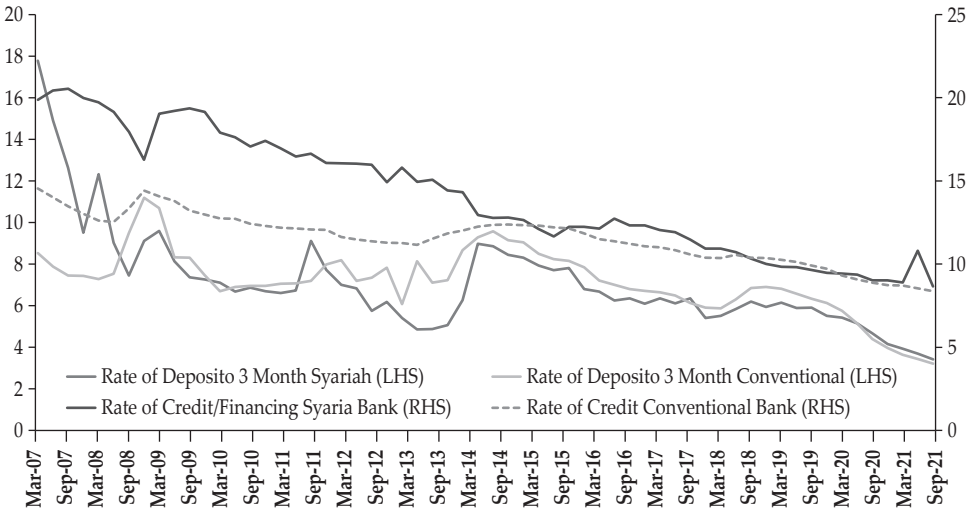


Figure 2.
Islamic Banks and Conventional Banks Interest Rates

This study contributes to the literature in four important aspects. First, despite the rapid development of Islamic financial markets in Indonesia in recent years, it is interesting to examine the financial stability by means of constructing its index using the dynamic factor model (DFM). To our knowledge, this is the first study formally constructing the Islamic financial stability index for Indonesia.[8] Second, since the DFM method has a greater coverage of areas in the construction of financial stability index, it can be useful as one of the leading indicators in predicting the business cycle and serve as a signal for timely policy actions. Third, the financial stability indexes are used to relate with economic performance in Indonesia using the non-linear autoregressive distributed lagged (ARDL) models. The NARDL

7 This law is effective since 22 September 2005 and IDIC has been officially operating since then.

8 Mande et al (2020) evaluate the extent to which financial stability matters for economic growth in emerging markets. Using dynamic panel estimation techniques, they explore both the stock market and banking sector dimensions. The findings reveal that the magnitude of the impact to be relatively more pronounced when the underlying source of instability in the financial system is stock market volatility. They conclude that, compared to its composite indicator, the influence of financial stability on economic growth is statistically more meaningful when examined using the individual indicators of financial instability as compared to their composite indicator.

method has the advantages to identify the long-run and short-run dynamic effect of financial stability on economic performance, as well as an asymmetric effect. Finally, the quantile regression is used to further cross check the robustness of the empirical findings.

The remainder of this paper is structured as follows: In Section 2, the relevant literature is reviewed. The empirical model, econometric approach, and data used are explained in Section 3. Section 4 presents the empirical findings and provides an interpretation, and Section 5 wraps up the discussion.

II. LITERATURE REVIEW

Financial stability is considered a dynamic process that promotes financial system expansion rather than strictly limiting natural swings and changes. Both macro and micro techniques are suggested by Houben et al. (2004) and Mohamed et al. (2012) to understand the causes of financial instability. According to the macroeconomic perspective, instability is believed to be caused by two main factors. These are the sharp price swings and the overleveraged state of the economy. They contend that building wealth and increasing fixed assets are among the primary goals of finance for individuals, businesses, and governments, and that this leads to an observed rise in the prices of the related transferable claims. Thus, the eventual realisation of these claims is associated with excessive borrowing and investment.

Belouafi et al. (2015) review the stability of the Islamic financial system in comparison to the traditional interest-based system that has been explored in the literature on Islamic economics and finance. They offer a critical analysis of that research where 40 studies from the past 30 years (1983–2013) are analyzed. The pre- and post-subprime financial crisis sub-periods are contrasted. While the post-crisis period concentrates on empirical study, the pre-crisis period concentrates on theoretical investigations. The findings indicate that the crisis appears to have increased interest in Islamic finance stability. About 75 percent of the examined literature is after the financial crisis; during the last five years (2008–2013), there were roughly five studies published annually, as opposed to fewer than one during the period before the crisis. Additionally, the most used proxy for assessing the stability of Islamic financial intermediaries is the Z-score statistic. The findings also demonstrate that there is a sizable gap between Islamic finance theory and practice. While actual studies are still inconclusive, theoretical studies assert the "superiority" of the Islamic financial system based primarily on equity and participatory ways of funding.

Based on data pertaining to specific Islamic and commercial banks in 19 banking systems with a significant presence of Islamic banking, the relative financial health of Islamic banks is evaluated empirically. Čihák and Hesse (2010) discover that (a) small Islamic banks typically outperform small commercial banks in terms of financial strength; (b) large commercial banks typically outperform large Islamic banks in terms of financial strength; and (c) small Islamic banks typically outperform large Islamic banks in terms of financial strength, which may be due to difficulties with credit risk management at large Islamic banks. Additionally, they also discover that other banks' financial health is not much impacted by Islamic banks' market dominance. Saragih and Achsanta (2022) examine the impact of market power on cost of intermediation and profitability

using Indonesian dataset from 2009 to 2019. Their results show that private banks have higher monopoly power because their operations are solely focused on maximising profits. In contrast, government banks are more likely to pursue non-profit maximising motivations driven by political or social motives, which makes them less inclined to exercise their monopolistic power.

In the case of Indonesia, Machdar (2020) analyzes the effect of financial inclusion on sustainable economic growth of banking companies and investigates the effect of financial inclusion on sustainable economic growth through financial system stability. The secondary data used in this quantitative analysis are gathered from the yearly financial statements of the banking organizations listed on the Indonesia Stock Exchange from 2010 to 2017. The findings demonstrate that (a) financial inclusion has no impact on the sustainable economic growth of Indonesian banking firms and (b) the impact of financial inclusion on sustainable economic growth in Indonesian banking companies is mediated by the stability of the financial system. The finding suggests that with conditions of financial inclusion that are still low in Indonesia while the number of banks is increasing, it is necessary to have strong financial system stability. Filasti et al. (2021) find that high board remuneration is positively associated with Islamic banks' stability because Shariah board presents as the second layer of governance in Islamic banks to enhance the monitoring activity. In addition, Indonesian Islamic banks are in the banking market with a good regulatory regime.

Bank lending is the main source of finance due to several structural developments including deregulation, the economic crisis, and consolidation in Indonesia. Mulyaningsih et al. (2016) examine the relationship between banking competitiveness and stability, using individual bank datasets and the generalized method of moment (GMM) approach. The empirical results reveal that competitive banking will improve economic stability. In a cutthroat market, banks must grow productivity, expand loan disbursements, diversify their clientele, increase assets, and strengthen capitalization. Their study emphasizes the importance of efficiency in lowering risk for both large and small institutions. Furthermore, a bank's ability to handle market shocks depends on having appropriate capital, regardless of its size. Noman, Gee, & Isa (2017) also evaluate the impact of competition on the financial soundness of the commercial banks in the Association of Southeast Asian Nations (ASEAN) from 1990 to 2014. The GMM estimates using a two-step system show that financial stability (Z-score, equity ratio, and non-performing loan (NPL) ratio) is positively correlated with competition as measured by the H-statistic. In contrast, market power as evaluated by the Lerner index has a positive correlation with NPL ratio and a negative correlation with Z-score and equity ratio. These findings firmly back up the contention that ASEAN banks are competitively stable.

Yusgiantoro et al. (2019) expand on earlier research on the effects of bank market power as a proximate for bank consolidation in a sample of Indonesian commercial banks between 2010 and 2015. The empirical results demonstrate that increased bank market power is linked to lower insolvency risk and better capital ratios. However, a more thorough examination shows that greater market dominance is bad for both state-owned banks and smaller privately held banks' capacity to maintain their financial soundness. To increase financial stability, they contend that market power should be increased in large private banks while being reduced in small private banks through competition. Another competition

and stability study is carried out by Khattak et al. (2021) for Indonesia. They examine how portfolio diversification and competition affect the stability of Indonesia's conventional and Islamic banks. When compared to the conventional banking industry, they find that the Islamic banking sector is less stable. While variety increases stability, competition in the banking industry decreases it. They discover that while diversification has no effect on Islamic banks, competition has a negative effect on them. The discovery that competition and diversification work best together to increase the stability of the Indonesian banking industry is intriguing. These findings have significant policy ramifications for Indonesia's banking industry.

Fouejieu (2017) determines whether inflation targeters in emerging markets are more financially precarious than their non-targeting counterparts. It also evaluates how much less sensitive to financial imbalances targeting central banks are as compared to those using alternative policy measures. The analysis reveals that monetary policy in target countries is considerably more sensitive to financial risks based on a sample of 26 emerging nations, including 13 targeters. However, the financial sector looks to be more vulnerable to targeters despite better central banks' responses to financial imbalances. Thus, the conclusion casts doubt on the notion that central banks can ensure financial system stability through the setting of policy interest rates. Instead, it recommends that the primary goal of monetary policy should continue to be the control of inflation, with the goal of financial stability being handled by a (macro) prudential authority.

Economic growth in Indonesia has been trending down from about 6.5% in 2010 to around 5% between 2015-2019 on average. Dutu (2016) demonstrates that most of the Indonesia's growth over the past ten years has been driven by supply factors, particularly rising multi-factor productivity (MFP), as Indonesia reaped the benefits of post-Asian-crisis structural reforms, using a dynamic stochastic general equilibrium (DSGE) model. However, since 2010, the rate of multi-factor productivity development has decreased, a trend that has been furthered by weaker global growth. Some of those challenges have been successfully countered by a series of interest rate reductions. However, supporting monetary policy will not be enough to sustain long-term growth and raise inflation risks in the absence of additional structural reforms to boost productivity growth.

Karim, Al-Habshi, & Abduh (2016) investigate the relationship between Indonesia's macroeconomic indicator and bank stability. Z-score is used to determine the bank's stability, and the Gross Domestic Product (GDP) in US dollars, Interest rates (IR) in percentage, and Consumer Price Index (CPI) are used to regress the bank's stability using the ARDL model. Cholesky standard deviation shock to the model and Impulse Response Function (IRF) are utilized to further analyze the long-term relationship and the effect of bank stability. For three different models: (i) the commercial bank model, (ii) the Islamic bank model, and (iii) the total banking sector model, the ARDL and IRF are carried out individually. The empirical results point to a long-term association between macroeconomic factors and the stability of commercial banks. The results also indicate a long-term link between macroeconomic conditions and the stability of the banking sector. However, there is little proof that the stability of Islamic banks and macroeconomic conditions are related over the long term. This conclusion is nevertheless constrained by the data's availability and the number of Islamic

banks tested. However, this study claims that due to insufficient data, only 5 out of a total of 10 Islamic banks were included in the sample, that are compared to the higher number of commercial banks used as the sample.

Heniwati et al (2021) examine whether Shariah banks are more financially stable than non-Shariah banks and to compare how different explanatory variables affect financial health and efficiency in Indonesia. Regression analysis is carried out utilizing unbalanced panel data from BankFocus for the years 2011–2018. The two response variables used in the analysis are Z- score for return on average assets, liquid asset to deposit, and short-term funding ratio. The assumptions are verified using a variety of control variables. A model with various specifications is utilized to test the findings' robustness. Their findings show that while Shariah banks are less healthy and present a larger insolvency risk for long-term activity, the opposite is true for short-term activity. Other study suggests that due to distinct influencing elements on the health of the bank, Shariah and non-Shariah banks contribute differently to the national system of financial stability. Ismail et al. (2017) also discover that, together with the institutional Islamic bank dimension itself, the performance indicators of Islamic banks significantly contribute to the development of the micro- and macro-prudential aspects of financial stability.

By proposing a new composite financial stability index to track the financial vulnerabilities and crisis times, Elsayed et al. (2022) investigate the relationship between monetary policy and financial stability in the Gulf Cooperation Council (GCC) countries. To achieve this, the study calculates monetary policy reaction functions for each GCC nation (namely Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates) throughout the time period from 2006-Q4 to 2020-Q2 using the nonlinear autoregressive distributed lag model (NARDL). The empirical findings demonstrate that monetary authorities respond significantly to negative or positive shocks to financial stability, but they react differently in the short or long term. Ibrahim and Rizvi (2017) find that larger Islamic banks are more stable, at least once they reach a certain size. The stability-size relation is strengthened in terms of regulation by capital restraints and activity constraints.[9]

Widarjono (2020) explores the stability of Islamic banks in Indonesia. The Z-score and non-performing loans are used to measure stability. The datasets consist of aggregate data from Islamic banks, including Islamic commercial banks and Islamic business units, rather than data from a single bank from January 2010 to December 2018. The empirical results from ARDL show that size, CAR, and efficiency are the key factors influencing stability in Islamic banks. The stability of the Islamic bank is supported by its larger size and CAR. The instability of the Islamic bank is increased by lower efficiency. Meanwhile, Inflation and exchange rates affect the Islamic bank's stability. Economic downturns due to inflation and depreciation of rupiah increase the instability of Islamic banks. Using a policy loss evaluation approach, Agenor and Flamini (2022) demonstrate that cooperation is essential for fostering stability in an economy susceptible to financial shocks. First, the coordinated use of the policy rate and the required reserve ratio suggests that these instruments are remarkably effective and complementary in achieving

9 According to Mahat and Dahir (2018), the relationship between financing liquidity and financial stability is both positively and negatively correlated with bank regulation and bank size, indicating that the former enhances stability while the latter detracts from it.

macroeconomic and financial stability, with the required reserve ratio being significantly more effective than the base policy rate in achieving financial stability. Second, the overall policy loss nearly doubles when the goal of macroeconomic stability is left to the monetary authority alone (i.e., without coordination). They highlight that negative policy spillovers are to blame for these outcomes.[10]

III. EMPIRICAL MODEL, ECONOMETRIC APPROACH, AND THE DATA

3.1. Construction of A Financial Stability Index – Islamic Financial System

The dynamic factor model (DFM), which can deal with the issue of high dimensionality and has more predictability, is used to build an index for financial stability. Multivariate time series are frequently modelled using the DFM as linear functions of unobserved components and idiosyncratic disturbances, where an unobserved factor may exhibit an autoregressive behaviour. The model can be defined generally as follows:

$$X_t = AZ_t + \varphi_t \tag{1}$$

$$Z_t = B_1 Z_{t-1} + B_2 Z_{t-2} + \ldots + B_{t-k} Z_{t-k} + \mu_t \tag{2}$$

$$\varphi_t = C_1 \varphi_{t-1} + C_2 \varphi_{t-2} + \ldots + C_{t-q} \varphi_{t-q} + \varepsilon_t \tag{3}$$

where X_t represents a vector of dependent variables (n×1), A represents a matrix of parameters (n×n_f), Z_t represents a vector of unobservable factors (n_f×1), φ_t represents a vector of disturbances (n×1), B_i represents a matrix of autocorrelation parameters for i (n_f ×n_f), μ_t represents a vector of disturbances (n_f×1), C_i represents a matrix of autocorrelation parameters for i (n×n), and ε_t represents a vector of disturbances (n×1).

Following Stock and Watson (1989, 1993, 2002), a set of fourteen financial variables are chosen and represented as a DFM. The parameters (factor loadings) are estimated using the maximum likelihood method (ML). Then, using the Kalman filter, a financial indicator known as the financial stability index is extracted. Afterward, several forecasting tests are used to validate the financial stability index. A latent (unobserved) variable is proposed in the straightforward model to adhere to an AR(2) procedure. The relationship between each financial variable and the latent variable's current value is captured by a parameter called factor loading (λ_i). The DFM's state-space to construct the Islamic financial system stability representation is as follows:

10 For the comprehensive bibliometric and content analysis, please see Islam et al. (2022) where they review the Islamic banks in Turkey that serve as a model for future scholars and policymakers.

$$\begin{bmatrix} NPL \\ DF \\ RM2 \\ IDX \\ IslamicR \\ DRRIslamicR \\ IslamRUSFed \\ 1yeargovIslamicR \\ 10yeargovIslamicR \\ REER \\ HPI \\ COP \\ InterReserve \\ PSC \end{bmatrix} = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \lambda_6 \\ \lambda_7 \\ \lambda_8 \\ \lambda_9 \\ \lambda_{10} \\ \lambda_{11} \\ \lambda_{12} \\ 13 \\ 14 \end{bmatrix} Z + \begin{bmatrix} \varphi_{1t} \\ \varphi_{2t} \\ \varphi_{3t} \\ \varphi_{4t} \\ \varphi_{5t} \\ \varphi_{6t} \\ \varphi_{7t} \\ \varphi_{8t} \\ \varphi_{9t} \\ \varphi_{10t} \\ \varphi_{11t} \\ \varphi_{12t} \\ \varphi_{13t} \\ \varphi_{14t} \end{bmatrix} \tag{4}$$

$$\begin{bmatrix} Z \\ Z_{t-1} \end{bmatrix} = \begin{bmatrix} \theta_1 & \theta_2 & \theta_3 \\ 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} Z_{t-1} \\ Z_{t-2} \end{bmatrix} + \begin{bmatrix} \mu_t \\ 0 \end{bmatrix} \tag{5}$$

$$Var \begin{bmatrix} \varphi_{1t} \\ \varphi_{2t} \\ \varphi_{3t} \\ \vdots \\ \varphi_{14t} \end{bmatrix} = \begin{bmatrix} \sigma_1^2 & 0 & 0 & \dots & 0 \\ 0 & \sigma_2^2 & 0 & \dots & 0 \\ 0 & 0 & \sigma_3^2 & \cdots & 0 \\ 0 & 0 & 0 & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & \sigma_{15}^2 \end{bmatrix} \tag{6}$$

where NPL is non-performing loans of Islamic banks, DF is Deposit Fund of Islamic Banks, RM2 is real money supply (M2), IDX is Jakarta Islamic Index, IslamicR is Sharia Interbank Call Money short term interest rate, DRRIslamicR is Bank Indonesia interest rate (BI7DRR) / Sharia Interbank Call Money short term interest rate (IslamicR) spread. IslamicRUSFed is Sharia Interbank Call Money short term interest rate (IslamicR) / the US federal fund rate spread, 1yeargovislamicR is one year government bond yield / Sharia Interbank Call Money short term interest rate (IslamicR) spread, 10yeargovIslamicR is 10-year government bond yield / Sharia Interbank Call Money short term interest rate (IslamicR) spread, REER is real effective exchange rate, HPI is house price index, COP is crude oil price, InterReserve is net international reserves, and PSC is domestic credit to private sector. Besides, Equations (4), (5) and (6) are corresponding to Equations (1), (2) and (3), respectively.

The parameters of the model are estimated using maximum likelihood (ML) based on the econometric software STATA 16. The unobserved factor is subsequently predicted using the Kalman filter and all sample information, and hence, the financial indicator is extracted, Zt, which also called the financial stability index to measure the stability in the Indonesia Islamic financial system. The index is then used to investigate the effect of financial stability on economic performance of Indonesia.

a. Assessment of explanatory power of a financial stability index

Selected financial indicators are utilised to estimate the factor, which is an adaptation of Stock and Watson's (2002) concept. The estimated factor calculates the average changes in the group of chosen financial indicators. Following that, the calculated factor's explanatory power is evaluated in relation to the movement of the Indonesian economic cycle. A financial stability index's capacity to predict the business cycle is examined using formal prediction tests. In particular, in-sample and out-of-sample analyses are employed to evaluate the financial stability index's explanatory power. Bernanke (1990) approximates the equation using the formula:

$$g_{t+h|t} = a_\alpha + \sum_{i=1}^{k} \beta_i g_{t+1-i} + \sum_{i=1}^{p} \omega_i Z_{t+1-i} + \varepsilon_t \quad (7)$$

where g is the business cycle series (economic growth rate), Z is the estimated factor or the financial stability index, and ε_t is the error term. Equation (7) incorporates lags of g and lags of Z up to lag lengths of k and p, respectively. The Schwarz Information Criterion (SIC) is used to determine the optimal lag length. Based on SIC, three different models have been identified: Model (1) with lag k=1 and p=1, Model (2) with lag k=1 and p=2, and Model (3) with lag k=2 and p=1.

The t-test, F-test, and breakpoint test coefficients are all included in the in-sample analysis. Equation (7) states that the financial stability index can explain and predict the economic cycle even when the autoregressive component is considered, if the coefficients of Z (i.e.) are statistically significant. The Chow breakpoint test is used to check the stability of the coefficients of Z over the sample period to detect structural stability in the coefficients of Z in Equation (7). In addition, structural changes or crises may occur over the sample period, such as the global financial crisis of 2007–2008, which had negative effects on the Indonesian economy in the third quarter of 2008.

There is a danger that one will either overestimate or underestimate a model's performance. Therefore, the out-of-sample predictive test is run to assess the financial stability index's ability to predict the business cycle. By estimating Equation (7) recursively over the forecast period with various lag lengths, where the lags of k and p are selected at each sample period using SIC to obtain the values of root mean squared error (RMSE), pseudo out-of-sample forecasting is used to achieve this purpose. An autoregressive (AR) model is computed as a benchmark model (Model 1) for comparison using the same forecasting technique. The performance of the alternative model is calculated using a relative RMSE to the benchmark model; a relative RMSE with a value lower than 1 indicates that the alternative model performs better than the benchmark model, or vice versa.

Out-of-sample forecasting is only descriptive; hence the idea of forecast rationality is used, which includes accurate forecasting and effective forecasting. However, the marginal or incremental information that the predicted values at various horizons convey is not considered by the conventionally accepted prediction rationality. So, in this study, a direct test is used. Vuchelen and Gutierrez (2005) design the test primarily to identify the information richness of a forecast in multiple-period forward forecasts as well as the characteristics of forecast rationality. Vuchelen and Gutierrez (2005) show that the general form for the direct test can be expressed as follow:

$$A_{t+h} = \beta_1 + \beta_2 F_t^{t+h-1} + \beta_3 \left(F_t^{t+h} - F_t^{t+h-1}\right) + \mu_{t+h} \quad (8)$$

where the forecast values of the business cycle are generated using alternative models. Based on Equation (8), three hypotheses can be tested simultaneously. Firstly, failure to reject the joint null hypothesis for forecast rationality – β_1=0 and β_2=β_3=1 – implies the forecasts are rational. Secondly, rejection of the null hypothesis of β_3=0 indicates that the forecast values at time t+h made at time t (F_t^{t+h}) adds no incremental information relative to the forecast values at time t+h-1.

3.2. Econometric Method

After obtaining the financial stability index of Islamic financial system, this study utilizes the following model to examine the relationship between financial stability and economic performance:

$$RGDPPC_t = \beta_0 + \beta_1 K_t + \beta_2 PG_t + \beta_3 HC_t + \beta_4 FSIndex_t + \beta_5 X_t + u_t \quad (9)$$

where *RGDPPC* is real GDP per capita, *K* is physical capital, *PG* is population growth, *HC* is human capital, *FSIndex* is Islamic financial stability index, *X* is other control variables. The expected sign for *K* and *HC* is positive, whereas *PG* is negative. All variables are in natural logarithm. Recent studies have increasingly attempted to capture the asymmetric changes introduced by macro-financial phenomena, particularly the stability of financial system, both in the long and short run (e.g., Bahmani-Oskooee et al., 2019; Hajilee et al., 2017; Ibhagui, 2020). Earlier research on the effect of financial development on economic performance uses linear models. The autoregressive distributed lag (ARDL) model of Pesaran et al. (1999) and Pesaran et al. (2001), which is part of the linear specification, is unable to account for the disparate effects of financial stability on economic performance. Thus, this study extends the ARDL model to the non-linear ARDL (NARDL) model developed by Shin et al. (2014) to capture the complexity of the financial stability on economic performance in Indonesia. The NARDL model allows us to determine whether positive and negative financial stability shocks have any impacts on short and long run economic performance. Equation (9) augmented with asymmetric coefficients of NARDL is as follows:

$$RGDPPC_t = \beta_0 + \beta_1 K_t + \beta_2 PG_t + \beta_3 HC_t + \beta_4 FSIndex_t^+ + \beta_5 FSIndex_t^- + \beta_6 X_t + u_t \quad (10)$$

where β = (β_0, β_1, β_2, β_3, β_4, β_5, β_6) is a vector of long-run coefficients to be estimated. The asymmetric effect of financial stability is accounted for by including the positive changes $FSIndex_t^+$ and the negative changes $FSIndex_t^-$ in Equation (10). $FSIndex_t^+$ and $FSIndex_t^-$ constitute the partial sums of positive and negative changes in the financial stability, respectively. They are specified as follows:

$$FSIndex_t^+ = \sum_{i=1}^{t} \Delta FSIndex_t^+ = \sum_{i=1}^{t} \max(\Delta FSIndex_i, 0)$$

$$FSIndex_t^- = \sum_{i=1}^{t} \Delta FSIndex_t^- = \sum_{i=1}^{t} \min(\Delta FSIndex_i, 0)$$

whether asymmetry exists in the long run is tested by $\beta 4 = \beta 5$ for financial stability variable and economic performance. Equation (10) can be written in the following error-correction form to estimate the short-term coefficients:

$$\begin{aligned}\Delta RGDPPC_t = {} & \alpha_0 + \alpha_1 RGDPPC_{t-1} + \alpha_2 K_{t-1} + \alpha_3 PG_{t-1} + \alpha_4 HC_{t-1} + \alpha_5 FSIndex_{t-1}^+ \\ & + \alpha_6 FSIndex_{t-1}^- + \alpha_7 X_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta RGDPPC_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta K_{t-i} \\ & + \sum_{i=1}^{r} \beta_{3i} \Delta PG_{t-i} + \sum_{i=0}^{s} \beta_{4i} \Delta HC_{t-i} + \sum_{i=0}^{u} \beta_{5i} \Delta FSIndex_{t-1}^+ \\ & + \sum_{i=0}^{v} \beta_{6i} \Delta FSIndex_{t-1}^- + \sum_{i=0}^{w} \beta_{7i} \Delta X_{t-i} + \mu_t\end{aligned} \tag{11}$$

Δ indicates the first difference, p, q, r, s, u, v, and w are the lag lengths. If cointegration exists, the long-run coefficients of positive and negative changes of *FSIndex* correspond to $\beta_4 = \alpha_5 / \alpha_1$, $\beta_5 = \alpha_6 / \alpha_1$, respectively $\sum_{i=0}^{u} \beta_{5i}$ shows the short-run effect of the increases in financial stability on economic performance, while $\sum_{i=0}^{u} \beta_{6i}$ measures the short-run effect of the decreases on economic performance. The NARDL model is performed irrespective of whether the variables are integrated in order 0 or 1 (I(0) or I(1)). However, it cannot be applied if one of the variables is I(2). Hence, the unit root tests (Augmented Dickey Fuller and Phillip and Perron) are conducted to test the order of integration of the variables. Additionally, to examine the cointegration among the variables, the bound test approach introduced by Pesaran et al. (2001) and Shin et al. (2014) is performed. The null hypothesis of no cointegration $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = 0$ is tested using the Wald F-test.

According to Shin et al. (2104), there are four possible specifications: (i) long-run and short-run asymmetry, (ii) long-run asymmetry and short-run symmetry, (iii) long-run symmetry and short-run asymmetry, and (iv) long-run and short-run symmetry. An advantage of using the asymmetric ARDL model is that it allows for asymmetries in the financial stability-economic performance relationship in the long-run as well as the short-run. Among the authors who used the NARDL estimation method are Wakimin et al. (2019), Sanusi et al. (2019), and Long et al. (2021) in their data analysis. Recent years have seen a rise in the popularity of the NARDL technique, which has been applied to several sectors, including agricultural economics, real estate economics, environmental economics, and energy economics. Researchers using the NARDL technique to find asymmetries in financial markets include Dhaoui et al. (2018), Chen et al. (2020), Kocaarslan and Soytas (2019); Majeed et al. (2020). The NARDL model can concurrently capture the short- and long-term asymmetric impacts by jointly analysing nonlinearity and nonstationarity.

3.3. The Data

The variables are measured on a quarterly basis, with the sample period spanning from 2006: Q1 to 2021:Q4. For the construction of the Islamic system financial stability index, fourteen variables are used for Islamic financial stability index. The variables include non-performing loans (NPL) for Islamic financial system, the deposit fund of Islamic banks (DF), real money supply (RM2), Jakarta Islamic Index (IDX), Sharia Interbank Call Money short-term interest rate (IslamicR), Bank Indonesia interest rate (BI7DRR) / Sharia Interbank Call Money short term interest rate spread, Sharia Interbank Call Money short term interest rate / the US federal fund rate spread, one year government bond yield / Sharia Interbank Call Money short term interest rate spread, 10-year government bond yield / Sharia Interbank Call Money short term interest rate spread, money supply, interest rate, interest rate spreads, and the real effective exchange rate. The house price index, crude oil price, net international reserves are also included in the model, and domestic credit to private sector, which illustrates the performance of the domestic private sector. Before estimating the DFM, all variables are de-meaned and standardised. The Central Bank of Indonesia is the main source of all data. Table A.1 present the summary of the datasets in Appendix.

IV. RESULT AND ANALYSIS

4.1. Empirical Results

The findings of the DFM estimation of the Islamic financial stability are reported in Table 1 for three models with different number of variables. As shown in Model 1 that consists of fourteen variables, the null hypothesis that all parameters (i.e., the independent variables, the unobserved factors, and the autoregressive components) are zero is rejected at all conventional levels based on the Wald Chi-square statistics. Additionally, the findings show that, deposit fund of Islamic banks (DF), Sharia interbank call money short-term interest rate, BI7DRR/IslamicR spread, BI7DRR/USfed spread, net international reserves and domestic credit to private sector, the unobserved determinants are persistent and important in forecasting each of the observable variables. Moreover, a negative estimated sign means that Indonesian financial situation was tightening, whereas a positive estimated sign suggests that it was expanding. Based on the predicted positive coefficient of the Sharia interbank call money short-term interest rate (see Table 1), when the rate decreases, the money supply rises, which finally results in an expanding of the financial system. Model 2 only contains ten variables where the insignificant four variables with the highest p-values of Model 1 are dropped. The result demonstrates that two interest rate spread variables (one year and ten-year with Sharia interbank call money), house price index and crude oil price are insignificant. The null hypothesis that all parameters are zero is rejected at all conventional levels based on the Wald Chi-square statistics. Model 3 has 8 variables and similar with Model 2, two interest rate spread variables (one year and ten-year with Sharia interbank call money) are insignificant.

The Islamic financial stability index can be retrieved using the Kalman filter from the estimation of the DFM, and the Islamic financial stability index is shown

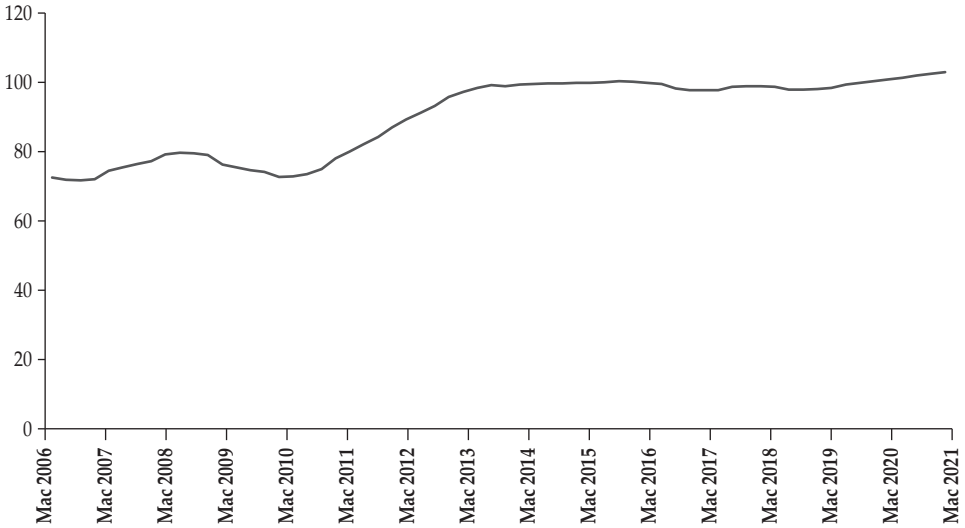
Table 1.
Result of dynamic factor model estimation of Islamic financial stability (FSI)

Financial variables	Model 1 (14 variables)		Model 2 (10 variables)		Model 3 (8 variables)	
	Coefficients (λi)	p-value	Coefficients (λi)	p-value	Coefficients (λi)	p-value
Non-performing loans (NPL)	1.0129	0.809	-	-	-	-
Deposit Fund of Islamic Banks (DF)	0.5351	0.034**	0.0535	0.034**	0.0535	0.034**
Real M2	0.0001	0.985	-	-	-	-
Jakarta Islamic Index (IDX)	-2.10e-06	0.903	-	-	-	-
Sharia Interbank Call Money short-term interest rate (IslamicR)	0.1150	0.000***	0.1150	0.000***	0.1145	0.000***
BI7DRR/IslamicR spread	-0.0057	0.002***	-0.0054	0.002***	-0.0057	0.002***
BI7DRR/USfed spread	0.0367	0.000***	0.0370	0.000***	0.0369	0.000***
One year government bond yield / IslamicR spread	0.0014	0.603	0.0014	0.603	0.0014	0.603
10-year government bond yield / IslamicR spread	-0.0001	0.831	-0.0005	0.831	-0.0005	0.831
Real effective exchange rate (REER)	-0.0003	0.917	-	-	-	-
House price index (HPI)	-0.0013	0.625	-0.0013	0.625	-	-
Crude oil price (COP)	0.0002	0.930	-0.0002	0.930	-	-
Net international reserves (NIR)	0.0484	0.001***	0.0484	0.001***	0.0484	0.001***
Domestic credit to private sector	0.6689	0.000***	0.6689	0.000***	0.6689	0.000***
Zt-1	1.0102	0.000***	1.0101	0.000***	1.0004	0.000***
Zt-2	0.9652	0.000***	0.9543	0.000***	0.9472	0.000***
Wald Test (Chi-square)	126877.96	0.000***	126869.82	0.000***	126867.18	0.000***

Note: ** and *** denote 5% and 1% significance levels, respectively.

in Figure 3. [11] A reduction of value in the index indicates financial instability. The Islamic financial stability index constructed can capture the 2008-2009 global financial crisis and the 2020-2021 COVID 19 pandemic crisis periods. Several forecasting tests, including in-sample analysis, pseudo out-of-sample forecasting analysis, and forecast rationality as outlined in Section 3.2, are used to assess the financial stability index for its capacity to explain the Indonesian business cycle. In Appendix Table A.2, Tables A.3 and A.4, respectively, the findings of the in-sample analysis, the out-of-sample analysis, and forecast reasonableness are reported.

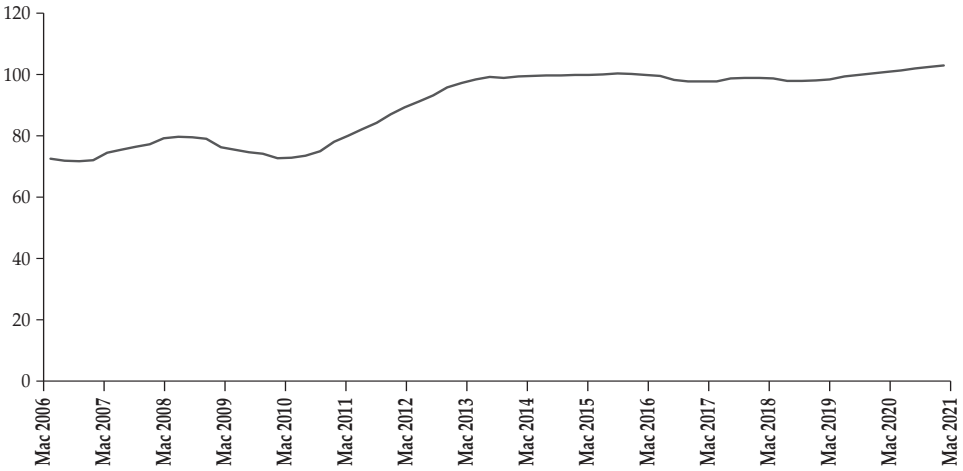
Model 1:14 variables
Financial Stability Index



Relative Contributions	Percent
1. Banking Condition	7.02
2. Monetary and Credit	70.77
3. Interest rates	16.89
4. External Condition	5.15
5. Prices	0.17
	100.00

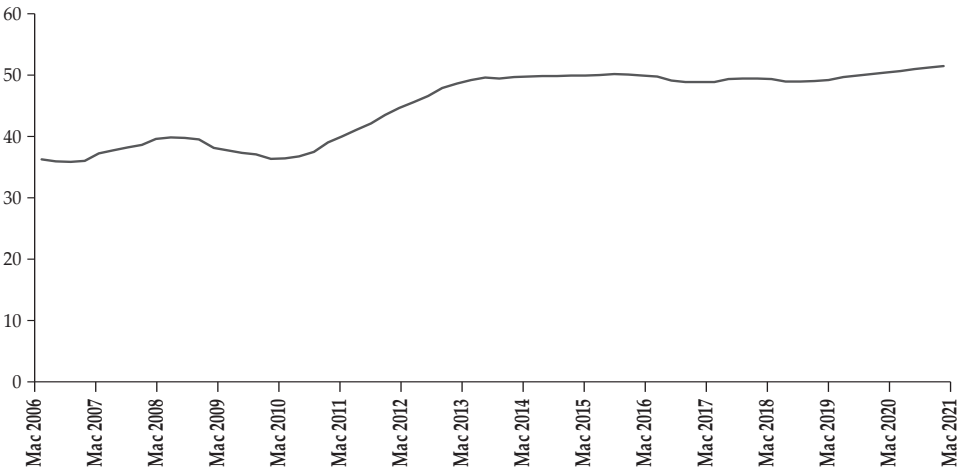
11 The financial stability index is validated for its predictive power on Indonesian business cycle using a series of forecasting tests, including in-sample analysis, pseudo out-of-sample forecasting analysis and forecast rationality. For further details, please refer to Appendix Table A.2, Table A.3 and Table A.4 respectively.

Model 2: 10 variables
Financial Stability Index



Relative Contributions	Percent
Banking Condition	5.74
Monetary and Credit	71.77
Interest rates	17.13
External Condition	5.19
Prices	0.17
	100

Model 3: 8 variables
Financial Stability Index



Relative Contributions	Percent
Banking Condition	5.75
Monetary and Credit	71.89
Interest rates	17.16
External Condition	5.20
	100

Figure 3.
Financial Stability Index of Islamic Financial System

As shown in Table 2, the Indonesia business cycle appears to be predicted by the Islamic financial stability index, which is supported by significant F-tests and the absence of structural breaks. Additionally, Table A.3 indicates all alternative models have relative RMSEs that are less than one for the 1- and 2-quarter projection timeframes. This finding suggests that the financial stability index's inclusion enhances forecasts' ability to anticipate the Indonesian business cycle. Finally, Table A.4's findings demonstrate that for all possible models, the forecast of the business cycle using the Islamic financial stability index is logical, appropriately scaled, and provides minor information at the 1-quarter forecast horizon. In a nutshell, the Indonesian business cycle is explained by the Islamic financial stability index. The results of three-model evaluations are summarized and reported in Table 2. The relative RMSE with a value lower than 1 indicates that the Model 2 performs better than Models 1 (benchmark model) and 3.[12] Therefore, this study selects Model 2 to construct the financial stability index of Indonesia' s Islamic financial system.

Table 2.
Summary of Model Evaluations

Categories	Model 1 (FS Islamic Index I)	Model 2 (FS Islamic Index II)	Model 3 (FS Islamic Index III)
No. of variables used in index construction	14	10	8
F-test	Significant	Significant	Significant
Parameter structural break (Chow test)	No break point	No break point	No break point
Relative RMSE*	Lower than 1 at 1-and 2-quarter horizon for all models	Lower than 1 at 1-and 2-quarter horizon for alternative models 1 and 3	Lower than 1 at 1-and 2-quarter horizon for alternative model I
Rational forecast	Rational at 1-quarter horizon	Rational at 1-quarter horizon	Rational at 1-quarter horizon
Proper scale	Properly scaled at 1-quarter horizon	Properly scaled at 1-quarter horizon	Properly scaled at 1-quarter horizon
Information content	Provides incremental information at 1-quarter horizon	Provides incremental information at 1-quarter horizon	Provides incremental information at 1-quarter horizon

The relative contribution of each financial variable on the Islamic financial stability index is measured by using the weight of each financial variable has on the index that is proportional to its lambda coefficient, which is factor loading (λ_i) as estimated in Equation (1). A negative factor loading suggests the financial condition tightens when the financial variable increases. Mainly, the financial variables with negative factor loading are from the interest rate and price index groups. Meanwhile, a positive factor loading indicates an easing financial condition

12 The relative RMSE is observed at the sample period of 2006Q1 – 2021Q4.

when the financial variable increases. Figure 3 shows the relative contribution of each group of financial indicators on Islamic financial stability index[13]. As depicted in Figure 3 from Model 2, monetary and credit group (71.77 percent) is the major driver in influencing Islamic financial condition in Indonesia, followed by interest rate (17.13 percent), banking condition (5.74 percent), external condition (5.19 percent); meanwhile prices (0.17 percent) are the minor contributor in Indonesian Islamic financial system stability. Based on the empirical evidence, the selected Islamic financial stability index and the major contributions of the Islamic financial system stability are presented in Figure 4 and Figure 5, respectively. The box region in Figure 4 highlights how Islamic financial stability index performs quite well amid Indonesian financial downturns during the global financial crisis of 2008–2009 (a small inverted U-shaped curvilinear relationship) and 2020-2021 COVID 19 period crisis (an upward trend). Due to higher value of financial stability index indicates financial stability, the Islamic financial system stability in Indonesia has increased from 2010:Q1 to 2014:Q1, then remains stable until the 2020-2021 COVID 19 pandemic period. In short, the Islamic financial system stability in Indonesia is becoming more stable since the index exhibits an upward trend, where the stability slightly increased during the COVID 19 period.

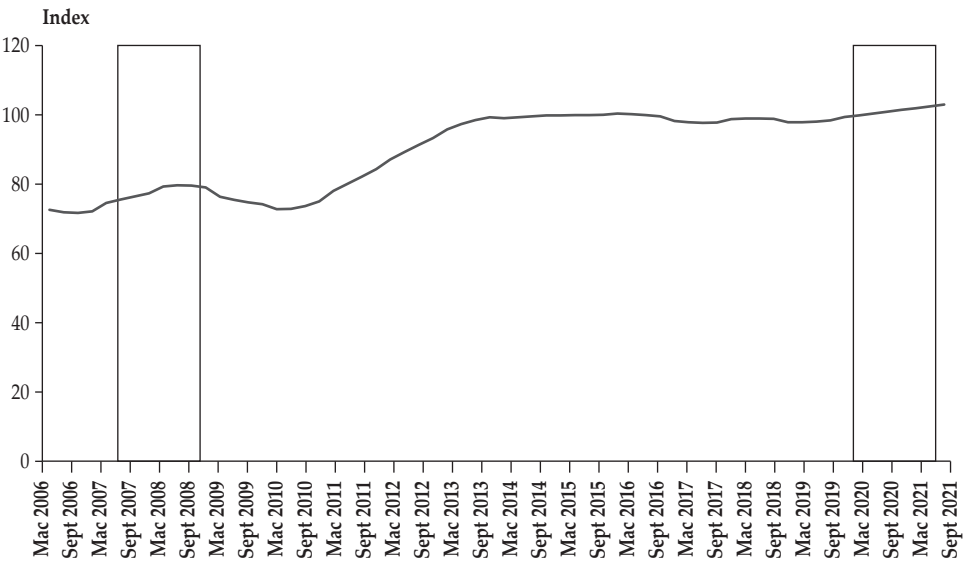


Figure 4.
Islamic Financial System Stability Index of Indonesia (Base year = 2015)

13 Interest rates group consists of Bank Indonesian interest rate and all the four interest rate spreads; price group includes house price index, crude oil price and stock market index; NPLCB and CAR represents the conditions of banking system; credit and monetary group consists of domestic credit to private sector and money supply; REER and net international reserves represents the group of external conditions.

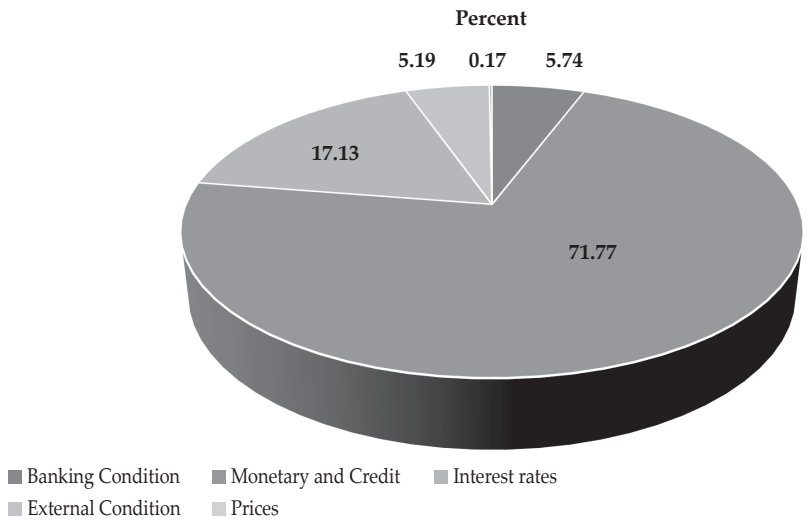


Figure 5.
Relative Contributions to Islamic Financial System Stability

Figure 6 presents the time plots of economic growth (%) and Islamic financial system stability from 2006:Q1 to 2021:Q4. Both series seem to move together in the long run except during the COVID 19 pandemic period. Following a fall of 5.32% in the second quarter of 2020, this has pushed Indonesia into a recession. The last time recession is during the 1997-1998 East Asian financial crisis. After obtaining the Islamic financial stability index, the index is used to examine the effect of financial stability on economic performance using the NARDL approach. Before presenting the results, the descriptive statistics, correlations, and unit root tests are reported in Tables 3a, 3b and 4, respectively. The descriptive statistics are based on the original datasets. The correlations show that Islamic financial stability is positive correlated with real GDP per capita. Table 4 reports the results of Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) unit root tests. The findings reveal that the variables are integrated of order zero or I(0) and one or I(1). This implies that the NARDL method is appropriate since no variable is integrated of order two or I(2).

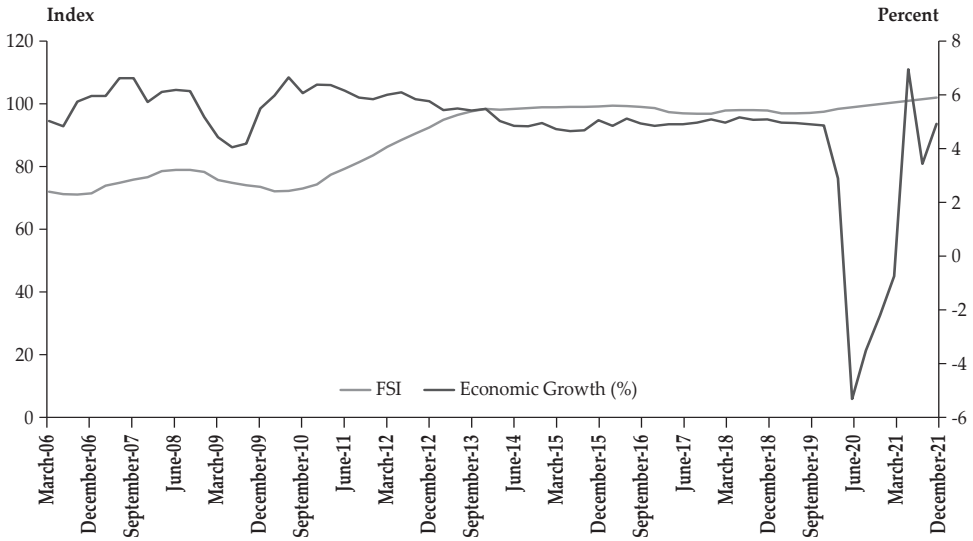


Figure 6.
Time Plots of Economic Growth and Islamic Financial System Stability Index

Table 3a.
Descriptive Statistics

Variables	Unit of measurement	Mean	Std. Dev	Min	Max
Real GDP per capita	Rupiah	8193233.0	1383725.0	5861180.0	1.03e
Islamic Financial stability index (FSI)	Index	90.097	11.323	71.705	102.957
Human capital (HC)	Years of schooling	2.348	0.038	2.287	2.419
Investment	% of GDP	30.757	2.675	23.896	32.832
Population growth (PG)	Percent	1.257	0.111	1.025	1.362
Inflation	Percent	5.375	3.281	1.330	15.740
Government spending (Govt)	% of GDP	9.135	0.424	8.225	9.773
Trade openness (Trade)	% of GDP	45.722	7.269	32.423	59.784

Table 3b.
Correlations

Variables	GDPPC	FSI	HC	Investment	PG	Inflation	Govt	Trade
GDPPC	1							
FSI	0.904	1						
HC	-0.636	-0.561	1					
Investment	0.698	0.695	0.022	1				
PG	-0.858	-0.661	0.801	-0.299	1			
Inflation	-0.693	-0.525	0.213	-0.632	0.597	1		
Govt	0.413	0.529	0.095	0.746	-0.111	-0.409	1	
Trade	-0.853	-0.706	0.496	-0.689	0.757	0.759	-0.613	1

Table 4.
Results of Unit Root Tests

	Augmented Dickey Fuller (ADF)		Phillips-Perron (PP)	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
Level				
GDPPC	-1.8061	-1.2976	-2.1270	-1.1917
Islamic Financial Stability Index	-3.1851**	-2.1888	-1.2179	-1.5009
Human capital	-1.6985	-2.4964	-1.2084	-2.5934
Investment	-3.3095**	-4.5963***	-3.1203**	-1.3022
Population Growth	-3.0163**	-2.0894	3.2526**	-0.7066
Government Spending	-2.5523	-2.0230	-2.3143	-2.1202
Trade Openness	-2.2935	-4.0212**	-1.9498	-2.2908
Inflation	-1.6871	-2.9513	-3.3353**	-3.8965
First Difference				
GDPPC	-7.5703***	-	-7.5588***	-
Islamic Financial Stability Index	-1.7737	-	-3.2723**	-
Human capital	-2.2209	-	-3.1006**	-
Investment	-1.4145	-	-2.9773**	-
Population Growth	-1.9645	-	-0.6484	-
Government Spending	-2.3079	-	-4.4603***	-
Trade Openness	-3.1721**	-	-3.3265**	-
Inflation	-6.6490***	-	-7.0924***	-

Notes: *** and ** denote significant at 1% and 5% levels, respectively.

Table 5 reports the NARDL bounds cointegration test results. Model 7a is the baseline model where it only contains population growth, investment, human capital and Islamic financial stability index. Models 7b, 7c and 7d incorporate one additional control variable namely inflation, government spending and trade openness, respectively. The lag orders of the ARDL models are based on the Schwarz Information Criterion (SIC). The empirical results reveal that all F-test statistics are greater than the upper bound critical values, which imply that the variables are cointegrated or there is a long run co-movement relationship. The long-run and short-run asymmetries are tested and then confirmed using the Wald test, as shown in Table 6. All the bounds cointegration tests passed the serial correlation and CUSUM stability test diagnostic checks as depicted in Figure 7.

Table 5.
NARDL Bounds Cointegration Test

a) Financial stability index = Islamic financial stability								
	Model 7a (k=5) Baseline model ARDL(1, 0, 2, 2, 0)		Model 7b (k=6) Baseline + Inflation ARDL(1, 1, 0, 2, 0, 1)		Model 7c (k=6) Baseline + Government spending ARDL(1, 0, 0, 2, 0, 2)		Model 7d (k=6) Baseline + Trade openness ARDL(1, 0, 0, 2, 2, 2)	
F-statistic test value	9.65***	12.55***	20.60***	10.96***	20.60***		10.96***	
Critical values	I(0)	I(1)			I(0)	I(1)		
5%	2.596	3.677			2.473	3.583		
1%	3.43	4.721			3.225	4.571		
Long-term asymmetry								
Wald test	14.82***		17.25***		25.84***		18.47***	
p-value								
Short-term asymmetry								
Wald test	12.88***		15.61***		23.96***		14.04***	
p-value								

Notes: *** denotes significant at 1% level. The critical values are based on 65 sample observations

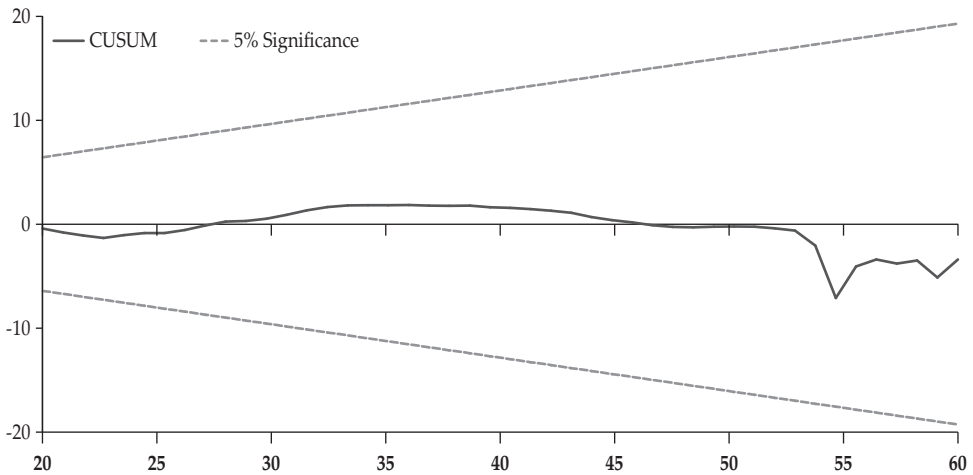


Figure 7.
CUSUM Stability Test

Table 6 present the NARDL level relation results of Islamic financial stability where the focus is the long-run coefficient / elasticity. Based on this table, the estimates appear to be stable since the significant coefficients of the lagged explanatory variables remain with the same signs for all lag levels. The long-run coefficients of the financial stability indicator (positive and negative) are significant at the 1% level, revealing a long-run relationship between Islamic financial stability and economic performance in Indonesia. The positive long run Islamic financial

stability coefficient is positive, implying that more stable Islamic financial system or a positive financial stability shock increases long-term economic performance. Nevertheless, the negative Islamic financial stability shocks (lower financial stability) decreases economic performance. This implies as improved financial stability relates to higher real GDP per capita or economic performance.

Specifically, a 1% increase in Islamic financial stability implies 0.272 – 0.319 percent ranges increase in economic performance, and a 1% decrease in financial stability tends to reduce 0.474 – 0.709 percent decline in long-term economic performance (Models 9a – 9d). Thus, a decrease in financial stability appears to be more disruptive to economic performance than an increase in financial stability. To obtain the asymmetric adjustment in the long run after the new equilibrium based on positive and negative shocks for NARDL, Figure 8 depicts the dynamic multiplier plot that indicates the positive or negative effect of financial stability at a particular time. The negative shock has a more effect on economic performance as compared to positive shock.

In terms of the control variables, population growth and investment have negative and positive signs and statistically significant. However, the human capital is an insignificant determinant of economic performance. The control variables namely inflation and government spending are insignificant determinants of economic performance, but the trade openness is significant in Model 8d. The short-run results are dynamic where the positive financial stability index has positive sign and is a significant determinant of economic performance but not the negative financial stability. The error-correction term is negative and significant, which confirms the long-run cointegration result. Any deviation in the short-run will adjust and move back toward the long-run equilibrium about 1.65 – 2.16 quarters (Models 8a – 8d).

Table 6.
Results of NARDL Level Relation of Islamic Financial Stability Dependent Variable: Real GDP per capita

Variables	Model 8a ARDL (1, 2, 0, 0, 1, 2)	Model 8b ARDL (1, 2, 0, 0, 0, 2, 2)	Model 8c ARDL (1, 0, 0, 0, 1, 2, 2)	Model 8d ARDL (1, 2, 1, 0, 0, 2, 2)
Long-run coefficients				
Islamic financial stability index (+)	0.306 (0.051)***	0.316 (0.039)***	0.319 (0.040)***	0.272 (0.043)***
Islamic financial stability index (-)	-0.709 (0.232)***	-0.709 (0.213)***	-0.474 (0.176)***	-0.692 (0.205)***
Population growth	-0.766 (0.118)***	-0.665 (0.092)***	-0.656 (0.090)***	-0.607 (0.096)***
Investment	0.138 (0.120)	0.125 (0.090)	0.448 (0.071)***	0.328 (0.108)***
Human capital	-0.047 (0.604)	-0.568 (0.488)	-1.107 (0.320)***	-1.132 (0.537)**
Inflation	-	0.611 (0.591)	-	-

Table 6.
Results of NARDL Level Relation of Islamic Financial Stability Dependent Variable: Real GDP per capita (Continued)

Variables	Model 8a ARDL (1, 2, 0, 0, 1, 2)	Model 8b ARDL (1, 2, 0, 0, 0, 2, 2)	Model 8c ARDL (1, 0, 0, 0, 1, 2, 2)	Model 8d ARDL (1, 2, 1, 0, 0, 2, 2)
Government spending	-	-	-0.087 (0.081)	-
Trade openness	-	-	-	0.203** (0.088)
Short-run Coefficients				
Δ Islamic financial stability indext (+)	0.012 (0.168)	0,159 (0.161)	0.1359 (0.079)*	0.144 (0.147)
Δ Islamic financial stability $index_{t-1}$ (+)	0.401 (0.167)**	0.606 (0.169)***	-	0.484 (0.151)***
Δ Islamic financial stability index (-)	0.099 (0.215)	-0.146 (0.194)	-0.080 (0.182)	0.116 (0.208)
$\Delta Population\ growth_t$	-0.341 (0.192)*	-0.386 (0.175)**	-0.414 (0.157)**	-0.307 (0.173)*
$\Delta Investment_t$	0.063 (0.102)	0.105 (0.093)	0.192 (0.092)**	0.131 (0.096)
$\Delta Human\ capital_t$	-0.427 (1.138)	0.687 (1.074)	-0.285 (0.949)	0.219 (1.214)
$\Delta Human\ capital_{t-1}$	-6.621 (1.272)***	-7.417 (1.197)***	-4.527 (0.937)***	-6.125 (1.085)***
$\Delta Inflation_t$	-	0.463 (0.208)**	-	-
$\Delta Inflation_{t-1}$	-	0.625 (0.235)**	-	-
$\Delta Government\ spending_t$	-	-	-0.014 (0.064)	-
$\Delta Government\ spending_{t-1}$	-	-	-0.339 (0.059)***	-
$\Delta Trade\ openness_t$	-	-	-	-0.035 (0.037)
$\Delta Trade\ openness_{t-1}$	-	-	-	0.156 (0.035)***
Error correction term (ECT_{t-1})	-0.463 (0.059)***	-0.573 (0.062)***	-0.606 (0.071)***	-0.541 (0.062)***
Speed of adjustment	2.16 Quarter	1.75 Quarter	1.65 Quarter	1.85 Quarter
Diagnostic Tests				
Serial correlation test	No serial correlation	No serial correlation	No serial correlation	No serial correlation
Stability test (CUSUM)	Stable	Stable	Stable	Stable

Note: ***, ** and * denote significant at 1%, 5% and 10% levels, respectively. Figures in the parentheses are standard errors.

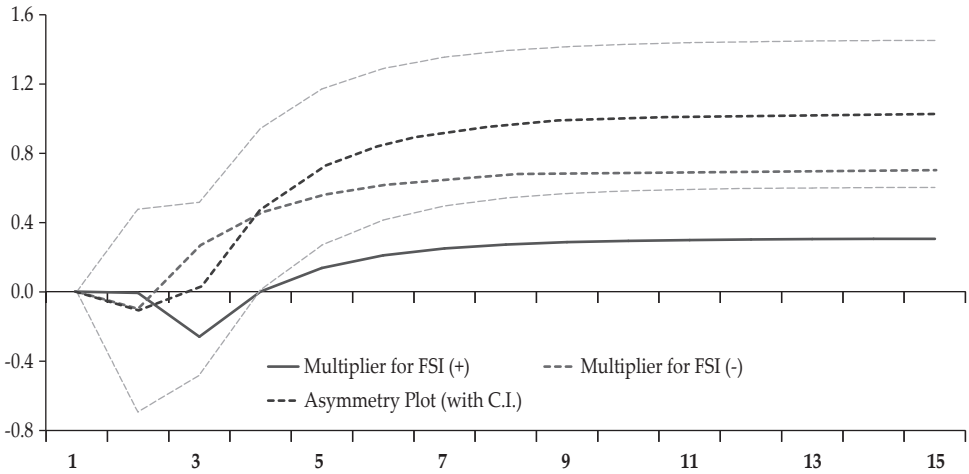


Figure 8.
NARDL Dynamic Multiplier

4.2. Robustness Checks

This study performs the robustness checks of the empirical findings using the quantile regression, where nine representative quantile points from 10 percent to 90 percent quantiles are used in the analysis. The quantile regression results of Islamic financial system financial stability are presented in Table 7. Here we only report a subset of the checks carried out by focusing on the coefficients of Islamic financial stability index. The table presents the results of nine representative quantiles, and the results show that the regression coefficients of Islamic financial stability of these nine quantile points are all positive and statistically significant. This means that Islamic financial stability is conducive to promote economic performance and proves that the roles of Islamic finance in channelling funds and other tasks in Indonesia and that Islamic financial stability is beneficial to promoting economic performance. Nevertheless, when the economic performance has reached at the high level, the role of Islamic finance stability diminishes as shown in the coefficients become smaller at higher quantile levels.[14]

Meanwhile, this study also provides the graphical results of quantile regression, which can give a comprehensive picture of the impacts of the Islamic financial stability index on the dependent variable (i.e., economic performance – real GDP per capita). Figure 9 depicts the coefficients of Islamic financial systems stability index at different quantiles from Table 7. The Islamic financial stability has positive sign but exhibits downward-sloping pattern. We therefore conclude that the quantitative nature of the results is robust to the sign, control variables and alternative estimation technique.

14 Only the coefficients of Islamic finance stability are reported to save space.

Table 7.
Quantile Regression Result of Islamic Financial Stability and Economic Performance

Models	-1	-2	-3	-4	-5	-6	-7	-8	-9
	q10	q20	q30	q40	q50	q60	q70	q80	q90
	Quantile coefficients								
Baseline Model (BLM)									
	0.651***	0.551***	0.439***	0.309***	0.287***	0.298***	0.289***	0.282***	0.278***
	(0.0820)	(0.116)	(0.134)	(0.104)	(0.0972)	(0.0625)	(0.0544)	(0.0507)	(0.0446)
BLM + inflation									
	0.620***	0.581***	0.495***	0.343***	0.293**	0.300***	0.291***	0.285***	0.271***
	(0.0818)	(0.113)	(0.141)	(0.123)	(0.122)	(0.0731)	(0.0581)	(0.0406)	(0.0467)
BLM + government spending									
	0.513***	0.535***	0.500***	0.456***	0.412***	0.383***	0.364***	0.360***	0.326***
	(0.0840)	(0.0622)	(0.0636)	(0.0753)	(0.0634)	(0.0669)	(0.0577)	(0.0555)	(0.0566)
BLM + trade openness									
	0.500***	0.430***	0.392***	0.336***	0.285***	0.283***	0.284***	0.288***	0.292***
	(0.121)	(0.116)	(0.118)	(0.106)	(0.0876)	(0.0745)	(0.0719)	(0.0558)	(0.0555)
BLM + three control variables									
	0.521***	0.528***	0.490***	0.469***	0.448***	0.422***	0.450***	0.428***	0.375***
	(0.0687)	(0.0659)	(0.0669)	(0.0853)	(0.0723)	(0.0891)	(0.0712)	(0.0664)	(0.0693)

Notes: ***, ** and * denote 1%, 5% and 10% significance levels, respectively. Standard errors in parentheses

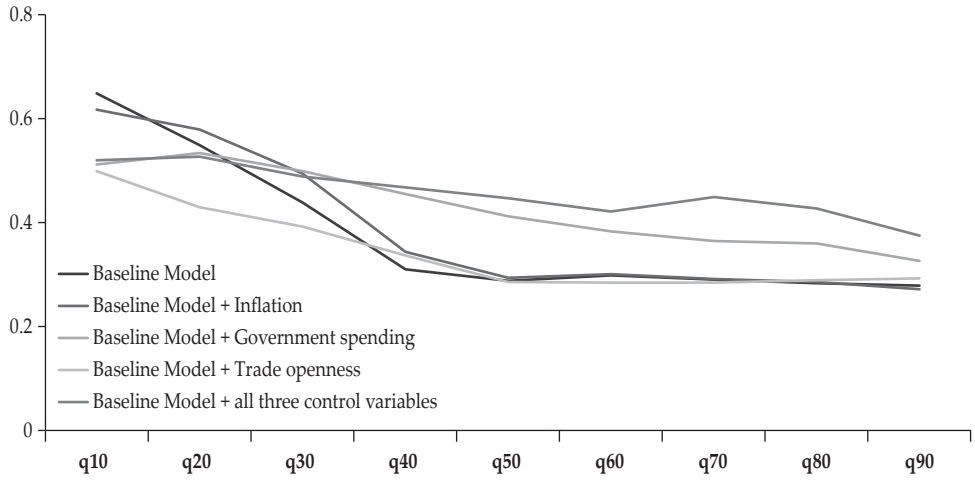


Figure 9.
Coefficients of Islamic Financial System at Different Quantiles

V. CONCLUSIONS

As the allocation of financing can support national economic growth, financial system stability is crucial for it to operate effectively and efficiently while preserving resilience to internal and external vulnerabilities. This study examines the role of Islamic financial system stability in influencing economic performance in Indonesia, using quarterly data from 2006:Q1 to 2021:Q4. The stability index is constructed utilizing the DFM that consists of three alternative models and the selection of the final financial stability index is based on various criteria used in the literature. Motivated by most studies in the field of financial stability that have only focused on conventional financial system, this study contributes to the literature on the Islamic financial system stability issue using a non-linear ARDL approach to capture the positive and negative stability effects on economic performance.

A variety of forecasting tests, including in-sample analysis, pseudo out-of-sample forecasting analysis, and forecast rationality, are used to evaluate the financial stability index for its capacity to explain the Indonesian business cycle. The empirical findings demonstrate that the Islamic financial stability indexes constructed capture well the 2008/2009 global financial crisis and the recent 2020-2021 COVID 19 pandemic economic recession. The empirical results of NARDL reveal significant asymmetries in the impact of Islamic financial stability on short- and long-term economic performance. The results suggest that positive and negative shocks to Islamic financial system stability affect economic performance differently in the short and long run, thus demonstrating the inadequacy of linear models to capture the effect of Islamic financial stability on economic performance. The positive Islamic financial stability shocks have a positive and more pronounced impact on economic performance than negative shocks in the long-term. Specifically, a significantly positive impact of positive Islamic financial stability shocks on economic performance demonstrates that Islamic financial system facilitation is an appropriate policy to address economic performance in Indonesia. On the contrary, negative shocks of Islamic and conventional

financial systems may reduce economic performance in the long run, indicating the importance of improving macroprudential policy and supervision for Islamic financial stability in Indonesia.

Our research has important implications for the continuing discussion over the ideal macroprudential and monetary policy mix to achieve higher economic growth, as well as whether monetary policy should address financial stability in addition to macroeconomic stability. There has not been much research done on the interaction between different macroprudential tools and monetary policy. This is crucial because, despite recent advancements, there is still a great deal of uncertainty surrounding the effectiveness of some of these instruments in addressing financial stability issues, as well as the degree to which they affect banks' incentives to engage in excessive lending over the cycle and regulatory arbitrage, their market signalling effects, and hence, economic performance. We leave these issues for future research.

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APPENDIX

Table A.1:
Data Description for Selected 14 Indicators to Construct Islamic Financial Stability Index

Indicators/ Variables	Frequency	Transformation	Timing	Source
Islamic Financial System Stability				
Non-performing loans/funds	Quarterly	Level	Lagging	OJK
Deposit Fund of Islamic Banks (DF)	Quarterly	Level	Lagging	OJK
Jakarta Islamic Index (IDX)	Quarterly	Level	Leading	BI
Sharia Interbank Call Money	Quarterly	Level	Leading	BI
1-year Indonesia Government Securities	Quarterly	Level	Leading	Bloomberg
10-years Indonesia Government Securities	Quarterly	Level	Leading	Bloomberg
Other Variables				
Money supply (RM2)	Quarterly	Growth	Leading	BI
BI7DRR (Bank Indonesia 7 Days Repo Rate)	Quarterly	Level	Leading	BI
U.S. federal fund rate	Quarterly	Level	Leading	BI
Real effective exchange rate (REER)	Quarterly	Growth	Leading	BIS
International reserves	Quarterly	Growth	Leading/ Coincident	BI
Domestic credit to private sector	Quarterly	Growth	Lagging	OJK
House price index	Quarterly	Growth	Leading/ Coincident	BI
Crude Oil Price	Quarterly	Growth	Leading/ Coincident	CEIC

Notes: BI – Bank Indonesia; OJK – Indonesia Financial Services Authority, BIS – Bank for International Settlement

Table A.2.
Results of in-Sample Analysis for Islamic Financial Stability Index

Business cycle		
	F-test	3.1254* (0.0541)
t-test	Z_t	2.369**(0.0190)
	Z_{t-1}	3.0456***(0.0026)
	Z_{t-2}	3.5201***(0.0006)
	Z_{t-3}	-3.5597***(0.0005)
	Sum of coefficients	3.006
Chow test		
2008Q2		1.702 (0.1127)
2008Q3		1.715 (0.1075)
2008Q4		1.704 (0.1058)
2009Q1		1.608 (0.1201)
2009Q2		1.612 (0.1188)
2009Q3		1.624 (0.1105)
2009Q4		1.605 (0.1214)
2020Q1		1.712 (0.1078)
2020Q2		1.705 (0.1059)
2020Q3		1.711 (0.1076)
2020Q4		1.706 (0.1057)
2021Q1		1.626 (0.1104)

Notes: The results are obtained by estimating $y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \sum_{i=0}^{p} \delta_i Z_{t-i} + \varepsilon_t$ with lags of k and p equal to 2. However, the results of the lags of y are excluded in this table due to the emphasis on Z. All p-values are reported in squared parentheses. ***, ** and * represent 1%, 5% and 10% significance levels, respectively. Due to the Indonesian economic growth rate was -5.32% in 2021:Q2, the Chow test is only tested until 2021:Q1.

Table A.3:
Results of Pseudo Out-of-Sample Forecasting Error Measures of Financial Stability Index On Business Cycle

Sample period		**2006:1-2018:4**	**2006:1-2019:1**	**2006:1-2019:4**	**2006:1-2020:1**	**2006:1-2020:4**	**2006:1-2021:1**	**2006:1-2021:4**
Model	Horizon	Root Mean Squared Errors (RMSE)						
Benchmark Model 1	*h = 1*	0.0016	0.0013	0.0375	0.0092	0.0033	0.0134	0.0200
	h = 2	0.0031	0.0244	0.0392	0.0103	0.0132	0.0104	0.0164
	h = 3	0.0221	0.0294	0.0330	0.0142	0.0119	0.0085	0.0156
	h = 4	0.0274	0.0262	0.0309	0.0129	0.0103	0.0100	0.0179
Model	Horizon	Relative RMSE to Benchmark Model						
Alternative Model 2	*h = 1*	0.9150	1.0950	0.9950	0.9950	1.0950	1.0150	0.9750
	h = 2	1.1450	1.0250	1.0050	1.0250	1.0650	1.0250	0.9650
	h = 3	1.0350	1.0250	1.0050	1.0550	1.0750	1.0450	0.9950
	h = 4	1.0350	1.0250	1.0050	1.0650	1.0750	1.0650	1.0150
Model	Horizon	Relative RMSE to Benchmark Model						
Alternative Model 3	*h = 1*	1.9850	1.2850	0.9950	1.0550	0.4150	0.9550	0.8550
	h = 2	0.9650	1.0850	1.0050	1.0050	0.7550	0.9650	0.8150
	h = 3	0.9750	1.0850	1.0150	0.9250	0.7750	1.0850	1.0650
	h = 4	1.0350	1.0950	0.9950	0.9150	0.8450	1.3250	1.1750

Note: Selected lag length for benchmark Model 1 is k = 1 and p = 1; for alternative Model 2 is k = 1 and p = 2 and for alternative Model 3 is k = 2 and p = 1. Lag length selection is based on Schwarz Information Criterion (SIC).

Table A.4.
Evaluation of All Sectors Business Cycle Forecast Using Islamic Financial Stability Index

Horizon	Model 1				
	Coefficient Estimates			Hypothesis Tests	
	β_1	β_2	β_3	$\beta_1 = 0$, $\beta_2 = \beta_3 = 1$[a]	$\beta_3 = 1$[b]
$h = 1$	0.0121	0.8616***	0.8013***	4.1697	2.6011
$h = 2$	-0.0050	0.2965*	0.0597	7.4049	5.1522
$h = 3$	0.0055	-0.0577	0.2761	11.0732***	3.1362
$h = 4$	-0.0062	1.0064	0.2447	12.6046***	3.5379
	Model 2				
	Coefficient Estimates			Hypothesis Tests	
	β_1	β_2	β_3	$\beta_1 = 0$, $\beta_2 = \beta_3 = 1$[a]	$\beta_3 = 1$[b]
$h = 1$	0.0112	0.8620***	0.8225***	3.9598	2.2438
$h = 2$	0.0046	0.4971	0.4230	4.3038	1.5575
$h = 3$	-0.0053	-0.1954	0.1532	12.8420***	2.6826
$h = 4$	-0.0104	0.7443	0.3268	12.8133***	2.1757
	Model 3				
	Coefficient Estimates			Hypothesis Tests	
	β_1	β_2	β_3	$\beta_1 = 0$, $\beta_2 = \beta_3 = 1$[a]	$\beta_3 = 1$[b]
$h = 1$	0.0116	0.8593***	0.8527***	3.2068	1.2204
$h = 2$	0.0033	-0.1492	-0.7382	15.4478***	12.3803***
$h = 3$	-0.0051	-1.8587	-1.5227	88.0956***	52.7818***
$h = 4$	-0.0057	-0.6102	-1.0108	26.8704***	11.429***

Notes: Results are obtained by regressing $A_{t+h} = \beta_1 + \beta_2 F_t^{t+h-1} + \beta_3 \left(F_t^{t+h} - F_t^{t+h-1} \right) + \mu_{t+h}$.

This forecast method is developed by Vuchelen & Gutierrez (2005).

a reports Chi-squared test statistics.

b reports F-test statistics.