

# Impact of Credit Risk Indicators on the Financial Health of Malaysian Commercial Banks During COVID-19: An ARDL Bound Test Approach

Shahid Al Mamun<sup>1</sup>, Zaiton Osman<sup>1\*</sup>, Izaan Jamil<sup>1</sup>

<sup>1</sup> Faculty of Business, Economics, and Accountancy, Universiti Malaysia Sabah, Malaysia

\*Corresponding Author: [zaosman@ums.edu.my](mailto:zaosman@ums.edu.my)

Received: 3 December 2024 | Accepted: 29 December 2024 | Published: 1 March 2025

DOI: <https://doi.org/10.55057/ijaref.2025.7.1.5>

**Abstract:** *The COVID-19 pandemic presented unprecedented challenges for financial institutions worldwide, particularly commercial banks. This study investigates the impact of credit risk indicators, i.e., Capital Adequacy Ratio (CAR) and Non-Performing Loans (NPL), on the financial performance of six major Malaysian commercial banks, listed on the KLCI index between Q1 2015 and Q4 2022. Using the Autoregressive Distributed Lag (ARDL) Bound Test and Error Correction Models (ECM), the study identifies a significant long-run relationships between CAR and Return on Assets (ROA) for Maybank and RHB Bank. The results also reveal that NPL had a detrimental impact on bank profitability during the pandemic, highlighting the critical role of capital adequacy and effective credit risk management in maintaining bank performance, amid economic shocks. These findings offer actionable insights for policymakers and bank managers to enhance stability and profitability in Malaysian's banking sector.*

**Keywords:** COVID-19 Pandemic, Malaysian Banks, Financial Performance, Credit Risk, Capital Adequacy Ratio, Non-Performing Loans, Return on Assets

## 1. Introduction

The (COVID-19) pandemic significantly disrupted the global economy, with Malaysia's banking sector particularly affected. As Bank Negara Malaysia (BNM) noted, the crisis was unprecedented due to the halt in economic activities. This situation has led to a spike in non-performing loans (NPLs), strain the profitability and liquidity of commercial banks., As these institutions struggled to allocate resources to manage distressed assets. Additionally, maintaining an adequate Capital Adequacy Ratio (CAR) has become critical. High NPL levels and the need for capital reserves can erode a bank's capital base, reducing its lending capacity and ability to support economic growth. This study contributes to the existing literature by analysing the impact of NPL and CAR on the financial health of major Malaysian banks during the COVID-19 pandemic. The findings offer crucial insights into the importance of credit risk management and capital adequacy in sustaining financial performance during economic disruptions.

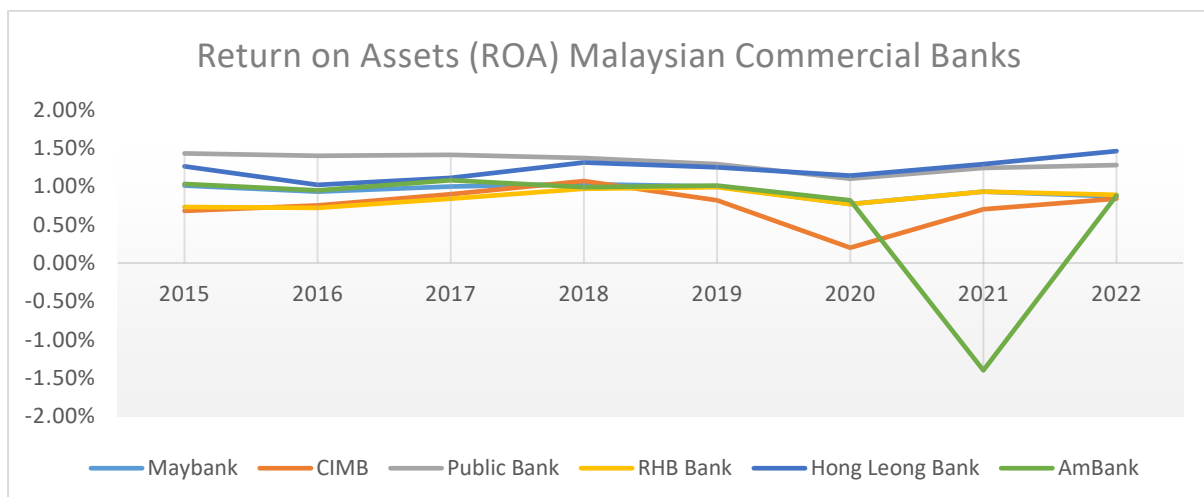
**Table 1: Commercial Bank and its Market Capitalization**

No.	Name of commercial bank	Market Capitalization (MYR)
1	Malayan Banking Berhad (MBB)	138,656,653
2	CIMB Group Holdings Berhad (CIMB)	92,788,431
3	Public Bank Berhad (PBB)	62,202,705
4	RHB Bank Berhad (RHB)	36,899,551
5	Hong Leong Bank Berhad (HLBB)	34,448,238
6	AMMB Holdings Berhad (AMMB)	23,034,889

*Note: As of December 2022. MYR denotes Malaysian Ringgit*

*Source: Bloomberg Terminal*

Currently, the FTSE Kuala Lumpur Composite Index (KLCI) includes all six publicly listed banks in Malaysia. The combined market capitalization of these banks presented in Table 1 is significant, making them major players in Malaysia's commercial banking industry. Their substantial operations attract a diverse range of customers, and they are important actors in understanding the larger economy. Meanwhile, Figure 1 shows ROA for six significant Malaysian banks from 2015 to 2022. It depicts the impact of the COVID-19 epidemic on their profitability trajectories and highlights a decline in ROA for all banks in 2019 and 2020. MBB's ROA remained relatively stable with minor variations, while CIMB and PBB experienced a sharp decline in 2019 followed by an improvement in 2020 before reaching equilibrium by 2022. PBB exhibited further stabilization by that time, whereas RHB and HLB saw annual fluctuations. AMMB's ROA increased in 2022 after continuous declines up until then. Overall, all banks showed a propensity for their ROA to decline due to pandemic strain before stabilizing differently by 2021. Evaluating these banks' managerial efficiency, as indicated by their ROAs during peak pandemic times and subsequent recovery phases, sheds light on unique responses to challenges posed by rising NPLs and regulatory capital requirements.



**Figure 1: Return on Assets of Malaysian Commercial Banks (2015-2022)**

Figure 1 illustrates the ROA trends for six major Malaysian commercial banks—MBB, CIMB, PBB, RHB, HLB, and AMMB over the period from 2015 to 2022. All banks experienced varying levels of ROA throughout the period, with noticeable dips during 2020, likely due to the impact of the COVID-19 pandemic. AMMB exhibited the most significant drop, with its ROA falling below -1.5% in 2020, but showing a recovery by 2022. In contrast, PBB and HLB maintained relatively stable ROA levels, even during the pandemic. CIMB, while experiencing a decline in 2020, recovered by 2022. The data highlights the resilience and differing responses of each bank to the economic challenges posed by the pandemic.

The increase in NPL has strained Malaysian commercial banks' short-term financial health by reducing profitability and capital adequacy due to additional provisions set aside for potential loan losses (Sivarajan et al., 2023). This adverse impact is compounded by heightened credit risk, which leads to tighter lending standards and consequently constrains credit availability for businesses and individuals (Affandi et al., 2021). Previous research consistently indicates that an increase in non-performing loans can adversely affect a bank's profitability, liquidity, and capital adequacy (Louzis et al., 2012). Similarly, Sivarajan et. al (2023) highlight the significant decline in financial performance of Malaysian banks due to elevated NPL ratios, underscoring the need for robust credit risk management strategies. Furthermore, Christina et. al (2021) found a strong negative correlation between NPL ratios and ROA, emphasizing that effective NPL management is crucial for maintaining bank profitability and stability.

Thus, the main objective of this study is to assess the impact of CAR and NPL on Malaysian commercial banks' ROA. The selection of these six banks is essential because they have a substantial position in Malaysia's financial services market, and their data offers a thorough perspective on industry performance. Opting for banks with greater market capitalization listed on KLCI guarantees comprehensive coverage when evaluating the wider effects within the Malaysian commercial banking industry. This study aims to provide valuable insights into how Malaysian commercial banks have responded, managed, addressed, coped with, and faced exceptional economic challenges, difficulties, hardships, and trouble by analyzing trends in NPL rates and their impact on overall banking health through ROA. The empirical results of this study could potentially aid investors in making informed investment decisions and managing their portfolios effectively. BNM might also pay attention to regulating policies to ensure Malaysian banking can sustain its business, especially during unprecedented events.

## **2. Literature Review**

### **Impact of Non-Performing Loans (NPL) on Bank Performance**

The relationship between Non-Performing Loans (NPLs) and bank performance, particularly through Return on Assets (ROA), is extensively documented in financial literature. Berger and DeYoung (1997) and Louzis et al. (2012) emphasize that increased NPLs have a detrimental effect on profitability by curtailing interest income and necessitating higher loan loss provisions. This negative trend is corroborated by multiple studies across different regions. In Turkey, Ekinci and Poyraz (2019) demonstrate a significant reduction in ROA as NPLs rise, while similar findings are reported in the Middle East and North Africa (Boudriga et al., 2009) and Kenya (Kithinji, 2010).

In Malaysia, the COVID-19 pandemic intensified this dynamic. Quang et al. (2021) emphasize that heightened credit risk during crises directly weakens bank profitability, further highlighting the importance of effective NPL management strategies. The global financial crisis of 2008 showed similar patterns, with Erdiñç and Abazi (2014) confirming the cyclical nature of NPLs and their adverse impacts on bank performance during economic downturns.

### **Role of Capital Adequacy Ratio in Financial Stability**

The Capital Adequacy Ratio (CAR) plays a fundamental role in stabilizing the banking sector, particularly during periods of heightened credit risk. Berger and DeYoung (1997) argue that banks with higher CAR levels are better equipped to absorb losses and maintain their profitability. Their findings align with Athanasoglou et al. (2008), who assert that well-capitalized banks can manage risks more effectively, which enhances profitability and strengthens financial stability.

In times of crisis, CAR is crucial. For example, during the global financial crisis of 2008, Berger and Bouwman (2013) found that banks with stronger capital buffers were more resilient to shocks, maintaining profitability and stability. Similarly, Beck and Keil (2022) highlight that regions with stringent regulatory frameworks saw less severe declines in CAR, demonstrating the importance of capital adequacy in mitigating credit risk. These findings emphasize the critical role that CAR plays in absorbing losses and safeguarding bank stability, particularly during financial crises.

On the other hand, some studies suggest a trade-off between higher CAR and profitability. For instance, Jokipii and Milne (2011) highlight that while higher CAR levels enhance stability, they may also reduce lending capacity, which can constrain short-term profitability. However, Barth et al. (2004) emphasize that in the long term, robust capital requirements, like those mandated by the Basel Accords, foster systemic stability and prevent broader financial crises.

### **COVID-19's Impact on the Banking Sector**

The COVID-19 pandemic caused unprecedented disruptions in the global banking sector. In Malaysia, the Movement Control Order (MCO) led to a sharp slowdown in economic activity, impacting banks' profitability. Bank Negara Malaysia implemented a loan moratorium to prevent an immediate spike in NPLs, providing temporary relief to the sector (Jee et al., 2022). However, the pandemic's long-term effects on credit risk remained a concern, as deferred losses would eventually impact banks' financial health. Nizar et al. (2023) found that, although banks faced increasing CAMEL ratios, their ROA remained relatively stable, owing to effective risk management practices and regulatory interventions.

### **Credit Risk and Its Multifaceted Impact on Bank Profitability**

Credit risk is a central factor in determining bank profitability, and its impact on ROA is well-documented. According to Bissoondoyal-Bheenick and Treepongkaruna (2011), higher credit risk tends to correlate with lower returns, diminishing profitability. This relationship is particularly evident during economic downturns, where rising NPLs reduce banks' ROA.

The global financial crisis and the COVID-19 pandemic both underscore the importance of managing credit risk. Berger and Bouwman (2013) and Athanasoglou et al. (2008) highlight that banks with stronger CAR levels are better positioned to manage credit risk and sustain profitability during crises. Similarly, Ghosh (2015) found that rising NPLs and credit risk indicators significantly affect ROA, further emphasizing the need for robust risk management frameworks.

In emerging markets, credit risk has a profound impact on bank profitability. Ghosh (2015) and Makri et al. (2014) show that NPLs have a direct negative effect on ROA, with the impact being more severe in regions with weaker economic structures and less developed financial systems. These findings underscore the critical importance of credit risk management in safeguarding profitability, particularly during times of economic stress.

### **3. Conclusion**

The literature overwhelmingly supports the critical role that credit risk indicators, particularly NPLs and CAR, play in determining the financial health of banks. Effective credit risk management and sufficient capital buffers are essential for maintaining profitability, particularly during crises such as the COVID-19 pandemic. Policymakers, like Bank Negara Malaysia, play a crucial role in stabilizing the sector through timely interventions and

regulatory support. Future research should continue to explore how digitalization and emerging financial risks will shape the banking industry's resilience in the post-pandemic era.

#### 4. Data and Methodology

Malaysian commercial banks listed in FTSE KLCI was selected in this study and quarterly data from Q12015 to Q42022 extracted from Bloomberg Terminal. The selected banks, namely MBB, CIMB, RHB, PBB, HLBB, and AMMB, offer a dataset that encompasses crucial financial metrics like ROA, CAR, and NPL. These metrics assess profitability, risk management, and overall stability, encompassing multiple variables as presented in Table 1. Furthermore, this study includes COVID-19 (C19) as a dummy variable to account for the impact of the pandemic on Malaysian commercial banks' ROA. C19 will take 0 values from Q12015 until Q42019, and 1 from Q12020 until Q42022.

**Table 1: List of Variables**

Variable	Role	Formula
Return on Asset (ROA)	Dependent	$\frac{\text{Net Income}}{\text{Total Assets}} \times 100$
Capital Adequacy Ratio (CAR)	Regressor	$\frac{\text{Tier 1 Capital} + \text{Tier 2 Capital}}{\text{Risk - Weighted Assets}} \times 100$
Non Performing Loan (NPL)	Regressor	$\frac{\text{Total Non - Performing Loans}}{\text{Total Loans}} \times 100$
COVID-19 (C19)	Regressor	Dummy Variable

Basic function of this study can be written as follows:

$$\text{ROA} = f(\text{CAR}, \text{NPL}, \text{C19}) \quad (1)$$

Equation (1) shows the ROA as a function of CAR, NPL, and C19. To approximate a normal distribution, this study re-specifies Equation (1) in econometric form and the econometric model of this study can be written as follows:

$$\text{ROA}_{i,t} = \alpha_1 + \beta_1 \text{NPL}_{i,t} + \beta_2 \text{CAR}_{i,t} + \beta_3 \text{C19} + \varepsilon_t \quad (2)$$

where ROA is the return on assets, NPL is the non-performing loan ratio, CAR is the capital adequacy ratio, C19 is the COVID-19 dummy variable,  $\beta_i$  is the unknown parameters to be estimated. and  $\varepsilon_t$  represents the random error term.

The initial analysis of this study begins with a descriptive statistic to provide a summary of the entire set of data. Next, a unit root test is performed for each variable to determine their stationary level. The objective of the unit root test is to ensure that no variable stationarity at I(2), as the Autoregressive Distributed Lags (ARDL) model by Pesaran et al. (2001) used in this study can only be applied to variables that are I(0), I(1), or mixed. To provide detailed explanations of the features and characteristics of these tests, the study employs the Augmented Dickey-Fuller by Dickey and Fuller (1979).



This study employed the F-statistic bound test within the ARDL framework to investigate the existence of cointegration among the variables, which is in line with the main objective. The test employs two asymptotic bounds critical values based on the  $I(d)$  regressors, where  $0 \leq d \leq 1$  (Pesaran et al., 2001). The presence of cointegration is shown when the F-statistic value exceeds the upper bound threshold critical value. Under the condition that the F-statistic value is lower than the critical value, the null hypothesis of no cointegration is deemed valid. Unlike previous cointegration tests (Engle-Granger, 1987; Johansen and Juselius, 1990) which required variables to be stationary at the same level, ARDL allows for variables to be stationary at different levels, reducing issues of endogeneity and residual correlation (Njenga, 2024). The Error Correction Model (ECM) enables the derivation of short-run dynamics simultaneously with the long-run equilibrium, preserving all pertinent information. Furthermore, ARDL demonstrates robustness in its application to small time-series data (Wang, 2022). The specific ARDL model can be expressed as follows:

$$\Delta ROA_t = a_1 + \sum_{i=1}^p \beta_{1i} \Delta ROA_{t-i} + \sum_{i=1}^q \beta_{2i} \Delta LNPL_{t-i} + \sum_{i=1}^q \beta_{3i} \Delta LCAR_{t-1} + \sum_{i=1}^q \beta_{4i} \Delta C19_{t-1} + \varphi_1 \Delta ROA_{t-i} + \varphi_2 \Delta NPL_{t-i} + \varphi_3 \Delta CAR_{t-i} + \varphi_4 \Delta C19_{t-i} + \varepsilon_t \quad (3)$$

where dependent variable represents  $ROA_t$ ,  $NPL_t$  is non-performing loan,  $CAR_t$  is Capital Adequacy Ratio, and  $C19_t$  is the dummy variable of COVID-19.  $\beta_{ii}$  denotes of short-run dynamics while  $\varphi_i$  represents the corresponding cointegration multiplier of the underlying ARDL. The null hypothesis of no cointegration for Equation (3) is  $H_0 : \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = 0$ . If null hypothesis is rejected, this indicates the presence of cointegration between ROA with the regressors. This study will proceed to causality analysis based on the ECM based ARDL written as follows:

$$\Delta ROA_t = \alpha + \sum_{i=1}^p \beta_{1i} \Delta ROA_{t-i} + \sum_{i=1}^q \beta_{2i} \Delta NPL_{t-i} + \sum_{i=1}^q \beta_{3i} \Delta CAR_{t-1} + \sum_{i=1}^q \beta_{4i} \Delta CAR_{t-1} + \theta ECT_{t-1} + \varepsilon_t \quad (4)$$

where  $ECT_{t-1}$  represents the performance of ROA to the lagged of deviation from the long-run equilibrium, and  $\theta$  denotes of the speed of adjustment of the error correction term.  $\theta$  and  $ECT_{t-1}$  and must in negative sign statistically significant as evidence of the presence of cointegration. If result failed to reject null hypothesis,  $ECT_{t-1}$  will not be included in determining the causality between FCPO with the regressors. Selected samples are evaluated in terms of model adequacy and robustness tests based on a series of diagnostic tests, including Lagrange multiplier for serial autocorrelation, and Breusch-Pagan-Godfrey for heteroskedasticity. Furthermore, stability tests based on Ramsey's regression equation specification error test (RESET) and cumulative sum (CUSUM) and CUSUM of square (CUSUMSQ) tests were also conducted in this study.

## 5. Results and Discussion

Process of analysis for this study began with a general overview of data characteristics by using descriptive statistics. Result from descriptive analysis of major Malaysian banks reveals diverse financial performances and presented in Table 2. MBB and PBB lead in ROA with 0.9528 and 1.3129, respectively, reflecting strong profitability, while CIMB and AMMB show lower averages of 0.7275 and 0.7341. MBB's CAR is robust at 18.0678, with RHB displaying occasional higher CAR values. For NPL, PBB and HLBB demonstrate superior credit management with lower averages of 0.4474 and 0.7434, while CIMB has a higher NPL mean

of 3.2856 but consistent performance. These figures offer insight into the banks' strengths and areas of risk. This study proceeds to examine the level of stationarity.

**Table 2: Result of Descriptive Statistics**

Bank	Variable	Mean	Std Dev	Skewness	Kurtosis
MBB	ROA	0.9528	0.0901	-0.2948	2.0199
	CAR	18.0678	1.3229	-0.9328	3.3671
	NPL	2.2119	0.3695	-0.5479	2.1569
CIMB	ROA	0.7275	0.2117	-0.3357	2.9286
	CAR	17.7506	0.8549	-0.6764	3.0331
	NPL	3.2856	0.1842	-0.1106	2.0601
RHB	ROA	0.8588	0.0941	-0.2573	1.9490
	CAR	16.4950	1.0412	0.2593	2.2904
	NPL	1.9544	0.3171	-0.2813	1.8917
PBB	ROA	1.3129	0.1014	-0.5165	1.8512
	CAR	15.4252	0.7004	0.0614	1.9207
	NPL	0.4474	0.0844	-0.7525	2.0559
HLBB	ROA	1.2281	0.1006	-0.2589	2.8196
	CAR	15.1669	0.8783	-0.6985	2.7854
	NPL	0.7434	0.1935	-0.2421	1.7886
AMMB	ROA	0.7341	0.9065	-2.1659	5.9895
	CAR	15.9575	0.6312	0.6695	2.6525
	NPL	1.5969	0.1508	-0.6307	3.7081

\*Notes: Std Dev is standard deviation.

Table 3 summarises the results of the unit root test for key financial indicators of ROA, CAR, and NPL across several major Malaysian banks (MBB, CIMB, RHB, PBB, HLBB, and AMMB) show that most indicators are non-stationary at their level [I(0)] but become stationary at first difference (I(1)), indicating that they stabilize when differenced. This suggests the need for differencing in subsequent analyses to handle non-stationarity. However, AMMB's ROA and NPL are exceptions, as they are stationary at level, indicating more stability in these financial metrics compared to the other banks. Considering all the output results, the ARDL model is the most suitable and effective for cointegration analysis.

**Table 3: Result of Unit Root Test**

Bank	Variable	I(0)	I(1)	Hypothesis Result
MBB	ROA	-1.9872	-5.0704***	The null hypothesis is rejected at I(1)
	CAR	-3.6937***	-	The null hypothesis is rejected at level
	NPL	-1.5137	-3.9077***	The null hypothesis is rejected at I(1)
CIMB	ROA	-2.0769	-4.1405***	The null hypothesis is rejected at I(1)
	CAR	-2.4130	-4.5764***	The null hypothesis is rejected at I(1)
	NPL	-2.5011	-5.8170***	The null hypothesis is rejected at I(1)
RHB	ROA	-2.0702	-5.3728***	The null hypothesis is rejected at I(1)
	CAR	-2.3400	-5.3480***	The null hypothesis is rejected at I(1)
	NPL	-0.8401	-6.3387***	The null hypothesis is rejected at I(1)
PBB	ROA	-1.1186	-4.9245***	The null hypothesis is rejected at I(1)
	CAR	-0.6268	-11.446***	The null hypothesis is rejected at I(1)
	NPL	-0.9757	-4.1924***	The null hypothesis is rejected at I(1)

HLBB	ROA	-0.6695	-4.0911***	The null hypothesis is rejected at I(1)
	CAR	-1.8063	-5.3303***	The null hypothesis is rejected at I(1)
	NPL	-1.7208	-5.6586***	The null hypothesis is rejected at I(1)
AMMB	ROA	-3.5292**	-	The null hypothesis is rejected at level
	CAR	-1.2281	-5.2228***	The null hypothesis is rejected at I(1)
	NPL	-3.2527**	-	The null hypothesis is rejected at level

\*Notes: I (0) is level and I(1) is the first difference of stationarity. \*\*\* and \*\* denotes of 5% and 1% level of significance.

Table 4 presents the ARDL F-bounds test results, assessing the cointegration between the ROA and its regressors. MBB's F-statistic of 6.1349 significantly exceeds the upper bound critical value at the 1% significance level, indicating strong evidence of cointegration, indicating that ROA of MBB has a long-term equilibrium relationship with the regressors. RHB also shows a presence of long-run relationship with an F-statistic of 4.7793, slightly above the upper bound of 1% significance level. Conversely, the F-statistic for CIMB, PBB, HLBB, and AMMB falls below the upper bound indicating of no cointegration. Thus, this study will proceed with the long run coefficient analysis for MBB and RHB.

**Table 4: Result of ARDL F-Bound Test**

Bank/ Model	Basic Function	%	I(0)	I(1)	F-Statistic
MBB (2, 0, 2, 1)	$ROA = f(CAR, NPL, C19)$	10	2.37	3.2	6.1349***
		5	2.79	3.67	
		1	3.65	4.66	
CIMB (2, 0, 2, 1)		10	2.37	3.2	2.8520
		5	2.79	3.67	
		1	3.65	4.66	
RHB (2, 0, 2, 1)		10	2.37	3.2	4.7793***
		5	2.79	3.67	
		1	3.65	4.66	
PBB (2, 0, 2, 1)		10	2.37	3.2	1.6171
		5	2.79	3.67	
		1	3.65	4.66	
HLBB (2, 0, 2, 1)		10	2.37	3.2	1.5598
		5	2.79	3.67	
		1	3.65	4.66	
AMMB (2, 0, 2, 1)		10	2.37	3.2	2.6144
		5	2.79	3.67	
		1	3.65	4.66	

Note: ( ) shown is the optimal model selection based on Akaike Information Criterion. I(0) and I(1) represent lower and upper bound respectively. \*\*\* denotes 1 percent level of significant.

Table 5 presents the long-run coefficients for MBB and RHB. For MBB, the NPL coefficient is positive (0.0638) but not statistically significant, indicating a weak association with ROA. CAR has a negative and significant coefficient (-0.0306), suggesting that higher capital buffers slightly reduce profitability due to the trade-off between capital and returns. The COVID-19 dummy (C19) has a significant negative impact on ROA (-0.1684), highlighting the pandemic's adverse effect on profitability. In the case of RHB, the NPL coefficient is positive (0.1784) but not significant, indicating no long-run relationship with ROA. CAR is positive and significant



(0.1672), suggesting that a stronger capital position boosts profitability. The C19 variable negatively impacts ROA (-0.1441) but to a lesser extent than for MBB.

**Table 5: ARDL Long-Run Coefficient**

Bank/Model	Basic Function	Regressor	Coefficient	T-Stat
MBB (2, 0, 2, 1)	$ROA = f(CAR, NPL, C19)$	NPL	0.0638	1.3923
		CAR	-0.0306	-2.5818**
		C19	-0.1684	-5.2513***
RHB (2, 0, 2, 1)		NPL	0.1784	1.5223
		CAR	0.1672	-4.7380**
		C19	-0.1441	-1.8795***

\*Notes: \*\*\* and \*\* denotes 1% and 5% level of significance

The ARDL-ECM short-run analysis result presented in Table 6 reveals the immediate effects of changes in CAR, NPL, and the C19 on ROA for Malaysian banks. For MBB, a prior increase in NPL significantly reduces ROA by 18.26%, while CIMB's ROA shows a 6.36% decline due to lagged CAR effects. RHB exhibits a mixed response, with CAR improving ROA in the short term, but C19 negatively impacting it. PBB benefits from a strong 68.95% boost in ROA from prior NPL changes, while HLBB and AMMB show varying but less significant relationships between NPL, CAR, and ROA. Overall, the analysis indicates a strong short-term relationship between CAR, NPL, and ROA, particularly for MBB and CIMB. However, other banks show less consistent or weaker short-term impacts from these financial indicators. Meanwhile, the result for the cointegrated model's ECT is statistically significant at the 1 percent level, as the coefficient value ( $\theta$ ) is less than 1 with a negative sign. ECT for MBB shows that -0.6627 or 66.27% of the disequilibrium is adjusted in the next period, while the ECT of RHB shows 56.18% (-0.5618) of the disequilibrium is corrected in the following period, indicating a return to long-run equilibrium.

**Table 6: Result of ARDL-ECM**

Dependent	Regressor	Coefficient	T-Stat	ECT ( $\theta$ )
$\Delta ROA_{MBB}$	$\Delta NPL$	9.67%	2.1485	-0.6627***
	$\Delta NPL_{t-1}$	-18.26%	-3.9170***	
	$\Delta C19_{t-1}$	-2.04%	-0.5816	
$\Delta ROA_{CIMB}$	$\Delta CAR$	-0.27%	-0.1173	-
	$\Delta CAR_{t-1}$	-6.36%	-2.5127***	
$\Delta ROA_{RHB}$	$\Delta CAR$	4.76%	2.9039	-0.5618***
	$\Delta CAR_{t-1}$	0.93%	0.5029	
	$\Delta CAR_{t-2}$	3.71%	2.3352	
	$\Delta NPL$	-3.06%	-0.3611	
	$\Delta NPL_{t-1}$	13.08%	0.1135	
	$\Delta C19_{t-1}$	-10.38%	-1.6146	
$\Delta ROA_{PBB}$	$\Delta CAR$	1.27%	0.9174	-
	$\Delta CAR_{t-1}$	3.02%	2.2037	
	$\Delta NPL$	-28.31%	-1.6076	
	$\Delta NPL_{t-1}$	68.95%	4.1576***	
	$\Delta C19_{t-1}$	-11.24%	-3.5551	
$\Delta ROA_{HLB}$	$\Delta NPL$	-20.10%	-1.2722	-
	$\Delta NPL_{t-1}$	20.92%	2.1255	
	$\Delta C19_{t-1}$	-32.10%	-3.7238	
$\Delta ROA_{AMMB}$	$\Delta CAR$	37.37%	2.1575	-
	$\Delta NPL$	38.31%	0.6737	

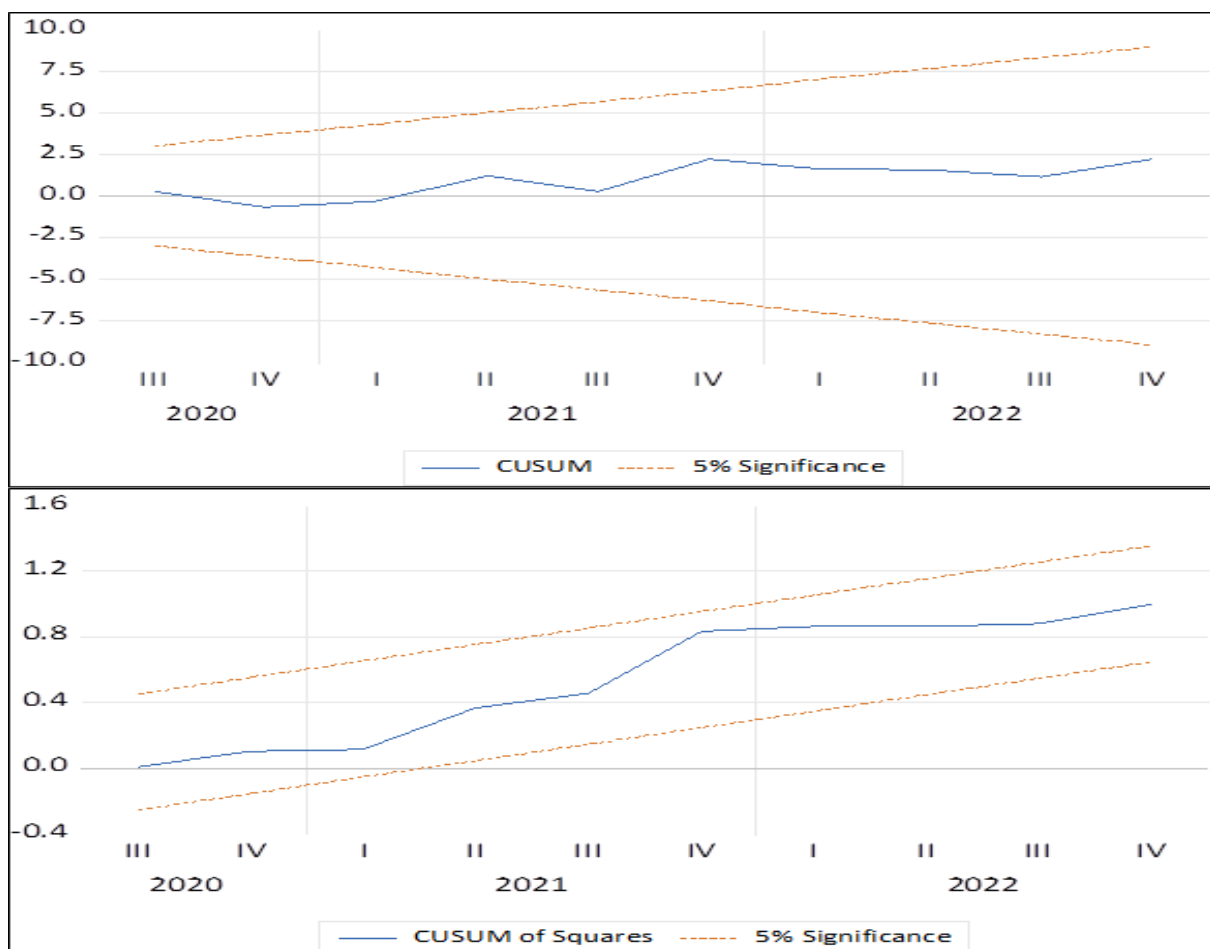
\*Notes: \*\*\* and \*\* denotes 1% and 5% level of significance. ECT is an error correction term and only applicable to the models in the presence of cointegration.

Lastly, result of diagnostic test presented in Table 7 for serial correlation, heteroscedasticity, and Ramset RESET while Figure 2-7 presented the results of CUSUM and CUSUMSQ. Result shows that all models is robust and well specified. The CUSUM and CUSUM of Squares tests for MBB, CIMB, RHB, PBB, HLBB, and AMMB show that the test lines remained within the 5% significance boundaries, indicating stability in both the mean and variance of the models. This suggests no significant structural shifts or instabilities in the financial and operational processes of these banks during the analysis period, supporting the reliability and predictability of the financial models used. The results demonstrate robustness across all banks, implying that strategic decisions and external factors did not significantly alter the core dynamics being modelled.

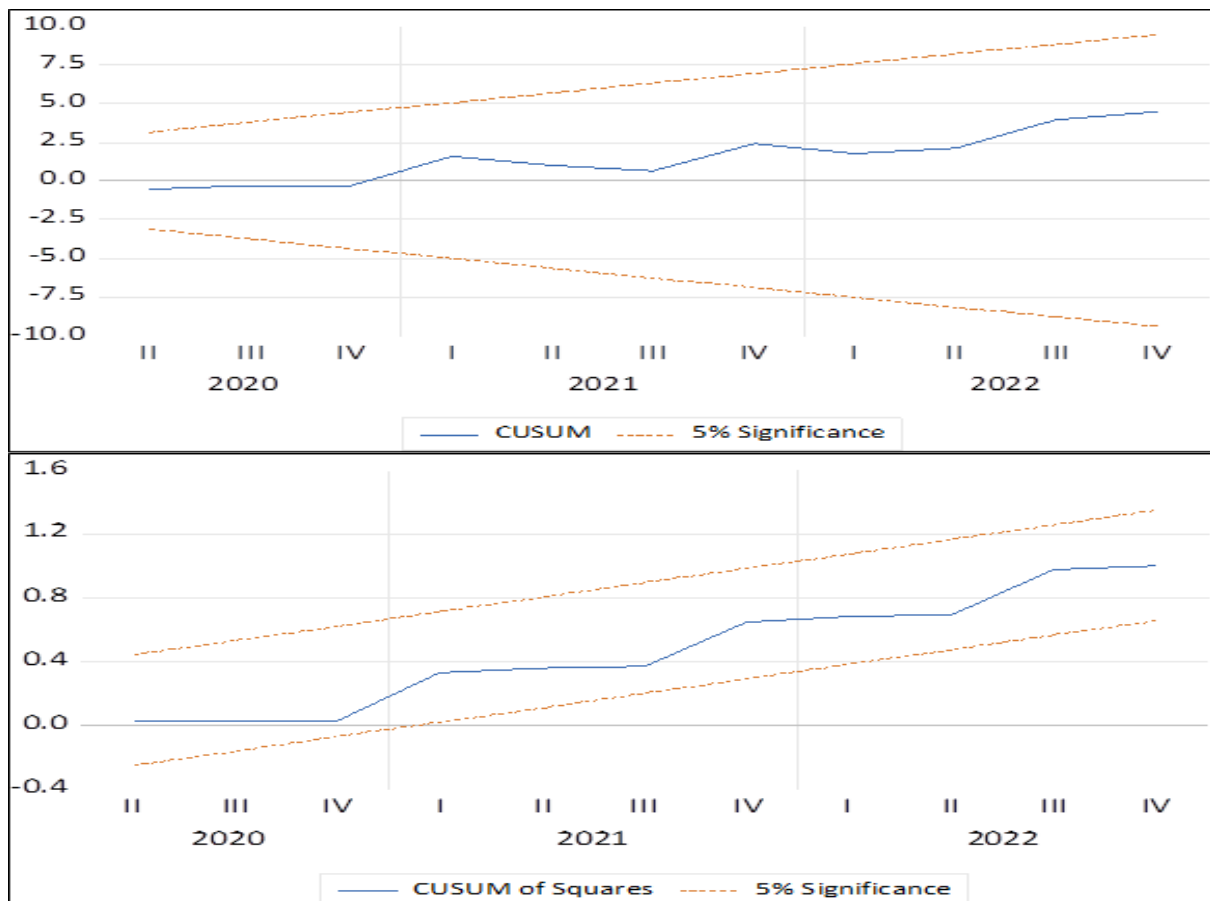
**Table 7: Result of Diagnostic Test**

Bank/ Model	$\chi^2_{sc}$	$\chi^2_{Het}$	RESET
MBB (2, 0, 2, 1)	5.2074	10.6427	0.0027
CIMB (2, 0, 2, 1)	1.6635	11.9188	0.0140
RHB (2, 0, 2, 1)	0.6105	14.9190	0.0422
PBB (2, 0, 2, 1)	1.2341	9.4292	0.2565
HLBB (2, 0, 2, 1)	0.6206	9.4329	6.9725
AMMB (2, 0, 2, 1)	7.3760	15.0046	13.8623

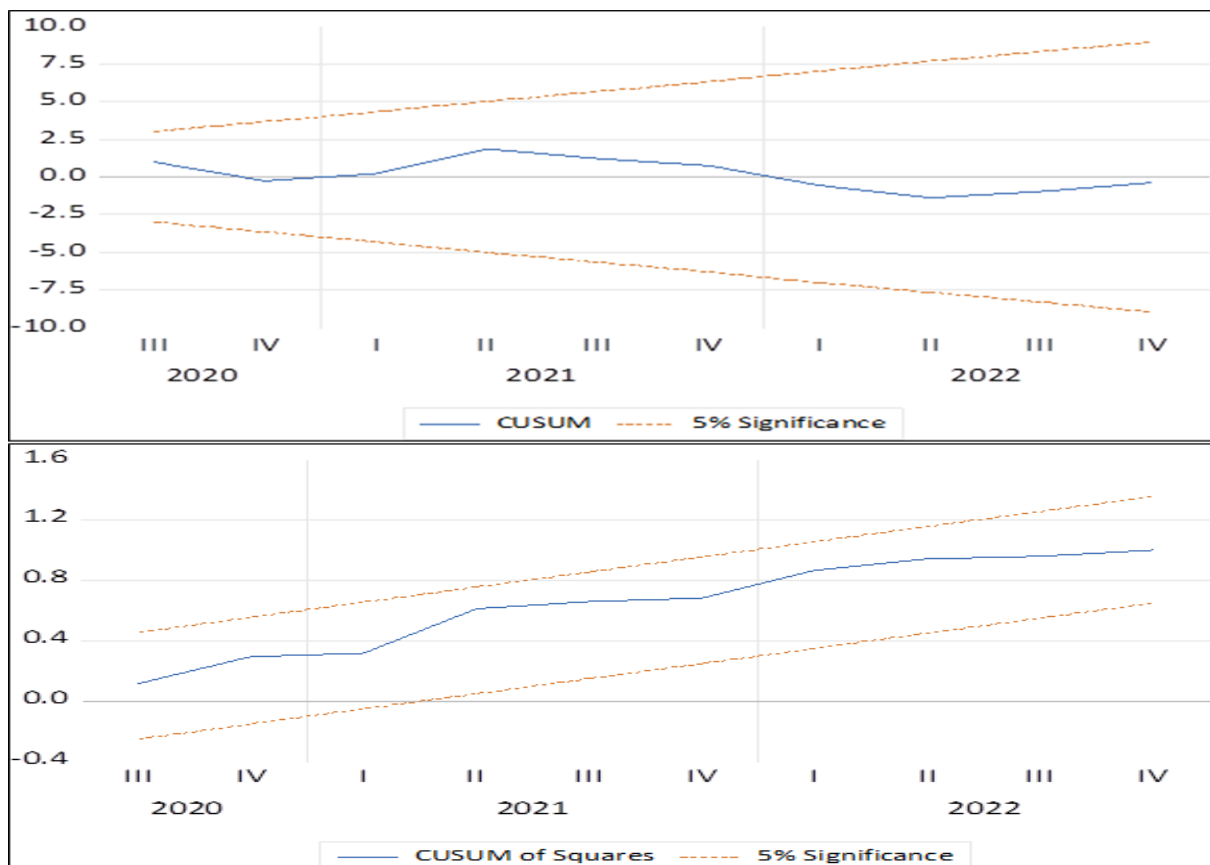
Note: \*\* denotes 5 percent level of significance.  $\chi^2_{sc}$  denotes the autocorrelation test statistic based on the Lagrange multiplier for serial correlation test,  $\chi^2_{Het}$  represents the heteroscedasticity test based on Breusch-Pagan-Godfrey. RESET denotes Ramsey's regression equation specification error test statistic.



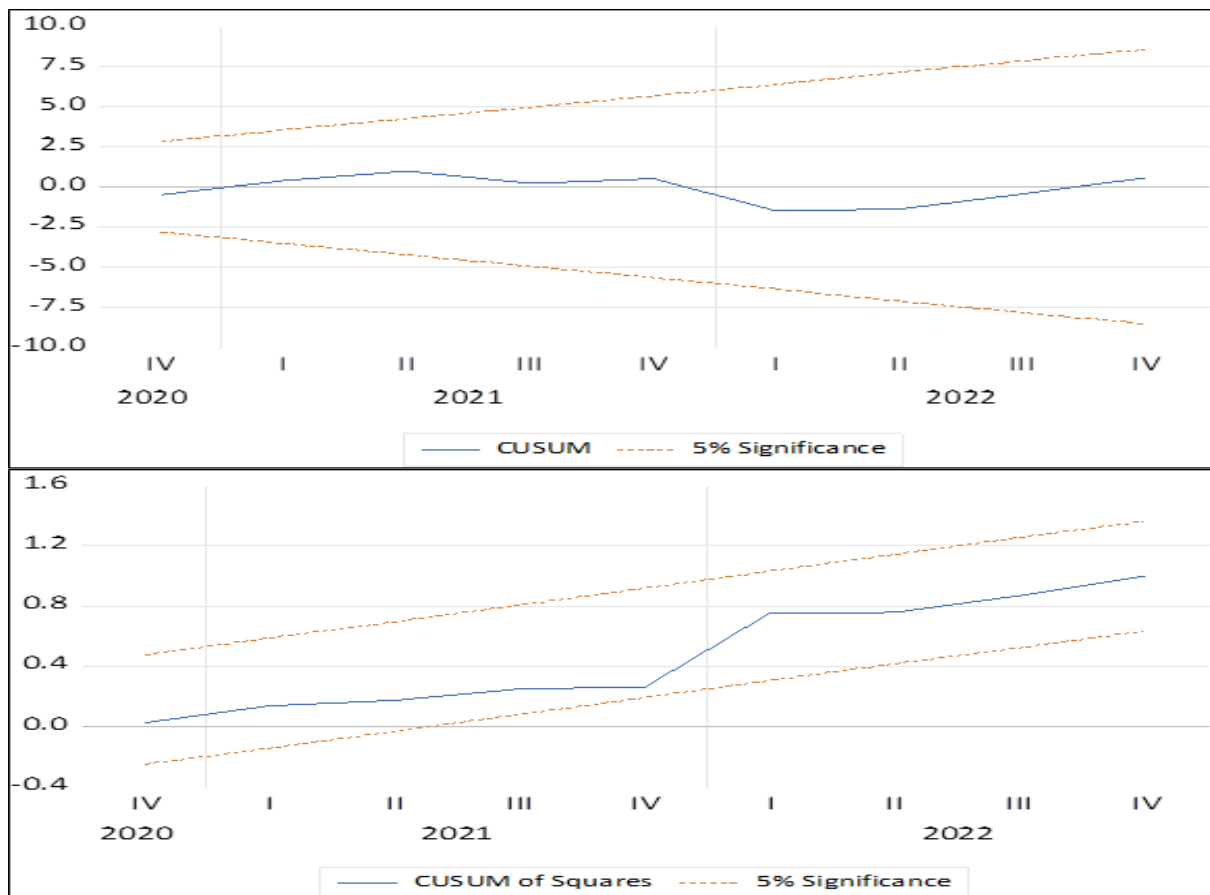
**Figure 2: CUSUM and CUSUM of Square Tests for MBB**



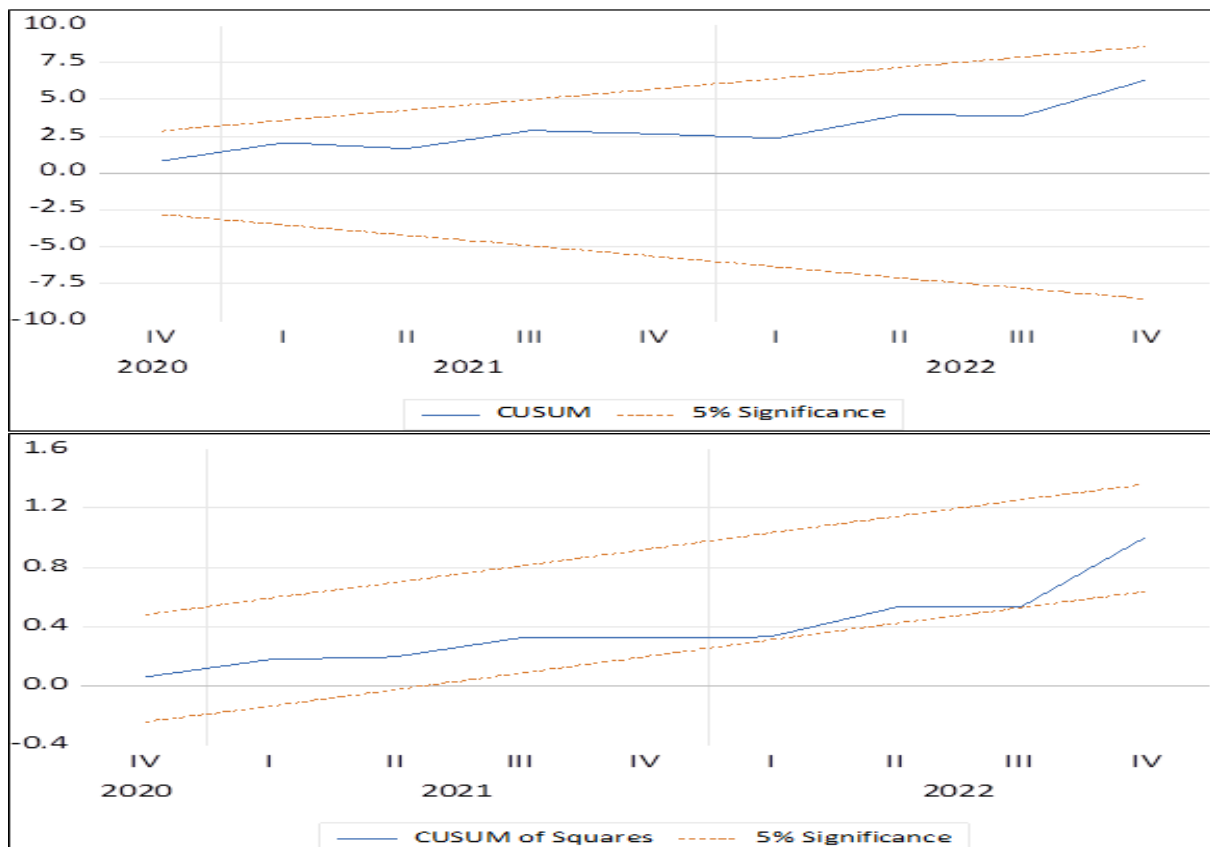
**Figure 3: CUSUM and CUSUM of Square Test for CIMB**



**Figure 4: CUSUM and CUSUM of Square Tests for RHB**



**Figure 5: CUSUM and CUSUM of Square Tests for PBB**



**Figure 6: CUSUM and CUSUM of Square Tests for HLBB**

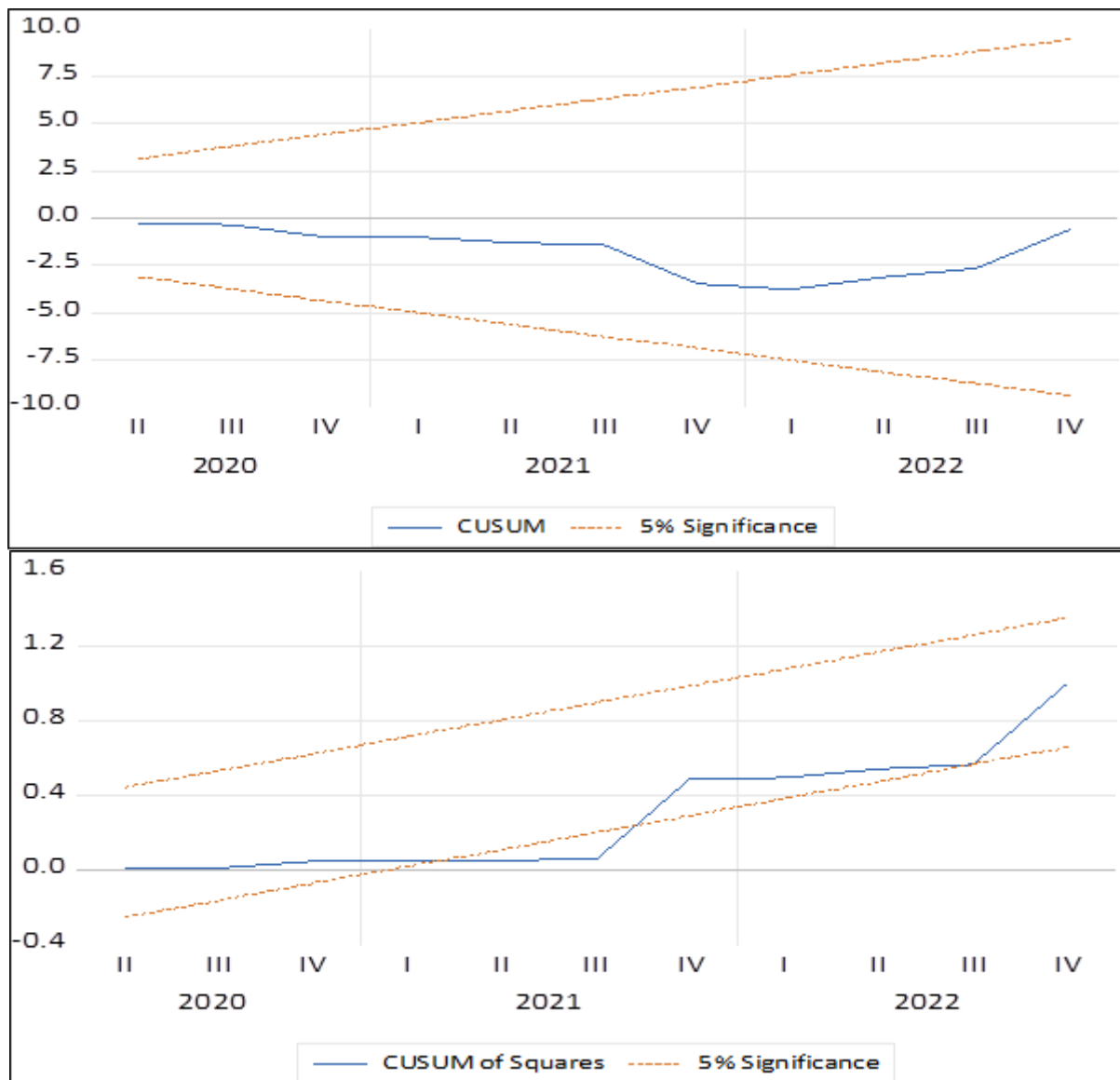


Figure 7: CUSUM and CUSUM of Square Tests for AMMB

## 6. Discussion and Conclusion

The primary objective of this study was to assess the impact of credit risk indicators, specifically Capital Adequacy Ratio (CAR) and Non-Performing Loans (NPL), on the financial performance of six major Malaysian commercial banks during the COVID-19 pandemic, using Return on Assets (ROA) as the dependent variable. By employing the ARDL Bound Test and Error Correction Model (ECM) on quarterly data from 2015 to 2022, the study identified both long-run and short-run relationships between CAR, NPL, and ROA, particularly for Maybank and RHB Bank.

The findings revealed that CAR has a significant long-run and short-run positive impact on ROA for RHB Bank, indicating that maintaining strong capital buffers enhances profitability. However, for Maybank, CAR negatively impacts profitability, suggesting a trade-off between capital retention and earnings. NPLs, although showing a positive relationship with ROA in some banks, were generally detrimental to profitability during the pandemic, underscoring the challenges banks faced in managing credit risk amidst economic downturns. Furthermore, the COVID-19 pandemic, modelled as a dummy variable (C19), had a consistently negative and



significant effect on the profitability of all banks, reaffirming the pandemic's impact on financial health.

These findings contribute to the body of knowledge by highlighting the critical role of capital adequacy and credit risk management in maintaining bank stability and profitability during periods of economic shocks, such as the COVID-19 pandemic. Bank managers must prioritize credit risk management strategies, including proactive loan loss provisioning and stringent underwriting standards, to safeguard against future crises. Additionally, policymakers, particularly Bank Negara Malaysia (BNM), should consider reinforcing capital requirements and stress testing frameworks to ensure financial system resilience.

Future studies could extend this research by incorporating additional variables such as loan loss provisions and off-balance-sheet exposures to provide a more comprehensive assessment of bank performance. Moreover, the inclusion of banks with different lending policies or those not listed in the FTSE KLCI could offer valuable insights into the broader impacts of credit risk on the banking sector in Malaysia.

## Reference

- Affandi, S., Ja'afar, A. I., Ismail, F., & Abdul Shukur, N. (2021). Bank lending behavior: Evidence from Malaysian dual banking system. *Advanced International Journal of Banking, Accounting, and Finance*, 3(8), 65-75. <https://doi.org/10.35631/AIJBAF.38006>
- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific, and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions & Money*, 18(2), 121-136.
- Barth, J. R., Caprio, G., & Levine, R. (2004). Bank regulation and supervision: What works best? *Journal of Financial Intermediation*, 13(2), 205-248.
- Beck, T., & Keil, J. (2022). Have banks caught corona? Effects of COVID on lending in the U.S. *Journal of Corporate Finance*, 72, 102160. <https://doi.org/10.1016/j.jcorpfin.2022.102160>
- Berger, A. N., & Bouwman, C. H. S. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109(1), 146-176.
- Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21(6), 849-870.
- Bissoondoyal-Bheenick, E., & Treepongkaruna, S. (2011). An analysis of the determinants of bank ratings: Comparison across ratings agencies. *Australian Journal of Management*, 36(3), 405-424.
- Boudriga, A., Boulila Taktak, N., & Jellouli, S. (2009). Bank-specific, business and institutional environment determinants of non-performing loans: Evidence from MENA countries. *Journal of Financial Stability*, 5(4), 263-275.
- Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366a), 427-431.
- Ekinci, R., & Poyraz, G. (2019). The effect of credit risk on financial performance of deposit banks in Turkey. *Procedia Computer Science*, 158, 979-987.
- Elnahass, M., Trinh, V. Q., & Li, T. (2021). Global banking stability in the shadow of COVID-19 outbreak. *Journal of International Financial Markets, Institutions and Money*, 72, 101333.

- Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, 55(2), 251-276.
- Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, 20, 93-104.
- Johari, E. (2022). Loan moratorium announcements and stock market reaction: An event study analysis (Pengumuman moratorium pinjaman dan reaksi pasaran saham: Analisis event study). *Jurnal Pengurusan*, 66, 3–14. <https://doi.org/10.17576/pengurusan-2022-66-01>
- Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.
- Jokipii, T., & Milne, A. (2011). Bank capital buffer and risk adjustment decisions. *Journal of Financial Stability*, 7(3), 165-178.
- Kithinji, A. M. (2010). Credit risk management and profitability of commercial banks in Kenya. *International Journal of Finance & Banking Studies*, 5(3), 145-156.
- Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business, and consumer loan portfolios. *Journal of Banking & Finance*, 36(4), 1012-1027.
- Makri, V., Tsagkanos, A., & Bellas, A. (2014). Determinants of non-performing loans: The case of Eurozone. *Panaeconomicus*, 61(2), 193-206.
- Njenga, J. K. (2024). Electricity consumption and economic growth in Kenya: An ARDL bound test approach. *Journal of Energy Research and Reviews*, 16(1), 28–36. <https://doi.org/10.9734/jenrr/2024/v16i1329>
- Nizar, N., Zainudin, A. D., Saddam, S. Z., & Abdul Aziz, M. R. (2023). The utilization of CAMEL framework in analyzing the financial soundness of commercial banks in Malaysia: Pre and in the time of COVID-19. *Information Management and Business Review*, 15(2(I)SI), 186-196. [https://doi.org/10.22610/imbr.v15i2\(I\)SI.3399](https://doi.org/10.22610/imbr.v15i2(I)SI.3399)
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326.
- Quang, P., Vu, H. V., & Huy, P. T. (2021). Do non-performing loans impact bank efficiency? *Finance Research Letters*, 46, 102393. <https://doi.org/10.1016/j.frl.2021.102393>
- Sivarajan, L. S., Alyasa-Gan, S. S., Che Yahya, N., & Salehuddin, S. (2023). Explaining non-performing loans of commercial banks in Malaysia. *Advances in Social Sciences Research Journal*, 10(6.2), 98-106. <https://doi.org/10.14738/assrj.106.2.15014>
- Wang, Y. (2022). ARDL approach for cointegration: Practical implications for economic analysis. *Economic Modelling*, 39, 1435-1446.