The Present Role of Market Risks in the Financial Performance of Indonesian Banks Post-2007 Financial Crisis and Post-2016 Financial Technology Disruption

HERMAN KARAMOY, HIZKIA H. D. TASIK Faculty of Economics, Sam Ratulangi University,

Manado, North Sulawesi,

INDONESIA

Abstract: - The 2007-8 financial crisis and the 2016 technology disruption have motivated investors to be more aware of the financial performance of the banks in Indonesia. This study attempts to examine the strength of market risk post the financial crisis and financial technology disruption. To our knowledge, this is the first study to examine the advancement of market risk in the Indonesian banking industry following the crisis and disruption. Literature has shown that the role of market risk in other countries accentuates after the crisis. Using panel data from forty-nine banks listed in the Indonesia stock exchange during the 2009 – 2020 period, this study concentrates on the role of Market Risk Indicators (MRIs) in financial performance. The findings suggest that MRIs alter the profitability indicators. The effect of MRIs becomes more robust as moving further away from 2007. Additionally, there is no evidence that NIM has become a tool to manage risk.

Key-Words: - Market Risk, Financial Performance, Financial Crisis, Profitability

Received: January 11, 2023. Revised: May 2, 2023. Accepted: June 2, 2023. Published: June 20, 2023.

1 Introduction

Indicators preceded the financial crisis that erupted in 2007 thought of as pleasing financial achievements. A report published by [1], explained that the financial crisis was preceded by an extended period of fast credit expansion, low-risk premiums, abundant liquidity, high leverage, and soaring asset prices. No one knew that it was a signal that a mistake had been made, a financial sin that would last a long time. Additional factors, such as the growth of real estate bubbles, made the list of sins much longer. Some of the facts had been common symptoms of the most major financial crisis in the past, and the 2007 financial crisis was no exception. Lenders were too effortless, letting the credit grow buoyantly and the housing prices soar.

On the one hand, credit growth tends to boost government revenues during booms and leave substantial gaps during busts. On the other hand, this fast growth could lead to an extreme increase in market risk when the industry recklessly deals with market risk management. Assets and liabilities were prone to a problem. The same report by [1], argued that excessive leveraging and the subsequent risk spreading via securitization made financial institutions extremely sensitive to asset market corrections. As a result, a turnaround in a relatively small part of the financial world (the U.S. subprime market) was enough to set off a crisis that brought down the entire system. Instead of purchasing assets at a discount and selling them at a profit, people at the time purchased them at a premium with their fingers crossed, anticipating that asset prices would continue to rise. The consequence of this mistake was inevitably borne by almost everyone in the world. As explained in [2], U.S. markets were at their most extreme levels of risk before the 2008 financial crisis due to investors' large risk premiums. [3], argued that risk management then became more crucial after the 2007 global financial crisis. Not only financial institutions, during or since the global financial crisis, but firms with experience in risk management also failed.

The 2007 crisis led to several consequences. Many banks worldwide suffered from capital and liquidity management crises due to the adverse effect of the financial crisis on financial markets. According to a report by [4], 168 banks were said to have closed in the United States between the years 2007 and 2009. Banks and other financial institutions were significant in every country to function the financial systems like pension funds, insurance, microfinance, deposits, and others. The weak capability in managing the systems adversely affected the cash flow of the banks. The Housing and Economic Recovery Act of 2008, the Economic Stimulus Act of 2008, the Dodd-Frank Wall Street Reform and Consumer Protection Act, the Emergency Economic Stabilization Act, and the Troubled Asset Relief Program (TARP) were the support packages that the U.S. government released to lessen the effects of the 2007 financial crisis, [5].

Meanwhile, the Federal Reserve Banks (Fed) released policies, where some included lowering the target for the Federal funds rate from 5.25% to 2%, and the discount rate from 5.75% to 2.25%. In December 2008, the rate lowered to 0–0.25%. [5], pointed out that the Fed also undertook open market operations to ensure member banks remain liquid and created a variety of lending facilities to enable the Fed to lend directly to banks and non-bank institutions against specific types of collateral of varying credit quality.

Many studies had attempted to suggest the early signs of a crisis in the banks that could be preventive ways to maintain financial performance e.g., [6], [7], [8]. Additionally, [9], summarized some significant crises that had ever occurred globally. However, to our knowledge, no study had ever attempted to examine the consequences of the financial crisis on the financial indicators of the banks in the subsequent years, especially in Indonesia, mainly how the market risk postfinancial crisis would evolve in the next thirteen years, particularly, how the market risk played a role in the Indonesian banking industry following the financial crisis and financial technology disruption. existing literature focused on Instead, the investigating the aftermath of the Asian financial crisis in Indonesian banking from various perspectives, for example, the net interest margin of Indonesian banks, [10], market discipline, [11], and bank ownership, [12], but not in market risk perspectives yet.

This study aims to investigate the impact of the crisis on the financial indicators through assets and liabilities that potentially lose value due to market risks. Particularly, this study attempts to determine whether the altered market risk in the post-crisis years may contribute to financial performance in the subsequent years and whether the effect of altered market risks weakens the further the banks move away from the 2007 crisis. This is due to the argument by [13], saying that the financial crisis altered the market risk. This study also aims to examine the size of market risk before and after the 2016 financial technology disruption in Indonesia to ensure the effect of market risk in specific periods. Although there are significant differences between

banks according to liquidity risk, credit risk, equity risk, and profitability risk, this study assumes that, on average, the risk of each bank is similar to enable the investigation of the effect of risk on the financial performance of the banking industry in Indonesia.

2 Literature Review

Banks prudently maintained financial performance when they maximized the profits and the wealth of shareholders. As a result, banks were exposed to various risks that had an impact on their operations. One of the major financial dangers to the banks was a market risk. The market risk was the possible loss of value in assets and liabilities as a result of changes in market factors including interest and exchange rates, equity prices, and commodity prices, [14]. Although banks frequently restricted the scope of market risks to the assets and liabilities covered in trading books, they might also include the market risk of assets and liabilities that were designated as available for sale or even hold-tomaturity assets and liabilities. Market liquidity risk. in particular the risk that a business would find it difficult to offset or liquidate a position without significantly changing the market price due to insufficient market depth or market disruption, was a component of market risk for trading positions. Global financial reforms had motivated banks to comply with international standards, including better risk management. In Indonesia, the central bank of Indonesia, [15], regulated compliance under Good Corporate Governance (GCG). AFDB, [16], pointed out that when the banks complied with the standards, they might improve the capacity to bear the risks to support their development-related activities, the core business risks. While market risk could be relatively easier to control, the global financial crisis was somewhat harder to predict. Bad market risk management attenuated the power of the banks to improve their performance. but unpredictable financial crises scenario made it worse. This scenario increased the funding costs and shrank the liquidity of the banks.

Banks were exposed to different types of core business risk in doing any activity to maximize profit while maintaining or improving financial performance. Therefore, minimizing their exposure to other sources of non-core risk must also be part of the agenda for improving financial performance. One of the recent core business risks attracting attention was market risks. The rising popularity of market risk followed the 2007 financial crisis. There were many views on how market risk could arise. According to Bank Indonesia, [17], market risk could result from the portfolio's adverse movement in the market, which would cause the bank to incur losses. The market risk was a result of interest rates and fluctuating exchange rates. The exchange rate's market risk was directly correlated with the firm's which established value. was bv market circumstances while calculating the share price of the company. [18], explained that market risk was caused by things like unfavorable price changes for one or more instruments, which harmed a market participant's portfolio. Another possible cause was leveraged positions that squeezed the liquidity and resulted in extreme losses or even bankruptcy. Market risk, according to, [19], was the risk associated with financial assets whose prices were exogenously decided on financial markets. The market risk was eliminated if an item was kept until maturity. [20], stated that market risk was caused by economic losses coming from adverse changes in the market value of financial instruments, assets, and obligations, caused by changes in macroeconomic variables like interest rates and stock prices. The key market risks were interest rate risk, prepayment and extension risk, credit risk, liquidity risk, and stock price risk. In addition, [20], stated that market risk included interest rate risk, currency rate risk, price risk, and banking credit spread. [21], suggested that market hazards stemmed from adverse market price fluctuations or rates, including interest, foreign exchange, and stock prices. Concerning changes in interest rates, the level of risk associated with the bank's lending activities depended on the makeup of its loan portfolio and the extent to which the conditions of its loans exposed the bank's revenue stream to rate fluctuations. Typically, banks identified exposures with heightened sensitivity to interest rate changes and devised risk mitigation techniques such as interest rate swaps.

Typically, market risk had always been confined to the bank's operations, but the financial crisis had proven the shifting in its importance. Markets grew more turbulent post-financial crisis than before, and prices became unpredictable. Broad asset deterioration in credit quality, large increases in funding costs, and squeezes on liquidity had harmed the bank. The AFDB, [16], observed that market risk consumed more capital resources than in the past and, although being a non-core risk, required higher attention and more active management. There were five types of market risks: currency, liquidity, equity interest rate, price. and counterparty. Market risk interferes with both the balance sheet and income statement. According to AFDB, [16], specific to balance sheet risk, market risk was inherent in the financial instruments associated with the bank's assets (loan, equity participations, investments earmarked for trading or held to maturity portfolios) and liabilities (borrowings and related derivatives), credit risk mitigation, and others. Due to the difference in the total assets and total liabilities, there would be mismatches of assets and liabilities over a particular period resulting in a net asset or liability position. The mismatches could involve the currency, the interest rate, or the structure of the maturity date. Any risk arising from a mismatched balance sheet position, if left unchecked, could result in a possible loss or gain in the case of a change in interest rates.

One potential loss might include a lowering in the banking system's efficiency. [22], examined the effect of market risk in 15 banks in Iran during the 2005-2011 period. They found that both market risk indicators, interest rate, and exchange rate, considerably affected the market efficiency. Notably, a higher interest rate reduced the efficiency, and appreciation in the exchange rate increased the efficiency. [23], estimated the potential losses of the trading using GARCH models and EVT. They argued that using VaR and E.S. test, the result showed that the market's increased volatility might determine the increased losses of the portfolio. EVT and GARCH models with structural breaks in the variance showed that higher capital requirements were necessary, especially when market shocks appeared.

The association of market risk and financial performance was still in debate. Among others, [24], [25], found a reverse relationship between risk parameters and the financial performance of commercial banks in Kenya. Notably, market risk negatively affected profitability (i.e., return on equity). Using the unbalanced panel data of twentyone banks from the years 2003 to 2012, [26], also showed a negative relationship between risk and financial performance in commercial banks in Tanzania. In contrast, a study by [27], on ten leading banks (i.e., five private banks and five public banks) in India found that two balance risk parameters (i.e., interest rate and liquidity risks) were insignificant to the profitability. They concluded that the market risk indicator was insignificant among all risk Similarly, [28], parameters. discovered no correlation between market risk and the financial performance of Malaysian public companies.

While financial crises shared some characteristics, they could take many different shapes. Noteworthy changes in asset prices and credit volume; severe financial intermediation disruptions and the supply of external financing to various economic actors; substantial balance sheet problems (of firms, households, and financial intermediaries); and extensive government support were all characteristics of financial crises (in the form of liquidity support and recapitalization). As a result, [29], demonstrated that financial crises were frequently complex occurrences that were difficult to pinpoint with a single indicator. Financial Stability Board, [30], reported that during the 2007 financial crisis, firms faced an increase in market risks. During the crisis, the firms saw the leveraged loan market collapse, the asset-backed commercial paper market almost completely dried up, and the value of subprime mortgages and some structured products like collateralized debt obligations and securities backed by subprime mortgages plummeted.

	T	abl	le	1.	List	: of	Ba	nks
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	Banks
BRI Agroniaga	Bank Mandiri
Bank IBK Indonesia	Bank Bumi Arta
Bank Amar Indonesia	Bank Syariah Indonesia
Bank Jago	Bank Maybank Indonesia
Bank MNC Internasional	Bank Permata
Bank Capital Indonesia	Bank CIMB Niaga
Bank Net Syariah	Bank Sinarmas
Bank Central Asia	OCBC
Bank Harda Internasional	Bank BTPN
Bank Bukopin	Bank BTPN Syariah
Bank Mestika Dharma	Bank Victoria International
Bank Negara Indonesia	Bank Oke Indonesia
Bank Rakyat Indonesia	Bank Artha Graha Internasional
Bank Bisnis Internasional	PT Bank Multiarta Sentosa Tbk
BTN Indonesia	Bank Mayapada Tbk
Bank Neo Commerce	Bank China Construction BK
Bank JTrust Indonesia	Bank OUB Indonesia
Bank Danamon Indonesia	Bank Mega Tbk
BPD Banten	Bank of India Indonesia
Bank Ganesha	Bank Nationalnobu
Bank Ina Perdana	Bank Pan Indonesia
BPD Jawa Barat dan Banten	Bank Panin Dubai Syariah
BPD Jawa Timur	Commonwealth Bank
Bank QNB Indonesia	PT Bank Woori Saudara 1906
Bank Maspion Indonesia	
Source: Authons' Data	

Source: Authors' Data

3 Methods

This study attempts to reveal the importance of market risk indicators on the financial performance of forty-nine banks in Indonesia that are selected based on the data availability.

Table 1 presents the list of banks. This study observes the financial performance of forty-nine banks listed on the Indonesian Stock Exchange. The variables used in this study include return on assets (ROA), earnings per share (EPS), capital adequacy ratio (CAR), net interest margin (NIM), operating income – operating expense (OEOI), interestearning assets (so-called market risk-weighted assets, MRWAs), and interest-earning liabilities (socalled market risk-weighted liabilities, MRWLs).

These assets and liabilities are total assets (TA) and total liabilities (TL) subject to the risk of interest rate fluctuations matured or repriced at different times or in different amounts. The MRWA and the MRWL are used to proxy the market risk indicators (MRIs). Table 2 presents the summary statistics.

Figure 1 displays the trends of MRWAs. It is interesting to investigate the patterns of MRWAs. The annual financial report of the banks shows that total assets tend to increase over time. Meanwhile, Figure 1 shows that the MRWAs tend to remain stable over the period. The report also shows that between 2016 and 2020, some banks clearly showed a spike in total assets. Meanwhile, the figure shows no substantial change in MRWAs during the same period. It is also clear that many banks did not deal with MRWAs at the beginning of the period. Some banks even did not have MRWAs over the period.

Figure 2 presents the trends of MRWLs. Unlike in Figure 1, Figure 2 shows more variations in MRWLs than in MRWAs.

Table 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
BANK ID	49 banks			1	49
YEAR	12 years			2009	2020
EPS	500	114.3225	212.2684	-368.0000	1182.0000
ROA	552	1.4467	4.9145	-20.1300	69.0400
PBV	290	1.3896	1.0408	0.0100	6.0700
CAR	497	31.3819	117.4182	2.2000	2529.4200
NIM	504	5.4488	2.4195	0.2200	19.3000
OEOI	542	90.0698	23.7867	33.2800	261.1000
LDR	428	80.8600	19.0100	5.7600	124.7000
MRWA (in <i>ln</i>)	327	24.0659	1.8979	18.5143	27.9716
MRWL (in <i>ln</i>)	276	23.7894	1.8509	18.5096	27.8821
TA (in ln)	406	4.24E+10	6.59E+10	5.84E+07	2.81E+11
TL (in <i>ln</i>)	458	3.12E+10	5.08E+10	4398049	2.40E+11

Source: Authors' Data



Fig. 1: The Trend of Market Risk-Weighted Assets (MRWAs), 2009 – 2020.

While MRWAs show a relatively flat trend, MRWLs of some banks show an increasing trend. Despite fluctuations observed in some banks, most banks show constant or increasing trends over time. Both figures indicate that the banks experience stability in assets and liabilities amid interest rate fluctuations. Do these stable figures signal whether interest rate-based market risk still has a significant role in banking financial performance?

Indonesian banks are exposed to basic risk due to the difference in repricing characteristics of the various rate indices such as the Indonesian saving rate, SBI, and other interest rates. Risk management activities are directed at optimizing net interest income as an instrument, taking the market interest rate into account.



Fig. 2: The Trend of Market Risk-Weighted Liabilities (MRWLs), 2009 – 2020.

For this reason, this paper also tries to display the relationship between MRIs and the net interest income, which, in this case, is proxied by the net interest margin. The use of net interest margin can represent net interest income because the higher net interest income may be due to a higher net interest margin and vice versa.

The first investigation made in this study is to discover if there is any relationship between MRIs and financial performance, particularly the profitability indicators. Let FP_{it} be the financial performance indicators of bank i = 1, ..., N observed at periods t = 1, ..., T and consider the following panel data regression model below

$$FP_{it} = \alpha + x'_{it}\beta + c_i + u_{it} \tag{1}$$

where x'_{it} is a K-dimensional row vector of timevarying explanatory variables, α is the intercept, β is a K-dimensional column vector of parameters, c_i is an individual-specific effect, and u_{it} is an idiosyncratic error term. The variable of interest is market risk indicators (MRIs), and the controlling variables are other financial performance indicators. In this study, the MRIs are proxied by the assets and liabilities sensitive to the changes in interest rates. These assets and liabilities are subject to market risk or so-called market risk-weighted assets (MRWAs) and market risk-weighted liabilities (MRWLs).

4 Results

4.1 MRIs and Financial Performance

There are two scenarios of analyses executed in this study. Firstly, the analysis aims to discover the effect of the assets that are subject to market risk and the effect of their counterpart on market risk. The counterpart is the total assets that cover both assets subject to market risk and assets not subject to market risk. The study then examines the difference in the effects. In the second scenario, this study employs a similar fashion to analyze the effect of the liabilities that are subject to market risk. Results from Table 3 show that the MRWAs, indeed, negatively affected the NIM (i.e., specification (3)), while ROA and EPS (i.e., specifications (1) and (3)) were unaffected.

	(1)	(2)	(3)
VARIABLES	ROA	NIM	EPS
EPS	-0.0001	0.0007	
	(0.0025)	(0.0009)	
PBV	-0.7136*	-0.0143	-38.6456***
	(0.4312)	(0.1493)	(11.7923)
OEOI	-0.0925***	-0.0110	-1.4937**
	(0.0230)	(0.0080)	(0.6557)
CAR	-0.1814***	-0.0625***	
	(0.0389)	(0.0136)	
MRWAs	-0.0120	-0.6566***	3.2567
	(0.5242)	(0.1925)	(16.2922)
NIM			2.5813
			(6.3437)
Constant	14.8333	23.5747***	252.9455
	(12.6034)	(4.6610)	(405.8977)
Observations	196	185	203
R-squared	0.2149	0.2023	0.0809
Number of	27	27	29
bank id	·		-
bank id			

Table 3. ROA, NIM, and EPS Models with Market Risk-Weighted Assets (MRWAs)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The result suggests that when banks expand the level of MRWAs, the profit margin they earn from their core lending and borrowing activities declines. This is because a lower NIM indicates that banks are generating less profit from their core operations and is therefore viewed as a negative indicator of financial health. In this case, the gap between the interest income generated by a bank's assets and the interest expense incurred by its liabilities narrows.

Compared to the asset's counterpart analysis (Table 4), total assets affected both NIM and EPS. While the effect on NIM is negative, the effect on EPS is positive. Surprisingly, the roles of assets are somewhat different.

Table 4.	ROA.	NIM.	and EPS	Models	with	Assets
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(1)	(2)	(3)
ROA	NIM	EPS
-0.0022	0.0015***	
(0.0037)	(0.0006)	
-1.1337*	0.3455***	-41.6047***
(0.6188)	(0.0947)	(12.5416)
-0.0951***	0.0045	-1.5239**
(0.0302)	(0.0053)	(0.6823)
-0.3459***	-0.0281***	
(0.0599)	(0.0089)	
0.1983	-1.1664***	58.3340**
(0.8385)	(0.1544)	(22.8892)
		25.6739***
		(9.7332)
15.1775	31.6062***	-1,121.1399**
(18.6830)	(3.4194)	(538.2936)
216	200	209
0.2004	0.3280	0.1014
30	28	30
	(1) ROA -0.0022 (0.0037) -1.1337* (0.6188) -0.0951*** (0.0302) -0.3459*** (0.0599) 0.1983 (0.8385) 15.1775 (18.6830) 216 0.2004 30	$\begin{array}{cccccccc} (1) & (2) \\ ROA & NIM \\ \hline & -0.0022 & 0.0015^{***} \\ (0.0037) & (0.0006) \\ & -1.1337^* & 0.3455^{***} \\ (0.6188) & (0.0947) \\ & -0.0951^{***} & 0.0045 \\ (0.0302) & (0.0053) \\ & -0.3459^{***} & -0.0281^{***} \\ (0.0599) & (0.0089) \\ & 0.1983 & -1.1664^{***} \\ (0.8385) & (0.1544) \\ \hline & 15.1775 & 31.6062^{***} \\ (18.6830) & (3.4194) \\ \hline & 216 & 200 \\ & 0.2004 & 0.3280 \\ & 30 & 28 \\ \hline \end{array}$

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. ROA,	NIM, and EPS Mo	odels with Market
Risk-We	eighted Liabilities	(MRWLs)

	(1)	(2)	(3)
VARIABLES	ROA	NIM	EPS
EPS	-0.0013	0.0002	
	(0.0032)	(0.0011)	
PBV	-0.8490*	-0.1693	-53.0894***
	(0.5055)	(0.1631)	(11.6234)
OEOI	-0.0929***	-0.0147*	-1.2599**
	(0.0250)	(0.0080)	(0.6166)
CAR	-0.1862***	-0.0605***	
	(0.0426)	(0.0138)	
MRWLs	-0.0739	-0.4473**	-8.8604
	(0.5894)	(0.1944)	(14.7323)
NIM			1.0205
			(6.2938)
Constant	16.6924	18.5599***	500.8930
	(14.2395)	(4.7113)	(362.6718)
Observations	169	161	168
R-squared	0.2190	0.1886	0.1470
Number of bank id	24	24	25

Standard errors in parentheses

*** p < 0.01, ** p < 0.05, *p < 0.1

When the assets that bear market risk are extracted from total assets, the MRWAs do not affect EPS, despite the enormous magnitude of total assets as shown in Table 4, specification (3).

The MRWLs of the banks have also shown a significant effect on banks' performance. Table 5 shows that MRWLs significantly affect NIM. The effect of MRWLs is thirty-two percent lower than the effect of MRWAs. However, they both significantly reduce the NIM. Tables 3 and 5 show that both MRWAs and MRWLs have an insignificant effect on ROA and EPS.

The lower contribution of MRWLs to NIM than MRWAs is not surprising. Table 6 shows that the total liabilities have a lower effect on NIM than the total assets, only fifty-three percent. Total assets have significant effects on NIM and EPS. Meanwhile, total liabilities only have effects on NIM.

The results from tables 3 through 6 show that the number of assets held by a bank has a direct effect on its NIM, as the interest revenue generated by these assets contributes to the bank's net interest income. Banks with greater asset levels can produce more interest income, resulting in greater net interest margins. Considering NIM is a major predictor of a bank's profitability, it has a substantial impact on earnings per share. Generally, banks with higher NIMs are more profitable and will consequently have greater EPS. In contrast, liabilities have a lesser influence on NIM because the interest expense paid on deposits and other obligations is already factored into the margin calculation.

Table 6. ROA, NIM, and EPS Models with	
I islailidias	

Liabilities				
	(1)	(2)	(3)	
VARIABLES	ROA	NIM	EPS	
EPS	-0.0009	0.0012		
	(0.0037)	(0.0008)		
PBV	-0.5210	0.2628**	-27.3406**	
	(0.5950)	(0.1253)	(10.9990)	
OEOI	-0.0503*	-0.0103	-0.5965	
	(0.0261)	(0.0063)	(0.5345)	
CAR	-	-0.0340***		
	0.1603***			
	(0.0423)	(0.0089)		
Total	0.4978	-0.6171***	21.4051	
Liabilities				
	(0.9572)	(0.1990)	(18.2551)	
NIM			7.8610	
			(6.6328)	
Constant	-0.5667	20.5804***	-291.5152	
	(21.4636)	(4.4510)	(422.3048)	
Observations	237	220	229	
R-squared	0.1477	0.1847	0.0571	
Number of	33	31	32	
bank id				

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

However, liabilities do not directly impact profits per share (EPS) because EPS is a measure of the bank's performance after expenses and taxes have been removed. EPS is primarily influenced by the bank's net income, which is the difference between the bank's total revenue and total expenses. Other elements, like operating expenses, loan loss reserves, and taxes, also contribute to the computation of earnings per share (EPS), in addition to the cost of capital (interest expense).

Table 7 shows the difference in magnitudes between MRWAs and Total Asset and the difference in magnitudes between MRWLs and Total Liabilities. While the difference on the assets' side is huge, the difference in the magnitudes of liabilities variables is relatively minor. Nevertheless, the magnitudes of total assets and total liabilities in attenuating the NIM is more powerful than the magnitudes of MRWAs and MRWLs counterpart. In other words, the differences, which are 0.5098 and 0.1698 are attributed to the free-market risk assets embedded in total assets and the free-market risk liabilities embedded in total liabilities, respectively.

The results shown in Tables 3 through 7, covering the data for the 2009 – 2020 period, provide essential insights into how different kinds of assets affect the financial performance indicators differently. The significant difference is evident in the effect of market risk indicators (MRIs) on net interest margin (NIM). This study tries to examine further the relationship between MRIs and NIM.

	(1)	(2)	(3)
VARIABLES	ROA	NIM	EPS
MRWAs minus Total Asset	-0.2103	0.5098***	-55.0773
MRWLs minus Total Liabilities	-0.5717	0.1698***	-30.2655
Number of bank id under	30	28	30
Asset Specification Number of bank id under Liabilities Specification	33	31	32

*** p<0.01, ** p<0.05, * p<0.1

4.2 MRIs – NIM Relationship

Due to the risk management activities that banks should undertake, including optimizing the net interest margin (NIM), the data analyses may be prone to endogeneity issues. Particularly, a theoretical relationship does not fit into the "y - on -X" regression which, by the assumption, the regressors determine the dependent variable. At the same time, one of the regressors is not determined by an omitted variable that is part of the error term. In other words, when an endogeneity problem exists, at least one of the regressors is endogenous or jointly determined with the dependent variable. Due to the endogeneity problem, $Cov(x, u) \neq 0$. Therefore, to show the relationship between financial performance and MRIs, one must explain the relationship between MRIs as the endogenous variable and NIM as the instrumental variable (IV) using a two-stage least square (2SLS) model. It is assumed that this IV meets both conditions of IV; namely, the IV must be valid, that is, Corr(z, u) =0, and the IV must be correlated with the endogenous variable $Corr(z, x) \neq 0$, which z denotes the IV. To test $Corr(z, x) \neq 0$, one can test the hypothesis H_0 : $\pi_1 = 0$ in $x = \pi_0 + \pi_1 z + v$, the first stage regression. These conditions will guarantee that the IV estimate is the same as the true $plim(\hat{\beta}_{1,IV}) = \beta_1 +$ estimate, particularly $\frac{Corr(z,u)\sigma_u}{Corr(z,x)\sigma_u} = \beta_1 \text{ when } Corr(z,u) = 0 \text{ regardless of}$ the value of Corr(z, x). If $Corr(z, u) \neq 0$, then $plim(\hat{\beta}_{1,IV}) \neq \beta_1$ so the IV estimate is inconsistent. Moreover, if Corr(z, x) is positive, then one will have a positive bias, and if Corr(z, x) is negative, then one will have a negative bias. Also, when Corr(z, x) is small, the bias will be larger. This Corr(z,u)/Corr(z,x) <study assumes Corr(x, u), to execute 2SLS analysis with IV. Let the following equation be the structural model predicting financial performance for banks i =1, ..., N observed at periods t = 1, ..., T.

$$FP_{it} = \alpha + x'_{it}\beta + q_{it}'\gamma + u_{it}$$
(2)

where FP_{it} is the dependent variable, x'_{it} is a Kdimensional row vector of financial indicators variable (i.e., time-variant endogenous variables), and q'_{it} is an *M*-dimensional row vector of control variables (i.e., time-variant explanatory variables excluding the constant), α is the intercept, β is a Kdimensional column vector of parameters, γ is an *M*dimensional column vector of parameters, and u_{it} is an idiosyncratic error term. Then, let z be the instrument with Cov(z, u) = 0 in the following reduced-form equation that regresses the endogenous variable on all exogenous ones.

$$x_{it} = \pi_0 + z'_{it}\pi_1 + o'_{it}\pi_2 + v_{it}$$
(3)

where z'_{it} is the *K*-dimensional row vector of NIM (i.e., the instrumental variable), o'_{it} is the *K*dimensional row vector of other instrumental variables, π_0 is the intercept, π_1 , and π_2 is a *K*dimensional column vector of parameters, and v_{it} is an idiosyncratic error term. The regression of this equation is also called first-stage regression. Therefore, IV will remove the attenuation bias when there is an IV, *z* such that Corr(z, u) = 0, and $Corr(z, x) \neq 0$ (i.e., $\pi_1 \neq 0$). In the 2SLS setting, this study no longer uses profitability indicators to proxy F.P. because the instrumental variable (i.e., NIM) used is a type of profitability indicator; otherwise, it will violate the theoretical requirement of 2SLS.

Instead, the proxy variable used in this study is the loan-to-deposit ratio (LDR). The prominent reason for employing this variable as the proxy is because both assets and liabilities mathematically have a relationship to LDR.

Table 8. 2SLS Models					
VARIABLES	LDR (1)	LDR (2)			
MRWAs	-0.0000				
	(0.0000)				
OEOI	0.0060	0.0180			
	(0.0570)	(0.1490)			
MRWLs		0.0000			
		(0.0000)			
Constant	111.0520	-44.0810			
	(94.8310)	(705.6270)			
Observations	342	342			
Number of bank id	40	40			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

2009 – 2015 and 2015 – 2020)					
	(1) 2009-	(2) 2009-	(3) 2016-	(4) 2016-	
	2015	2015	2020	2020	
VARIABLES	NIM	NIM	NIM	NIM	
EPS	0.0028	0.0034	0.0021**	0.0021**	
	(0.0020)	(0.0022)	(0.0009)	(0.0009)	
PBV	0.5364*	0.7357*	-0.1143	-0.1425	
	(0.3158)	(0.3911)	(0.1302)	(0.1217)	
OEOI	-0.0170	-0.0085	-0.0105*	-0.0094*	
	(0.0190)	(0.0204)	(0.0064)	(0.0055)	
CAR	-0.1064***	-0.1037***	-0.0074	-0.0064	
	(0.0261)	(0.0289)	(0.0128)	(0.0114)	
MRWA	-0.2111		-0.2933*		
	(0.3439)		(0.1573)		
MRWL		-0.0951		-0.3055*	
		(0.3547)		(0.1588)	
Constant	13.2276	9.2612	13.1500***	13.0838***	
	(8.9500)	(9.2088)	(3.8288)	(3.8894)	
Observations	82	72	103	89	
Number of bank id	20	18	25	22	

Table 9. Market Risk Models Before and After

Financial Technology Disruption in Indonesia (i.e.,

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Based on findings from specifications (1) and (2) of Table 8, there is no evidence of the relationship between MRIs (i.e., either MRWAs or MRWLs) and LDR when NIM is taken as an instrumental variable. The use of NIM as an instrumental variable aims to explain risk management when NIM is one of the tools. Therefore, for this reason, one can conclude that although, mathematically, market risk indicators in this study have a close relationship with LDR, the role of NIM as an instrumental variable is meaningless.

Another exciting point one may consider when examining the role of MRIs in the banking business performance is if MRIs still have a significant contribution to the profitability performance of the banks throughout 2009 through 2020, and how the contribution evolves during that time. For this reason, this study further examines the impact of MRIs in different periods.

4.3 The Development of MRIs

This study conducts multi-period analyses. These multi-period analyses aim to examine whether MRIs' effect attenuates or grows as the period moves further away from 2007, the financial crisis year. This study assumes that the effect of market risk should attenuate when the MRIs become less important post-financial crisis era. As seen from Table 9, the periods of 2009 through 2020 are divided into two sub-periods, namely the sub-periods of 2009 to 2015 and 2016 to 2020. The division of the period considers the disruption of financial technology in Indonesia. [31], found that

there was a significant increase in financial technology in Indonesia from 2015 to 2016. Specifications (1) and (3) in Table 9 present the effect of MRWAs during the sub-periods of 2009 through 2015 and 2016 through 2020, respectively. Meanwhile, specifications (2) and (4) present MRWLs during the same sub-periods.

The findings from specifications (1) and (3) suggest that the effect of MRIs (i.e., the MRWAs) is statistically insignificant in the 2009 - 2015 subperiod but then became significant in the 2016 -2020 sub-period. Meanwhile, the results from specifications (2) and (4) suggest that MRIs (i.e., the MRWLs) have shown similar patterns as their asset counterpart, which means that the effect of MRIs becomes more potent as moving further away from the 2007 financial crisis. The results have shed light on the importance of the market risk in different periods. During the technology disruption era, the role of market risk accentuates. Although further investigation is necessary, one can assume that the interest rate is one of the key factors that strengthen the power of market risk. As pointed out by [31], the interest rate has less power in the technology disruption period which leads to increasing uncertainty in the banking industry.

5 Discussion and Concluding Remarks

The findings show that MRIs affect profitability indicators but not all. The study has found that among ROA, NIM, and EPS, NIM stands out as the only variable affected by the MRIs. The effect becomes more substantial as moving further away from the 2007 financial crisis. The effect of MRWAs as the proxy of MRIs is insignificant in the 2009 - 2015 sub-period but becomes significant in the 2016 – 2020 sub-period. Meanwhile, the effect of MRWLs has shown a similar pattern. That said, both MRWAs and MRWLs can be powerful tools to manage risk. Managing liability is vital as this indicator covers the savings and deposits accounts. Both assets and liabilities sensitive to interest rates are proxies of market risk indicators.

The outcomes presented in Tables 3 to 6 indicate that the number of assets held by a bank has a direct impact on its NIM. That said, banks with greater asset levels are more likely to generate more interest income, which results in higher net interest margins. Additionally, banks with higher NIMs are more profitable and will have greater EPS. Conversely, liabilities have a smaller effect on NIM since the interest expense paid on deposits and other obligations are already considered in the margin calculation. However, liabilities do not directly influence EPS, which is determined by the bank's net income. Although there is a significant difference in the magnitude of asset variables, the difference in the magnitude of liabilities variables is relatively minor. Nonetheless, the magnitudes of total assets and total liabilities in moderating the NIM are more powerful than the magnitudes of MRWAs and MRWLs counterparts. In other words, the differences are attributed to the free-market risk assets embedded in total assets and the free-market risk liabilities embedded in total liabilities, respectively. The results provide crucial insights into how various types of assets affect financial performance indicators differently, notably in the impact of market risk indicators (MRIs) on NIM. However, further investigation is necessary to examine the effect of MRIs on other financial indicators. Likewise, performance further investigation is needed to discover the reasoning behind the insignificance of MRIs on ROA and EPS.

One thing to point out is that before the Fintech period took place in Indonesia, the role of market risk was inconsiderable. Perhaps, the fear of having a prolonged financial crisis made the banking industry more cautious and reluctant to deal with riskier financial management, which included the prevention of rapid credit growth. However, during the Fintech period, one could observe an increasing role of market risk on net interest margin. The increase in the role was triggered by the dependence of banks on assets and liabilities that bear risks and so-called MRWAs and MRWLs. Despite the increase of the market risk role, the contribution of overall assets and liabilities turned out to have a bigger negative impact on the net interest margin than the MRWAs and the MRWLs. These findings assumed that risk management in Indonesia was still on track. When the contribution of overall assets and liabilities became more extensive than that of MRWAs and MRWLs, it could signal that the risk management had been in a danger zone. Nevertheless, further investigation into this assumption is necessary.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

-Herman Karamoy carried out the trend analyses, problem formulation, and 2SLS Models.

-Hizkia Tasik carried out the panel data regression analysis and risk calculations.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflict of interest to declare.

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