The asymmetric impact of macroeconomic variables on Islamic bank home financing in Indonesia

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Abstract

Purpose – The study investigates the performance of non-performing financing (NPF) in the housing sector concerning the asymmetric influence of macroeconomic conditions.

Methodology – The method of the study adopts nonlinear autoregressive distributed lag (NARDL), while the data of the study ranges from 2014m6 to 2022m2.

Finding – The findings reveal an asymmetric relationship between macroeconomic variables and NPF is present both in the short and long run. In addition, the COVID-19 has worsened the NPF of Islamic banks' home financing in some sectors in the short run, while only such financing in the flat and apartment market has suffered during the pandemic in the long run.

Implication – The implication of the study suggests that the Islamic banking industry and financial authority need robust risk management and financial policies, respectively, to achieve and maintain the stability of Islamic banks in home financing activities.

Originality – The study is original in measuring the impact of macroeconomic influences on Islamic banks' home financing from a nonlinear viewpoint.

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Introduction

The Indonesian commercial banking sector is distinguished by sector-conventional and Islamic banks. Although the nature of both banks is similar, they differ in operation, with varying products and services (Olson & Zoubi, 2008). Islamic banks operate their businesses and offer services in compliance with Islamic principles (Samad, 2019). An Islamic Finance Development report showed that Indonesia ranked second in global Islamic finance in terms of total assets owned by Islamic banks (IFSB, 2019). As a result, Indonesian Islamic banks are clearly emerging, with higher growth of asset allocation through their various products and services.

Islamic banks distribute funds from the surplus to the deficit as an intermediary institution (Bakar & Sulong, 2018). Accordingly, this intermediary role is considered vital because it directly impacts the performance of banks. Islamic banks have considered interest rates as a benchmark for certain products and services (Redzuan, Kassim & Abdullah, 2018). Amongst the many sectors

comprising financing activities, the housing sector is pivotal and needs to be prudently managed in banking operations (Yusof & Usman, 2015). According to Islamic bank statistics issued by OJK (2022), home financing in Indonesia has represented a significant percentage of business in the last five years from February 2018 to February 2022, reaching 29% of total Islamic bank financing and rising to 31.1% in February 2022, therefore constituting the highest percentage compared to other sectors. Therefore, the question of the performance of Islamic bank financing in Indonesia arises.

This study investigates the presence of nonlinear symmetric and asymmetric relationships between macroeconomic variables and the non-performing loans of Islamic banks' home financing in Indonesia. This country was chosen due to the double-digit growth of its Islamic banking industry, and it is considered to see promising development in the following year (Ernst & Young, 2016). In addition, as stated by Khattak, Hamid, Islam, and Ali (2021), Indonesia is the most populous Muslim country in the world. Its Islamic finance and banking sector is emerging rapidly. Furthermore, the country already has robust regulation of the dual banking system, as stated in the UU No.21 in 2008; Islamic banks have grown significantly since this regulation was issued. Finally, Indonesia was also able to manage the Asian financial crisis of 1997/1998 and the global financial crisis of 2007/2008, attracting many researchers to study its banking system.

In terms of theory, Kiyotaki and Moore (1997) explain that the existing macroeconomic circumstances determine the lending performance of the banking sector. This condition then affects borrowers' ability to meet their obligation to pay back loans in which the borrowers are in favor during the stable economic condition. Kiyotaki and Moore's (1997) argument is the same as that of Bernanke and Gertler (1998), who conclude that by adopting a life-cycle consumption model, borrowers are unfavorable regarding the return of the funds during financial turmoil. However, a reciprocal condition can also occur, in which the banking sector experiences a high level of non-performing finance, directly influencing macroeconomic conditions.

Empirically, the contributions of the study are twofold. First, it enriches and comprehends the current literature and empirical research on Islamic banks' non-performing loans. Several researchers have conducted studies on the issue of Islamic banks' non-performing financing performance. In general, concerning risk management purposes, Kabir et al. (2015), Albaity et al. (2019), and Kasri and Azzahra (2020) state that risk management is important in managing Islamic banking performance. In addition, Klein (2013) and Abid et al. (2014) state that macroeconomic variables affect the performance of bank financing. This finding is supported by Rinaldi and Sanchis-Arellano (2006) and Gunsel (2012), who found that macroeconomic factors such as inflation have a positive and significant relationship with bad loans. In the home financing sector, related empirical studies have examined the determinants of home financing performance in several countries; for example, Koetter and Poghosyan (2010) in Germany, Starr and Yilmaz (2007), and Ali (2007) in Turkey explaining the interconnectedness between real estate financing and banking stability.

Second, the study provides a different perspective on the performance of Islamic banks' non-performing financing in the housing sector by testing for the presence of nonlinear symmetric and asymmetric effects and comparing these before and during the Covid-19 outbreak. In this regard, Elnahass, Trinh, and Li (2021) assessed the impact of the pandemic on banking performance across countries where banks tended to recover after the second quarter of 2020, with Islamic banks found to be less risky than conventional ones. Similarly, Fakhrunnas, Tumewang, and Anto (2021), Fakhrunnas et al. (2022), and Anto et al. (2022) studied the same time frame, discussing the impact of the Covid-19 pandemic on the home financing sector but focused their observation of home financing in Indonesia using a panel data approach.

Previous literature on Islamic banks' non-performing financing in the housing sector remains scarce and focuses on nonlinear symmetric and asymmetric measurements. To fill this gap, this study attempts to address several questions: (1) What is the impact of macroeconomic variables on Islamic banks' non-performing financing in the housing sector in Indonesia before and during the Covid-19 outbreak in relation to both short- and long-run relationships?; (2) Do macroeconomic variables and Islamic banks' non-performing financing in the housing sector in Indonesia have a symmetric or asymmetric effect?; and (3) What has been the impact of the Covid-19 pandemic on Islamic bank financing in the housing sector?

The study comprises several sections. After the introduction, the literature review is presented, followed by an outline of the study method, the results, and discussion. It ends with the conclusion and recommendations.

Literature review

The macroeconomic factors of credit have been associated with the standard economic, financial accelerator, and wealth effect theory (Redzuan et al., 2018). Case et al. (2005) define the wealth effect as the causal outcome of exogenous deviations in wealth based on consumption behavior. They also found that deviations in the housing sector significantly and positively affect consumption. According to theory, the macroeconomic factor becomes an exogenous factor that determines the performance of the banking sector in lending activities (Kiyotaki & Moore, 1997). When economic turmoil emerges, the banking sector faces more risk exposure when performing financing activities, including the home financing sector. In addition, Bernanke and Gertler (1998) explain that from the borrowers' viewpoint, they face more difficulties in returning funds during unstable economic conditions, and therefore the risk of default is higher.

Some empirical studies have examined the relationship between macroeconomic variables and non-performing financing in the banking industry; for example, those of Rinaldi and Sanchis-Arellano (2006), Gunsel (2012), Klein (2013), Kabir et al. (2015), Albaity et al. (2019), and Kasri & Azzahra (2020). The findings of the above-mentioned studies are in line with Rinaldi and Sanchis-Arellano (2006) and Gunsel (2012), who found many variations in the research findings depending on the period of the study, financial circumstances, and the study object. A recent study conducted by Fakhrunnas et al. (2022) explains that the relationship between macroeconomic variables and non-performing loans in the banking industry is nonlinear and asymmetric. They state that additional changes in certain macroeconomic variables at a certain level to a change of non-performing financing of the banking industry do not have the same impact when it has an additional decrease in change of certain macroeconomic variables at the same level to a change of non-performing financing of the banking industry. The same was also found by Bussiere (2012) and Mahmoudinia and Mostolizadeh (2022), who identified a similar nonlinear relationship in the influence of macroeconomic variables on other variables.

Several empirical studies have also examined the relationship between housing prices and macroeconomic factors in different countries, such as Koetter and Poghosyan (2010), Starr and Yilmaz (2007), and Deng, Zeng, and Li (2019). However, most studies have focused on conventional banks' home financing and performance associated with macroeconomic variables. In Malaysia, Yusof et al. (2017) demonstrated a significant relationship between the home financing of conventional and Islamic banks affecting the affordability of home ownership. Furthermore, they posited a lower significance of interest rates in determining home affordability concerning Islamic home financing loans. Yusof et al. (2018) provided evidence of the effect of macroeconomic shocks on the short- and long-run effects of home financing offered by Islamic and conventional banks. Moreover, Adzis et al. (2021) demonstrated interest rates as a significant determinant of mortgage loan default. Lo et al. (2022) discussed the importance of monetary supply, stock market, and foreign exchange markets for housing price to rent ratios in the UK. Similarly, Akça (2022) found long- and short-term relationships between housing prices and macroeconomic variables (e.g., interest rates, real exchange rates, and housing loans) in Turkey.

Mahmoudinia and Mostolizadeh (2022) identified asymmetric short- and long-run effects of the stock market and a long-run effect of the real exchange rate on housing prices in Iran using the NARDL model. By applying Granger causality, Habanabakize and Dickason (2022) found a significant effect of inflation, interest rates, rents, and political risk on housing prices in both the short and long run in South Africa. In addition, Michail and Koursaros (2022) suggested that interest rates, inflation, investment, and housing prices had an impact on the credit standing of banks in Cyprus. Laurinavicius et al. (2022) demonstrated that the inflation rate led to higher nominal house prices in Vilnius, while Arshad et al. (2018) proved that inflation, interest rates, and household consumption significantly influenced housing prices in nine Asian countries.

During the Covid-19 pandemic, some studies have also examined the impact of macroeconomic variables on banking performance, such as that of Elnahass, Trinh, and Li (2021) at the cross-country level, who found that Islamic banks had a higher risk than conventional ones during the outbreak, particularly with macroeconomic variables. Their findings indicate that banks tended to be riskier during the outbreak, leading to less stability. In the case of the Islamic home financing sector, using panel data analysis based on a regional approach, Fakhrunnas, Tumewang, and Anto (2021) found that macroeconomic variables, especially the regional inflation rate, had a much more significant effect during the COVID-19 pandemic. However, the impact of the outbreak has been less severe in the provinces located on Java Island compared to the ones outside it. In line with Fakhrunnas, Tumewang, and Anto (2021), Anto et al. (2022) demonstrated that during the pandemic, regional inflation had had a positive relationship with personal flat and apartment ownership but that inflation negatively affected home ownership. The findings of Anto et al. (2022) indicate that during the outbreak, the influence of inflation on bad loans in Islamic banks' home financing has been much more significant, even though it has had different effects on each home financing sector. However, few previous studies have examined the nonlinear impact of macroeconomic variables on Islamic bank home financing in Muslim-populated countries, including Indonesia.

Methodology

The use of the nonlinear symmetric and asymmetric approach is important for measuring the level of significance of an increase or decrease in certain independent variables (X) on the dependent variable (Y) as the impact may not be symmetric. As explained by Bussiere (2012), Fakhrunnas et al. (2022), and Mahmoudinia and Mostolizadeh (2022), in many cases, an increase to a particular degree of a certain variable may have a different impact on other variables compared to a decrease. Due to this phenomenon, measurement using a linear symmetric approach could lead to bias and misleading results. Hence, nonlinear symmetric and asymmetric approaches are needed to assess the phenomenon more precisely. The use of such approaches will provide a more accurate understanding of how macroeconomic variables influence banks' NPLs in Indonesia.

Table 1. Explanation of the variables

Variable	Measurement	Denomination	Data Source
Non-performing financing (NPF)	The percentage of Islamic banks' non-performing financing in the housing sector.	Percentage	Indonesian Financial Service Authority
Inflation (INF)	The rate of inflation on a monthly basis.	Percentage	Indonesian Statistics
Interest rate (IR)	The interest rate percentage determined by the Central Bank of Indonesia on a monthly basis.	Percentage	Central Bank of Indonesia
Production index (PI)	The level of the production index.	Number	Indonesian Statistics
Islamic bank financing (IFIN)	The natural logarithm of total financing in Islamic banks.	Log number	Indonesian Financial Service Authority
Islamic bank assets (ISIZE)	The natural logarithm of total assets in Islamic banks.	Log number	Indonesian Financial Service Authority

Moreover, the study uses monthly data from 2014m6 to 2022m2 retrieved from the Indonesian Financial Service Authority, Indonesian Statistics, and the Central Bank of Indonesia. Observations are made considering the availability of the data provided by the sources. The model is generally applied as follows:

$$\text{NPF}_t = \beta_0 + \beta_1 \text{Inf}_t + \beta_2 \text{Int}_t + \beta_3 \text{PI}_t + \beta_4 \text{LnIFIN}_t + \beta_5 \text{LnISIZE}_t + e_t \qquad (1)$$

The explanation of the variables is provided in Table 1, while e_t is the error term. The dependent variable is NPF, comprising NPF in flat and apartment financing (NPF1); in home

ownership financing (NPF2); in real estate and business financing (NPF3); and in shop house ownership financing (NPF4). The independent variables are macroeconomic ones, consisting of inflation, interest rates, and the production index, while the complementary variables comprise the total financing and total assets of Islamic banks. In addition, to explain the COVID19 Pandemic, a dummy variable is used to separate the period before (0) and during (1) it.

Furthermore, as suggested by Shin and Greenwood-Nimmo (2014), to examine the asymmetric effect of the observed variables, the research model for nonlinear autoregressive distributed lag (NARDL) is formulated below:

$$\Delta NPL_t = a_0 + a_1 \Delta NPL_{t-1} + a_2 \Delta POSMACROVAR_{t-1} + a_3 \Delta NEGMACROVAR_{t-1} +$$
$$a_4 \Delta LnIFIN_{t-1} + a_5 \Delta LnISIZE_{t-1} + \sum_{i=1}^{n} \theta_{1i} \Delta NPL_{t-1} +$$
$$\sum_{i=1}^{n} \theta_{2i} \Delta POSMACROVAR_{t-1} + \theta_{3i} \Delta NEGMACROVAR_{t-1} +$$
$$\sum_{i=1}^{n} \theta_{4i} \Delta LnIFIN_{t-1} + \sum_{i=1}^{n} \theta_{5i} \Delta LnISIZE_{t-1} + \mu_t \tag{2}$$

MACROVAR stands for the macroeconomic variables listed in Table 1, with the POS (positive) and NEG (negative) macroeconomic variable values generated from:

$$POSMACROVAR_t = \sum_{i=1}^{n} \Delta MACROVAR_t^+ = \max(MACROVAR_t, 0) \tag{3}$$
$$NEGMACROVAR_t = \sum_{i=1}^{n} \Delta MACROVAR_t^- = \max(MACROVAR_t, 0) \tag{4}$$

The calculation of the long-run coefficients, which consist of negative and positive results, is $\delta_1 = -\frac{a_2}{a_1}$ and $\delta_2 = -\frac{a_3}{a_1}$ for MACROVAR. Furthermore, the asymmetric short-run relationship is also calculated as $\theta_1 = \sum_{i=1}^{n} \theta_{2i} \Delta POSMACROVAR_{t-1}$ and $\theta_2 = \sum_{i=1}^{n} \theta_{3i} \Delta NEGMACROVAR_{t-1}$ for $MACROVAR$

After calculating the values of POS and NEG in the determined variables (Cheah et al., 2017; Fakhrunnas et al., 2022), as explained by Shin and Greenwood-Nimmo (2014), the NARDL method was employed by taking several steps similar to those in the ARDL test. First, ADF and PP unit root tests were conducted, as proposed by Dickey and Fuller (1981) and Phillips and Perron (1988), respectively, to check the level of stationary. Second, bounds testing co-integration, as suggested by Pesaran et al. (2001), was adopted to assess the presence of long-run relationship. Third, the value Wald test, as explained by Sriyana and Ge (2019), was calculated to determine the symmetric and/or asymmetric movement of the observed variables, in which H_0 of the Wald test means the relationship of the observed variables is symmetric. Fourth, Aikaike's Information Criterion (AIC) lag approach was used with fixed four lags due to the limited availability of the data from the sources. Fifth, bootstrapping analysis was conducted to understand the movement of the independent variables toward the dependent variables during the observation periods. Finally, a cumulative sum (CUSUM) test was conducted to examine the robustness of the tested model based on a 5% level of significance.

Results and analysis

Table 2 presents the data description covering the whole observation period before and during the COVID-19 pandemic. It consists only of a 24-month period, in which the data cut-off is March 2020 as the first COVID-19 case in Indonesia occurred in that month. From the data, it can be seen that the highest mean value of NPF generally refers to financing in the real estate and business activity sector, at 5.19%, while the lowest is in the apartment and flat sector, at only 2.21% on average.

Comparing the periods before and during the COVID-19 pandemic, Islamic banks clearly attempted to maintain growth in overall financing activities, as shown by the amount of financing during the pandemic, which is higher than before it. However, the NPF percentage for flat and apartment, home ownership and shop house ownership financing are higher than before the pandemic, even though the corresponding figure in the real estate and business sector has an opposite result. According to Islamic bank statistics issued by OJK (2022), the higher percentage of NPF in the real estate and business sector before the pandemic was driven by a higher NPF in 2018, which roughly reached ten percent.

Table 2. Description of the Data

Variable	All				Before Covid				During Covid			
	Mean	Max	Min	Std. Dev.	Mean	Max	Min	Std. Dev.	Mean	Max	Min	Std. Dev.
NPF1	2.21%	4.43%	1.06%	0.72%	1.45%	2.12%	1.06%	0.28%	2.38%	3.58%	1.40%	0.57%
NPF2	2.47%	3.41%	1.87%	0.31%	2.25%	2.60%	1.97%	0.14%	2.30%	2.79%	1.87%	0.24%
NPF3	5.19%	11.99%	1.34%	2.98%	6.13%	11.99%	1.42%	3.73%	1.99%	2.63%	1.34%	0.43%
NPF4	4.75%	6.50%	2.50%	0.86%	4.95%	5.88%	3.91%	0.64%	5.64%	6.49%	5.01%	0.42%
INF	3.50%	8.36%	1.32%	1.65%	3.08%	3.49%	2.48%	0.28%	1.74%	2.96%	1.32%	0.42%
INT	5.37%	7.75%	3.50%	1.43%	5.42%	6.00%	4.25%	0.57%	3.77%	4.50%	3.50%	0.36%
PI	136.68	158.00	104.02	10.44	146.33	158.00	125.18	7.11	138.55	149.68	104.02	11.24
IFIN	196,978.0	257,482.4	137,826.4	35,294.3	205,829.2	225,145.7	189,676.9	11,758.7	242,693.3	257,482.4	227,438.5	8,178.2
ISIZE	293,670.5	446,454.0	186,848.4	75,944.3	315,339.2	351,014.1	291,474.5	18,406.0	395,271.1	446,454.0	347,108.1	31,349.7

Table 3. Results of the Unit Root Test

Variable	In Level		1st Difference		Conclusion
	ADF	PP	ADF	PP	
NPF1	-0.936	-1.017	-5.430***	-5.851***	1st Difference
NPF2	-0.728	-1.137	-5.884***	-8.021***	1st Difference
NPF3	-1.156	-0.778	-4.800***	-4.812***	1st Difference
NPF4	-1.415	-1.379	-5.374***	-5.374***	1st Difference
INF	-0.352	-0.352	-4.230***	-3.391***	1st Difference
INT	-0.817	-0.756	-3.807**	-3.927**	1st Difference
PI	-4.715***	-4.714***	-6.272***	-23.098***	In Level
LnIFIN	-3.288*	-3.152	-5.753***	-7.881***	In Level
LnISIZE	-3.502*	-2.950	-5.610***	-10.452***	In Level

Note: ***, ** and * indicate a level of significance of 1%, 5% and 10% respectively

To begin the NARDL analysis, as explained by Shin and Greenwood-Nimmo (2014) a unit root test first needs to be conducted to check the level of stationary. Table 3 shows that all the NPF variables are stationary in the 1st difference, likewise inflation and interest rates. The level of stationary in level applies to PI, LnIFIN and LnISIZE, from which it can be concluded that all the obseved variables in the model have the different level of stationaries, but not more than 1nd difference. Therefore, according to Pesaran et al. (2001) and Shin and Greenwood-Nimmo (2014), this fulfills the requirement to conduct a NARDL test to examine the presence of nonlinear relationships in symmetric or asymmetric form in the observed variables.

Table 4. Short-Run Relationship Results

Variable	Model 1		Model 2		Model 3		Model 4	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
D(NPF(-1))	0.266*	0.469***	-0.412***	-0.417***	0.202	0.265**	-0.316***	-0.293**
	1.804	3.144	-3.674	-3.620	1.681	2.128	-2.737	-2.521
D(NPF(-2))	0.042	0.165	-0.483***	-0.573***	0.068	0.158	-0.236*	-0.253*
	0.329	1.377	-3.681	-4.116	0.571	1.272	-1.856	-1.887
D(NPF(-3))	0.160	0.195**	-0.107	-0.173	-0.140	-0.126	-0.115	-0.114
	1.526	2.049	-0.832	-1.287	-1.334	-1.170	-0.840	-0.777
D(COVID)		0.013***		0.003**		-0.008		0.006
		3.608		2.174		-0.778		1.258
D(COVID(-1))		-0.029***		-0.002		0.003		0.006
		-5.457		-1.554		0.280		0.981
D(COVID(-2))		-0.020***		-0.002		0.027		0.006
		-3.000		-0.980		1.529		0.789
D(COVID(-3))		-0.004		-0.001		0.034**		-0.005
		-0.706		-0.272		2.091		-0.665
D(INF_POS)	-0.393*	-0.076	-0.349***	-0.299***	-1.100**	-1.134**	-0.470*	-0.555***
	-1.675	-0.384	-5.164	-4.344	-2.053	-1.998	-2.000	-2.205
D(INF_POS(-1))	1.109***	0.748**	0.123	0.010	0.633	0.609	0.174	0.144
	3.751	2.842	1.377	0.101	0.895	0.804	0.567	0.432
D(INF_POS(-2))	-0.060	0.117	0.107	0.098	-0.139	-0.024	-0.143	-0.128
	-0.209	0.438	1.170	0.960	-0.189	-0.030	-0.434	-0.340
D(INF_POS(-3))	0.066	0.191	0.004	0.015	1.361**	1.576**	-0.170	-0.226

	0.270	0.837	0.053	0.175	2.070	2.258	-0.566	-0.709
D(INF_NEG)	0.003	0.076	0.120**	0.120**	-0.021	-0.159	0.485**	0.541**
	0.018	0.469	2.188	2.112	-0.045	-0.333	2.353	2.547
D(INF_NEG(-1))	-0.163	-0.053	-0.194***	-0.158**	-0.039	-0.041	-0.159	-0.080
	-0.796	-0.287	-2.981	-2.329	-0.069	-0.070	-0.627	-0.296
D(INF_NEG(-2))	0.543**	0.442**	0.060	0.042	0.345	0.347	0.457*	0.499**
	2.653	2.427	0.859	0.581	0.602	0.596	1.905	2.021
D(INF_NEG(-3))	0.066	0.002	-0.001	-0.013	0.096	0.003	0.125	0.209
	0.330	0.011	-0.014	-0.202	0.192	0.005	0.540	0.871
D(INT_POS)	-0.771	-0.793*	0.031	0.022	1.083	-0.494	-0.885	-0.832
	-1.573	-1.783	0.188	0.128	0.753	-0.318	-1.586	-1.412
D(INT_POS(-1))	-0.436	-0.952*	-0.343*	-0.374*	-0.523	-0.500	-0.575	-0.512
	-0.822	-1.915	-1.933	-2.008	-0.322	-0.292	-0.910	-0.774
D(INT_POS(-2))	-2.567***	-2.573***	-0.465**	-0.478**	5.538***	6.460***	-1.434***	-1.553**
	-4.378	-4.893	-2.264	-2.292	3.141	3.539	-2.007	-2.130
D(INT_POS(-3))	0.938	-0.073	-0.421*	-0.532**	0.651	1.920	-0.280	-0.604
	1.534	-0.114	-1.977	-2.314	0.363	0.988	-0.400	-0.824
D(INT_NEG)	-0.621*	-0.314	0.389***	0.505***	-0.625	-1.030	0.932***	1.062***
	-2.470	-1.365	3.757	4.512	-0.938	-1.499	2.769	2.970
D(INT_NEG(-1))	0.106	0.603	-0.261**	-0.211*	1.590**	0.985	-0.715*	-0.607
	0.309	1.655	-2.236	-1.673	2.023	1.130	-1.946	-1.532
D(INT_NEG(-2))	0.270	0.182	-0.250**	-0.328***	-0.146	-0.025	-0.945***	-1.095***
	0.841	0.622	-2.279	-2.835	-0.192	-0.032	-2.674	-2.978
D(INT_NEG(-3))	0.638**	0.671**	0.000	0.003	1.724**	1.803**	-0.247	-0.237
	2.274	2.599	-0.001	0.028	2.226	2.227	-0.690	-0.626
D(PI_POS)	0.000*	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-1.890	-0.986	-0.941	-0.584	-0.598	0.936	-0.555	-0.210
D(PI_POS(-1))	0.000	-0.001***	0.000	0.000	0.000	0.001*	0.000	0.000
	-0.965	-3.717	-0.343	-0.838	0.851	1.9448	-0.176	-0.062
D(PI_POS(-2))	0.000	0.000*	0.000	0.000	0.000	0.000	-0.000	0.000
	0.882	-1.891	0.247	-0.323	0.780	1.103	-0.791	-0.087
D(PI_POS(-3))	0.000	0.000	0.000	0.000	0.001***	0.001***	0.000	0.000
	-0.232	0.307	0.139	0.555	2.843	2.754	0.197	0.109
D(PI_NEG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-0.028	0.110	-0.140	-0.519	0.511	-0.255	-0.181	-0.274
D(PI_NEG(-1))	0.000**	-0.001***	0.000	0.000	0.000	0.001	0.000	0.000
	-2.037	-4.667	0.911	-0.147	0.057	1.413	0.214	1.017
D(PI_NEG(-2))	0.000	-0.001***	0.000	0.000*	0.000	0.001	0.000	0.000
	-0.895	-3.094	-1.543	-1.69	0.083	1.509	-1.278	-1.099
D(PI_NEG(-3))	0.000	0.000**	0.000	0.000**	0.000	0.000	0.000	0.000
	1.485	-2.065	-1.249	-2.194	-0.465	-0.184	-1.209	-0.803
D(LNFIN)	-0.031	-0.067	0.029**	0.020	0.056	0.076	0.005	-0.025
	-0.672	-1.584	2.014**	1.357	0.457	0.606	0.087	-0.460
D(LNFIN(-1))	-0.024	-0.057	0.010	0.003	0.202*	0.264**	-0.051	-0.063
	-0.586	-1.538	0.687	0.189	1.715	2.128	-0.944	-1.091
D(LNFIN(-2))	-0.024	-0.053	-0.004	-0.006	0.179*	0.216*	-0.042	-0.052
	-0.620	-1.529	-0.274	-0.460	1.665	1.896	-0.895	-1.061
D(LNFIN(-3))	-0.033	-0.047*	-0.004	-0.005	0.048	0.058	0.005	0.006
	-1.201	-1.879	-0.529	-0.539	0.689	0.812	0.177	0.183
D(LNSIZE)	-0.136***	-0.144***	-0.027***	-0.025**	0.003	-0.015	-0.057	-0.019
	-4.378	-4.517	-2.659	-2.071	0.032	-0.147	-1.523	-0.422
D(LNSIZE(-1))	-0.008	0.017	-0.036***	-0.035***	-0.097	-0.081	-0.093***	-0.097***
	-0.281	0.651	-3.650	-3.458	-1.260	-1.009	-2.745	-2.746
D(LNSIZE(-2))	-0.031	0.007	-0.011	-0.007	-0.115	-0.077	0.002	0.001
	-1.205	0.275	-1.061	-0.714	-1.550	-0.995	0.072	0.036
D(LNSIZE(-3))	-0.018	-0.002	-0.025***	-0.025***	-0.131*	-0.101	-0.037	-0.053*
	-0.722	-0.085	-3.060	-2.775	-1.861	-1.341	-1.282	-1.702
CointEq(-1)	-1.080***	-1.536***	-0.633***	-0.687***	-0.626***	-0.640***	-0.341***	-0.402***
	-5.853	-7.034	-5.649	-5.618	-6.298	-6.425	-4.576	-4.746
R-squared	0.799	0.856	0.810	0.823	0.646	0.670	0.604	0.631
Adjusted R-squared	0.664	0.739	0.682	0.679	0.408	0.402	0.338	0.332
F-Bounds Test	2.833***	3.561***	2.638***	2.271***	3.280***	2.971***	1.731***	1.621***
Wald Test	23.715***	17.366***	47.934***	1.775	77.356***	50.621***	3.469***	3.128***

Note: ***, ** and * indicate a level of significance of 1%, 5% and 10% respectively

With reference to the impact of macroeconomic variables on NPF in the home financing sector, it can be seen from the Wald test that the influence of inflation, interest rates and the production index is nonlinear and that the majority of the results are in an asymmetric form to NPF in almost all of the home financing sectors. The results of the F-bound testing also reveal that the macroeconomic variables have a long-run relationship with NPF in the home financing sector. The findings are in line with Fakhrunnas et al. (2022), who demonstrated that inflation, interest rates and the production index have nonlinear and asymmetric relationships with NPL in the Indonesian banking industry. It is also confirmed that an additional increase in the macroeconomic variables has a different impact when it has an additional decrease in macroeconomic variables to NPF in all home financing sectors.

In terms of short-run relationships, the results in model 1 explain that an increase in inflation and a decrease in interest rates have a negative relationship with NPF in the flat and apartment sector. The findings indicate that an increase in inflation and a decrease in interest rate reduce NPF in the flat and apartment sector. This is in line with Rinaldi and Sanchis-Arellano (2006), Gunsel (2012) and Fakhrunnas et al. (2022), who found that a lower interest rate results in lower borrowing costs, and means the borrower can return financing to the Islamic bank appropriately. Moreover, higher inflation means that the actual value of money returned to banks is lower, which benefits borrowers and makes it easier for them to return loans in the determined period (Anto et al., 2022). Moreover, a higher production index lowers NPF rates in the flat and apartment sector, which confirms the theory of business cycles, which posits that in the good economic conditions the capability of customers is better, particularly in returning loans to banks (Kiyotaki & Moore, 1997; Bernanke & Gertler, 1998).

In model 1B, the COVID-19 pandemic worsens NPF, which affects bank performance. However, an increase in interest rates also negatively affects the value of NPF. The finding is in contrast to those of Yusof and Usman (2015) in the case of Malaysia, who found a positive and significant relationship of interest rate to Islamic bank home financing. The findings possibly indicate that during the pandemic NPF in the flat and apartment sector has increased, but that banks have attempted to be prudent in response to the changes in interest rates by the central bank, particularly in performing their financing activities. In addition, a significant relationship between interest rates and Islamic bank home financing also confirms that banks are still exposed to interest rates, as stated by Redzuan et al. (2018)

In model 2, the impact of an increase in inflation and the COVID-19 pandemic are the same as in model 1. Inversely, a fall in inflation has a negative relationship to changes in NPF. In contrast to model 1, a decrease in interest rates has a positive relationship with NPF in the home ownership sector. This indicates that Islamic banks have possibly not been prudent, by providing financing facilities to deficit units, particularly during the pandemic period (Fakhrunnas et al., 2021). Surprisingly, the pandemic has not affected NPF in the real estate and business financing (NPF 3) sector or shop house ownership financing (NPF4). This may reflect the fact that both sectors have had better risk management during the outbreak compared to other sectors. Both models also possess the same results, showing that an increase in inflation has a negative relationship with a change in NPF. These findings are in line with those of Fakhrunnas et al., (2022) and Anto et al., (2021). In model 4 in particular, a decrease in inflation and interest rates has a positive relationship with a change in NPF in the shop house ownership sector. This means that when inflation and interest rates fall, the percentage of NPF also decreases. From these findings, it can be interpreted that a lower interest rate will create a lower cost of borrowing, which will increase the affordability of financing (Fakhrunnas et al., 2022). Moreover, a lower rate of inflation will possibly give an incentive to deficit units, in which borrowers have fewer funds to finance their business activities and more funds to be returned.

For the long-run relationship, model 1 reveals that an additional increase and decrease in inflation have a negative relationship with a change in NPF in the flat and apartment sector. From this, it can be interpreted that financing activities in the long run are not sufficiently robust to address inflation risk. This is possibly because of a lack of diversification in the business model and the provision of financing facilities to deficit units, particularly in adopting certain contracts that

have a high exposure to inflation risk (Kabir et al., 2015). Moreover, a reduction in interest rates means Islamic banks will have lower NPF, possibly due to the lower cost of financing to customers, which increases the possibility for them to return loans.

Table 5. Long-Run Relationship Results

Variable	Model 1		Model 2		Model 3		Model 4	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
COVID		0.024***		0.004		-0.020		-0.014
		3.830		0.769		-0.399		-0.480
INF_POS	-0.527***	-0.199	-0.005	0.053	-1.151	-1.595	-0.326	-0.552
	-3.108	-1.465	-0.054	0.451	-1.380	-1.300	-0.445	-0.712
INF_NEG	-0.322***	-0.246***	-0.040	-0.047	-0.276	-0.230	-0.611	-0.714
	-3.523	-4.018	-0.770	-0.867	-0.655	-0.489	-1.348	-1.619
INT_POS	-0.151	0.060	-0.003	0.011	-2.337***	-2.824**	-0.055	-0.196
	-0.879	0.418	-0.032	0.095	-2.921	-2.427	-0.087	-0.283
INT_NEG	-1.035***	-1.039***	0.249*	0.283*	-0.257	-0.014	2.856*	2.853*
	-4.135	-6.399	1.756	1.980	-0.203	-0.011	1.783	1.955
PI_POS	0.000	0.000***	0.000***	0.000	-0.001	-0.001	-0.001	-0.001
	-0.667	2.789	-2.862	-1.225	-1.290	-0.626	-1.479	-1.420
PI_NEG	0.000	0.001***	0.000***	0.000	0.000	0.000	-0.001*	-0.001
	-1.500	2.774	-3.364	-0.690	0.334	-0.024	-1.637	-1.203
LNFIN	-0.040	-0.010	0.053**	0.061**	-0.300*	-0.357	0.159	0.108
	-0.979	-0.343	2.457	2.605	-1.707	-1.591	1.042	0.733
LNSIZE	-0.081**	-0.125***	0.003	-0.006	0.392**	0.489**	0.188	0.209
	-2.358	-4.577	0.160	-0.281	2.408	2.225	1.042	1.210
C	1.226***	1.591***	-0.284	-0.212	-3.117*	-3.988*	-3.057	-3.042
	3.636	6.499	-1.198	-0.894	-1.794	-1.959	-1.307	-1.472

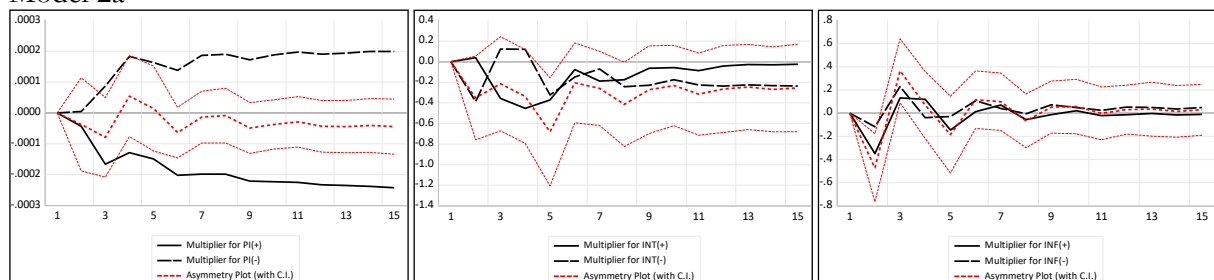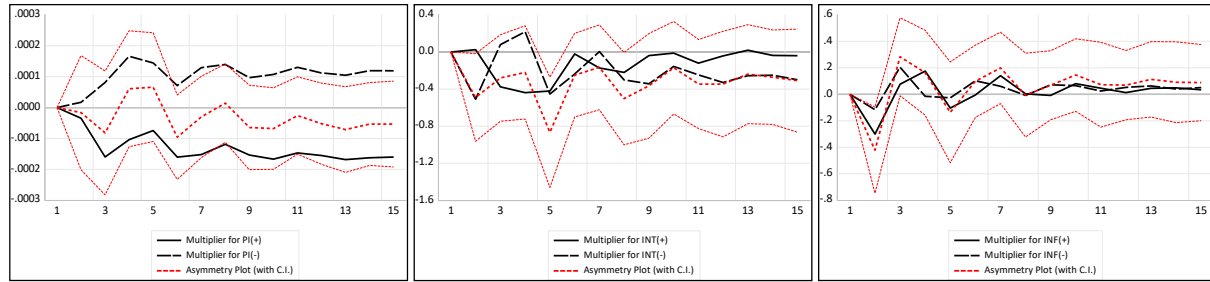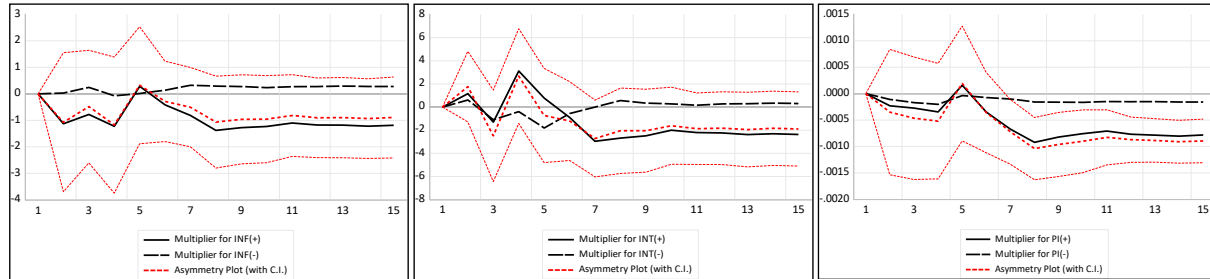Note: ***, ** and * indicate a level of significance of 1%, 5% and 10% respectively
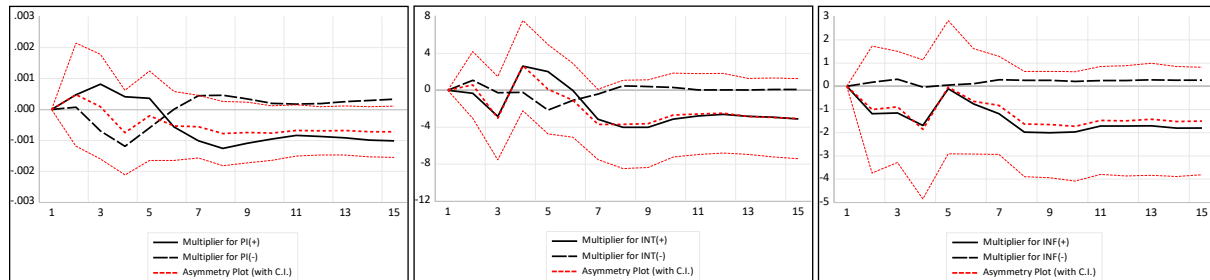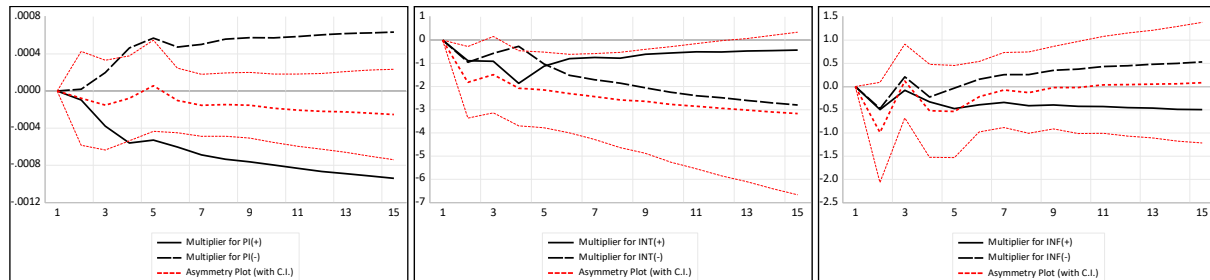
Model 1a
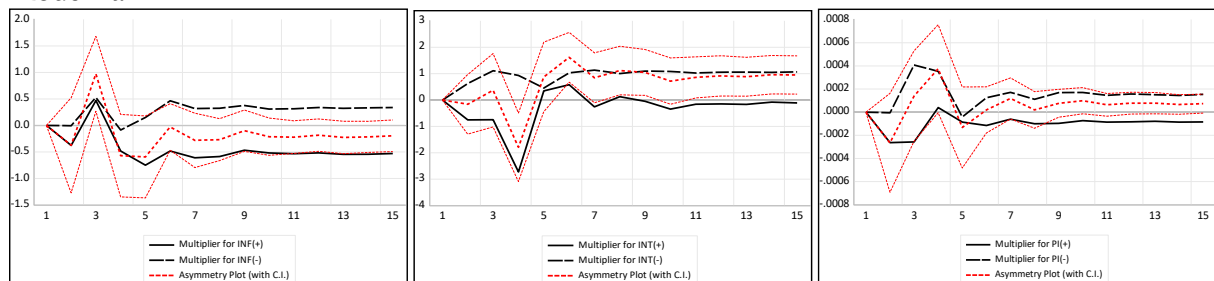
Model 1b
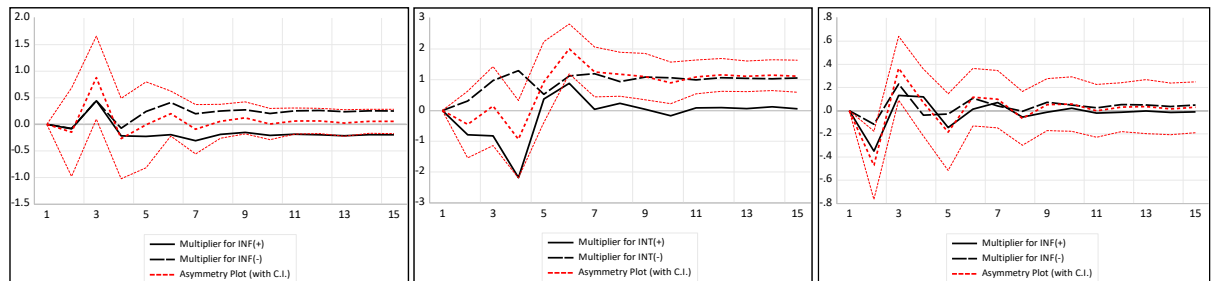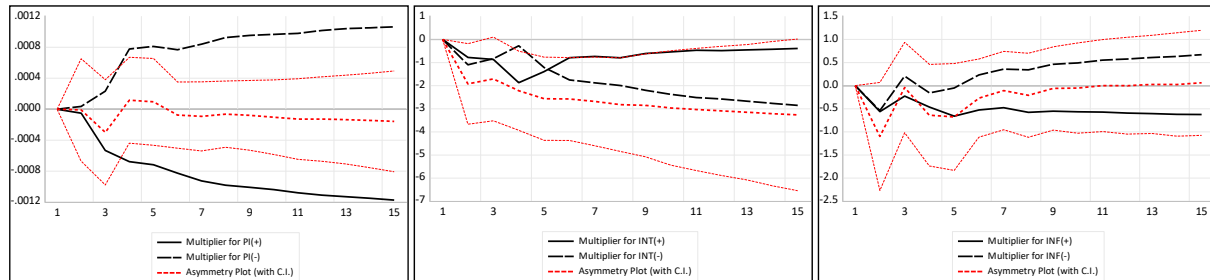

Model 2a

Model 2b

Model 3a

Model 3b

Model 4a

Model 4b

Figure 1. Bootstrapping Analysis Results

Furthermore, an increase in the production index tends to increase the change in NPF in the flat and apartment sector. This finding is contrary to the theoretical frameworks proposed by Kiyotaki and Moore (1997) and Bernanke and Gertler (1998), who argue that during a good

business cycle banks are considered to perform better. Higher NPF in stable and growing economic activities may be caused by the lack of risk management by Islamic banks when providing financing in the flat and apartment sector (Albaity et al., 2019). In the long-run, the COVID-19 pandemic has worsened Islamic bank performance, thus contributing to the increase in NPF value in the flat and apartment sector.

Compared to model 1, none of the other models has a significant relationship with the COVID-19 pandemic in the long run. The findings indicate that Islamic banks may already be successfully addressing the issue of risk management in response of the outbreak, particularly in the home ownership, real estate and business activities, and shop house ownership sectors. In model 2 specifically, an increase (or decrease) in the production index results in an increase (or decrease) in the NPF percentage in home ownership. This finding shows that Islamic bank performance does not benefit from economic conditions either during an increase or decrease in production activities. The lack of risk management is possibly the main factor as to why banks still see increases in the NPF percentage (Albaity et al., 2019 ; Kabir et al., 2015).
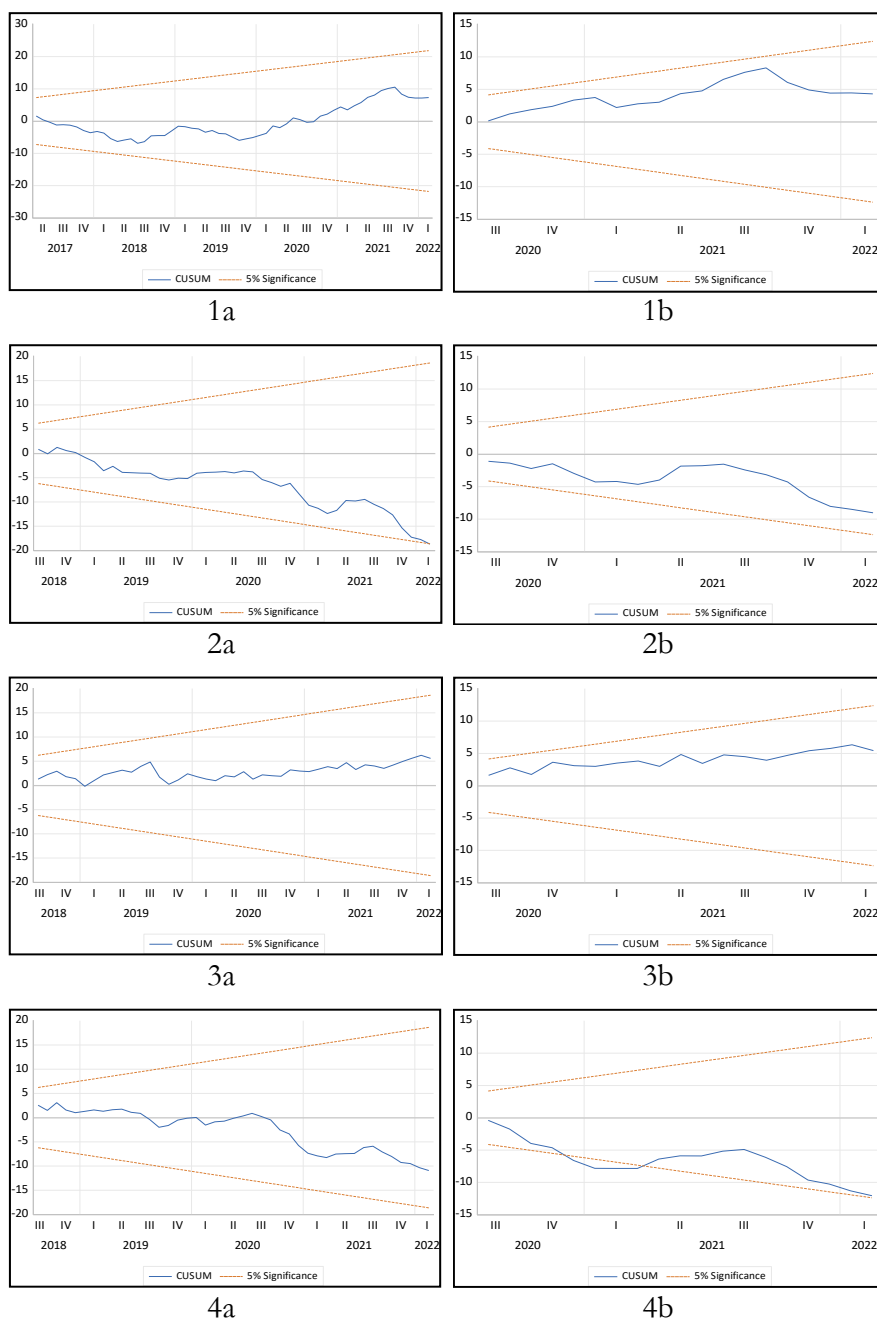

Figure 2. CUSUM Stability Results

In relation to home ownership financing, this indication is also possibly presence if referring to the condition when an interest rate reduction positively affects the change in NPF. The same also occurs with financing activities in shop house ownership (model 4) in the long run. This means that interest rates are still a determinant of bank NPF, as argued by Yusof and Usman (2015), Starr and Yilmaz (2007) and Ali (2007), who highlight the case of other countries even if banks are considered to be interest-free (Elnahass et al., 2021). With regard to financing activities in the real estate and business sector, an increase in interest rates has a negative relationship with a change in the level of NPF. This finding is in line with Fakhrunnas et al. (2022), who conclude that an increase in interest rates can reduce NPF because it makes banks prudent in providing financing facilities for deficit units. Banks may be much more selective in financing customers in the long run.

With reference to the results of the long-run relationship, it can be seen that Islamic banks have a significant relationship with macroeconomic variables such as inflation, interest rates and the production index. Each home financing sector may have a different risk profile to others. This may be caused by the differences in the use of Islamic underlying contracts in each sector. For instance, when the interest rate is still influencing the level of NPF, the contract that is implemented in financing activities may still adopt the interest rate as the benchmark to determine prices. This is in fact commonly applied in a dual banking system; as explained by Kasri and Azzahra (2020), the risk profile of Islamic banks including NPF in any sector is not significantly different in practice in conventional banks. This is based on the fact that Islamic banks still use the deposit-taking approach in their operations. Therefore, significant innovation is required to ensure that genuine practice is implemented by Islamic banks, which may promote more profit loss sharing (PLS) scheme financing.

Finally, to examine how each independent variable affects NPF in each sector during the period of observation, as suggested by Sriyana and Ge (2019), it is explained in Figure 2. A nonlinear symmetric or asymmetric effect is exhibited by the movement of the independent variables to dependent ones. In addition, the CUSUM stability results shown in Figure 2 show that in general the data are stable; the movement of the data is within the red line, under the 5% level of significance.

Conclusion

The objective of the study was to investigate the impact of macroeconomic variables on NPF in Islamic bank home financing. According to the results, in the short and long run, an asymmetric relationship exists between inflation, interest rates, and the production index as independent variables with NPF in all home financing sectors. Moreover, the COVID-19 pandemic has worsened NPF in the short run, excluding Islamic bank financing in shop house ownership, while in the long-run relationship, only financing in the flat and apartment sector has suffered an impact. The different impacts of the macroeconomic variables and of the outbreak on each type of Islamic bank home financing also reveal the different risk exposure faced by each home financing sector.

From its findings, the study fills the current research gap by identifying the presence of a nonlinear and asymmetric relationship between macroeconomic variables and the COVID-19 Outbreak and Islamic bank home financing sectors in Indonesia. The implications of the study are twofold. First, regarding the Islamic banking industry, of which a high percentage of its financing relates to the home financing sector, banks need to have robust risk management to address the issue of the nonlinear and asymmetric relationship between macroeconomic factors and NPF in the housing sector. Moreover, excessive provision of financing in certain sectors of home financing and adoption of the same underlying contract means banks face higher risk exposure and the possibility of higher NPF in home financing activities. Therefore, as a part of their risk management banks also need to consider diversification in their financing activities, such as diversifying the financing sectors and the underlying Islamic contracts in home financing activities.

Second, with reference to the financial authority, the findings reveal that Islamic banks are still influenced by interest rates. This indicates that they still adopt interest rates as the benchmark in determining the price and return of home financing activities. Therefore, the central bank may need to provide certain benchmarks, such as the expected return based on sectoral financing, for

adoption by Islamic banks. The use and adoption of such benchmarks would help diversify risk in the banking system and increase the level of confidence of Islamic bank stakeholders that conventional banks will not be mimicked, as Islamic banks were created as an alternative banking system with a different business model. However, the benchmarks created by the central bank must remain competitive for Islamic banks in the dual banking system.

In addition, a significant percentage of Islamic bank financing in the housing sector needs to be supervised carefully. As demonstrated by the subprime mortgage crisis of 2007/2008, home financing sectors can trigger the banking system to be unstable when the performance of financing fails to be maintained. Therefore, the central bank of Indonesia needs to consider and evaluate what percentage of Islamic banks are allowed to finance the housing sector by adopting a certain level of diversification. The central bank could also consider increasing or decreasing the percentage of loan to value, providing financial relaxation programs to certain home financing sectors, depending on the level of vulnerability to financial crises such as that caused by the COVID-19 pandemic.

From the monetary policy viewpoint, the presence of a nonlinear and asymmetric relationship between Islamic bank home financing and macroeconomic variables must be considered to determine a higher or lower interest rate, together with inflation targeting and its implications for economic growth reflected by the production index. The central bank must identify at what level Islamic banks can bear the risk of a change in monetary policy and the implications. A failure to identify the risk tolerance of Islamic banks' home financing may lead to a contagious effect, whereby the policies increase bank instability.

Finally, the study has the limitation that it only observes a single country and is based on limited data. Future studies need to extend the observation period and use more variables, particularly related to the economic policies of the financial authority during the time of financial crisis, such financial relaxation, monetary policies and other necessary variables.

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