

Noise Affect Price to Book Value Moderated by Size in Indonesia's Banking Sector

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ABSTRACT: This research aims to explore several variables that affect price to book value moderated by size in Indonesia's banking sector. This research used a panel data model for the period 2015 to 2024. This study found that the noise variable statistically significantly affects the price-to-book value variable. The noise variable consistently significantly affects price-to-book value without including size as a moderating variable, as well as when including size as a moderating variable. Size is considered a moderating variable because the interaction between size and noise significantly affects price-to-book value.

KEYWORDS: Price to Book Value, Interest Margin, Loan to Deposits Ratio, Enterprise Information Technology, Noise, Size

I. INTRODUCTION

Banks, as financial business institutions, have the task of collecting funds from surplus units and distributing them to deficit units, earning a margin for these operations. Banks can channel these funds through credit for investment or consumer purposes. Based on Article 1 of Law No. 7 of 1992 concerning banking, which was amended by Law No. 10 of 1998, which was also influenced by Job Creation Law No. 11 of 2020, it is stated that banks have the concept of "Institutions that collect funds from the public, inform them about savings or deposits or accounts, and then channel them to other institutions through credit or other forms to improve the standard of living of the community. Bank investments are attractive for obtaining greater capital and providing optimal returns. The following shows investments in banking stocks since December 2024. Financial stock indices are highly volatile and can provide profits for investors, as can be seen in the image below.



Figure 1.1: Banking Stock Index since December 2024

Source: <https://id.tradingview.com/chart/?symbol=IDX%3AIDXFINANCE>

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Table 1.1 below shows banking performance from 2017 to 2024. At the end of 2024, there were 105 banks, down from 115 banks in 2017. The banking index fluctuated from 2017 to 2024. *Total banking assets* in Indonesia amounted to IDR 7,387.6 trillion in 2017 and increased to IDR 12,460.967 trillion in 2024, representing an average growth of 7.75% per year during that period. The return rate in 2017 had the highest return rate of 46.73% and the lowest of - 10.91% in 2024. The financial sector experienced significant fluctuations, while BCA shares experienced the highest positive fluctuations, approaching the financial sector's industry

return rate, and the lowest at 5.18% in 2024. BBTN's return rate was 109.64% in 2017 and the lowest at -5.34% in 2024.

The rate of return on various stocks is shown by fluctuating values and becomes an option for investment. This rate of return is measured by *the annual return* on shares. Table 1.1 shows that the rate of return on shares varies considerably and can far exceed the market.

Previous explanation regarding investment decisions to purchase banking stocks on the Indonesia Stock Exchange (IDX). Banking stocks are usually purchased using the *Price to Book Value* measure (Manurung et.al, 2023). The use of *Price to Book Value* as a measure for purchasing banking stocks is due to the nature of bank stocks, where assets are owned as a result of public trust in banks to deposit their funds in the banks concerned. Based on this *PBV* measure, investors have a desire to determine how much they are willing to pay for the book value of the bank. The book value is the accumulation of retained earnings of the bank in question. Based on the formula developed by Manurung et al. (2025c), *PBV* is a function of *Return on Equity* (ROE), *Dividend Payout Ratio* (DPO), dividend growth (g), and expected return (r).

Table 1.1 Banking Performance and Return Rates of Several Bank Stocks

Kinerja Perbankan								
Indikator	2017	2018	2019	2020	2021	2022	2023	2024
Jumlah Bank	115	115	110	109	107	106	105	105
Aset	7.387,63	7.913,49	8.562,97	9.177,89	10.112,30	11.113,32	11.765,84	12.460,96
Kredit	4.781,93	5.358,01	5.683,76	5.547,62	5.820,64	6.497,62	7.186,94	7.942,95
DPK	5.289,38	5.630,45	5.998,65	6.665,39	7.479,46	8.153,59	8.457,93	8.837,24
Laba Bersih	131,14	150,01	156,49	104,72	140,21	201,82	243,33	255,20
ROA	2,45	2,55	2,47	1,59	1,85	2,45	2,74	2,69
NIM	5,32	5,14	4,91	4,45	4,63	4,80	4,81	4,62
CAR	23,18	22,97	23,40	23,89	25,66	25,62	27,65	26,69
LDR	90,04	94,78	94,43	82,54	77,49	78,98	83,83	88,57
NPL	2,56	2,37	2,53	3,06	3,00	2,44	2,19	2,08
BOPO	78,64	77,86	79,39	86,58	83,55	78,70	78,92	81,30
Aset Likuid	18,56	14,96	15,51	18,91	19,57	15,90	13,29	11,27
Indeks Finansial	900,64	910,52	1.033,43	993,40	1.031,02	1.150,98	1.269,55	1.130,96
Return Indeks Finansial	0,467318	0,01097	0,134989	-0,03874	0,0378699	0,1163508	0,1030166	-0,1091647
BCA	3723,93	4.469,36	5.816,58	6.010,52	6.593,96	7.872,04	8.869,75	9.386,19
Return BCA	0,428939	0,200173	0,301435	0,033343	0,0970698	0,1938259	0,126741	0,05822487
Mandiri	2728,36	2.581,07	2.772,93	2.400,59	2.757,25	4.081,20	5.229,53	5.178,97
Return Bank Mandiri	0,416403	-0,05398	0,074334	-0,13428	0,1485718	0,4801705	0,2813707	-0,0096682
BRI	2289,99	2.372,94	2.954,13	2.908,92	3.229,89	4.036,05	4.970,78	3.856,24
Return Bank BRI	0,611205	0,036223	0,244924	-0,0153	0,1103399	0,2495936	0,2315952	-0,2242183
BNI	3732,6	3.412,67	3.117,21	2.526,24	2.782,69	3.873,18	4.708,12	3.992,38
Return Bank BNI	0,848874	-0,08571	-0,08658	-0,18958	0,1015145	0,3918834	0,2155696	-0,1520225
DANAMON	5132,58	5.734,99	3.026,80	2.643,32	2.006,45	2.385,98	2.533,34	2.417,47
Return Bank Danamon	0,914327	0,11737	-0,47222	-0,12669	-0,240936	0,189155	0,0617608	-0,045738
CIMB NIAGA	820,62	569,74	616,68	689,24	696,75	930,41	1.456,99	1.584,76
Return Bank CIMB Niaga	0,597656	-0,30572	0,082388	0,117662	0,0108961	0,335357	0,5659655	0,08769449
J-TRUST	50,00	50,00	50,00	700,00	206,00	174,00	120,00	187,00
Return Bank J-Trust	0	0	0	13	-0,705714	-0,15534	-0,3103448	0,55833333

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BBTN	2634,83	1.903,82	1.624,02	1.324,20	1.328,04	1.181,93	1.133,42	1.072,89
Return Bank BBTN	1,096426	-0,27744	-0,14697	-0,18462	0,0028999	-0,110019	-0,041043	-0,0534047
MAYBANK	212,97	170,39	174,89	302,50	292,75	205,45	225,51	201,75
Return Bank Maybank	-0,21026	-0,19993	0,02641	0,729659	-0,032231	-0,298207	0,0976393	-0,1053612
Sumber : Bank Indonesia dan OJK								

Margin (often referred to as interest *margin* or *Net Interest Margin*) in a bank is a very important financial ratio. This *margin* is the main source of income for a bank. This *margin* is the difference between the interest earned by the bank in its lending activities, so *the margin* is the interest received minus the interest paid as a result of the lending activities carried out by the bank concerned. Interest *margin* is inseparable from bank policy and prevailing interest rates (Freixas and Rochet, 2008). The higher the interest *margin*, the higher the bank's *going concern*. However, the higher the interest *margin*, the lower the loans disbursed. Hasan *et al.* (2020) found that *the interest margin* has a positive effect on *ROA* and *ROE*. Manurung *et al.* (2020) also stated that *NIM* has a positive effect on bank performance as measured by *RAROC*. Widyastuti *et al.* (2017) also stated that *the interest margin* has a positive effect on bank profitability in Indonesia. Freddy and Toni (2020) stated that *the Net Interest Margin* greatly affects *the Price to Book Value*. Therefore, *the interest margin* is used as an independent variable in this dissertation research.

The Loan to Deposits Ratio (*LDR*) is a ratio of loans (credit) granted with third-party funds (*DPK*). This ratio is considered a ratio that describes banks as *intermediaries* in the Indonesian economic system. As a ratio, banks must not exceed 92% (Manurung, 2017). Banks want to have this ratio because they also have to fund interbank transactions, foreign exchange transactions, and investments in bonds. Research on the effect of *LDR* on *PBV* and investment decisions is still very limited. Lubis *et al.* (2019) conducted research on the effect of *LDR* on *ROA*. Abdurrohman *et al.* (2020) conducted research on the effect of *LDR* on *ROA*. Tantowi and Simanjuntak (2020) also conducted research on the effect of *LDR* on *ROA*. Fanesha *et al.* (2021) studied the effect of *LDR* on *ROA*. Setianingsih *et al.* (2023) studied the effect of *LDR* on *ROA*.

The *EITSP* (*Enterprise Information Technology Strategic Plan*) is a program that is always included in the bank's annual planning because technology is very important for banking today. If a bank does not have one of the information technologies in banking, it will fall behind in service. The 2017 PWC Report (PWC, 2017) states that the banking industry in Indonesia is undergoing a significant transformation driven by digital technology/information technology. Bank Indonesia Regulation (PBI) No. 9/15/PBI/2007 concerning the implementation of risk management in the use of information technology by banks and PBI No. 12/21/PBI/2010 concerning bank business plans require all banks to comply and submit their bank business plans and the implementation of risk management in the use of IT by banks to Bank Indonesia on time every year. The responsibility of the Board of Directors and all parties (business units and support units) of the Bank organization that use high information technology can increase financial stability (Flamini *et al.*, 2009).

According to Beccalli (2007), banking products and services have used information and communication technology (ICT), now referred to as digital technology (DT), in the production and delivery processes to achieve effective and efficient ways of generating customer satisfaction and experience. Computers are present in all fields, but their presence does not increase productivity (Solow, 1987). In fact, Roach (1994) states that the productivity paradox is a phenomenon characterized by a gap between the investment allocated to information technology and the *total output* produced. Kusumaningrum *et al.* (2021) discuss investment decisions and dividend policies on the Indonesia Stock Exchange for banking stocks. Simorangkir (2025) states that information technology is very important for banking and is measured by expenditure on information technology.

In the context of finance, *noise* is always associated with *irrelevant* or *misleading* information, *random fluctuations*, or *short-term* price movements that cause confusion for investors in making investment decisions. This *noise* is always measured by stock volatility (Feng *et al.*, 2014). Research on *noise* in relation to *PBV* and investment decisions is still very limited. Truemann (1988) states that investors are very fond of *trading* stocks if there is *trading noise* on those stocks. Ye and Tan (2021) state in their research results that *noise* trading often occurs in the Chinese stock market and that market returns are more volatile in good markets than in bad markets. Gao and Ladley (2021) discuss the existence of *noise* trading and market stability. Khasawneh and Abdel (2017) discuss *noise trading* in small markets such as the Amman Stock Exchange.

This study covers the period from 2015 to 2024. This period includes the COVID-19 pandemic. The existence of this period means that the study must include a dummy period for the COVID-19 period. Negative news about COVID-19 had a huge impact on various industries and businesses, causing a sharp decline in investment market prices and negatively affecting stock performance and *returns* (Neog and Rakshit, 2022). The COVID-19 pandemic variable was used as a dummy variable in this

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dissertation research. Sullivan and Widoatmodjo (2021) discuss this pandemic period in the financial sector, especially banks. Hidayanti and Cahyono (2023) discuss factors that influence *financial distress* during the COVID-19 period. Ciotti et al. (2020) discuss COVID-19 in the health sector. Rinofah et al. (2022) studied the factors that influence the potential for bankruptcy during the COVID-19 pandemic period. Nguyen et al. (20224) discussed the COVID-19 pandemic and the manufacturing sector. Erdiaw-Kwasie (2023) discussed the impact of the COVID-19 period on the performance of small companies.

The internal and external variables of the bank need to be moderated by other variables. Manurung (2019a) states that moderating variables can strengthen or weaken the relationship between independent and dependent variables. The moderating variable used in this study is bank *size*. Nodeh et al. (2016) used company *size* as a moderating variable in examining the effect of bank director structure on the financial performance of banks in Malaysia. Badara (2016) also conducted research using bank *size* as a moderating variable for Nigeria. Abbasi and Malik (2015) used company *size* as a moderating variable in influencing company financial performance. Hapsari (2018) conducted research on banking and used bank *size* as a moderating variable to examine the effect of *LDR* and *NPL* on banking performance. Therefore, this variable will also be used in this study as a moderating variable. Fitri et al. (2018) conducted research on banking performance using company *size* as a moderating variable. *Size* as a moderating variable has been proposed and used by previous researchers. However, moderating variables can be mediating variables, as stated by Sharma et al. (1981), namely, "If a specific variable is linked to a criterion variable and/or a predictor variable but does not interact with the predictor variable." In this study, bank assets are included as a *moderating* variable that acts as a mediating variable. Sitorus (2017) used bank assets as an intervening variable to influence bank profitability. Aprilia et al. (2018) conducted research on banking using *Return On Asset* as an *intervening* variable.

II. THEORETICAL REVIEW

In this study, company or bank performance is one of the factors influencing investment decisions, and this variable is placed as an *intervening variable*. Company performance is the ability of a company to generate value, which has increased. The ability of company management to manage the company has caused the company's value to increase. The increase in the company's share value is indicated by the company's share price on the stock exchange. For the banking industry, performance is measured by *Price to Book Value* (Manurung, 2025c; Pinto, 2010), because banks are service institutions and third-party funds, and the credit disbursed is a tool for banks to increase company value. Jamil (2017) investigated the factors that influence *PBV*.

Wilcox (1984) has shown that the P/B-ROE (Return On Equity) model appears to be superior to the price-earnings ratio valuation model. Fama and French (1991) showed that the book-to-market ratio explains return differences better than beta, and thought that size and book-to-market ratios are proxies for other fundamentals. Karmawan and Dewi (2025) studied the factors that influence Price to Book Value. Fatikhah and Ginting (2025) conducted research on the influence of DER, ROE, and Current Ratio on Price to Book Value. Nawawi (2024) stated that Price to Book Value is still influenced by key factors such as ROA and so on. Rahayu et al. (2023) discuss that investment decisions, the DER ratio, and dividend policy simultaneously influence *PBV*. Rahayu and Utami (2020) discuss the influence of investment decisions, profitability, and size on *PBV*.

Banking as an intermediary institution to collect funds from *surplus units* and channel them to *deficit units*. Banks pay interest to surplus units at a lower rate than the interest they receive from deficit units. This interest difference is known as the interest *margin* or *Net Interest Margin* (NIM). *Net Interest Margin* (NIM) is a financial ratio in banks as a measure of performance. *NIM* is the difference in interest earned by banks as a result of distributing funds and paying interest to third parties. This interest *margin* generally ranges from 3% to 6% (Manurung, 2020). Therefore, *net interest margin* can be written in a mathematical equation (Manurung and Dezmercoledi, 2013 and Manurung, 2025). Ho and Saunders (1981) discuss the *determinants of net interest margin* in theory and in practice in the United States. Andros and Chang (2021) discuss innovative approaches to managing interest *margins* with economics and statistical analysis of commercial bank resources.

Net interest margin is always related to interest rate theory, whereby an increase in interest rates will increase inflation and decrease company net profits (Dornbusch and Fischer, 2017). Domicic and Ridzak (2013) discuss the determinants of the *net interest margin* of banks in Europe. Doyran (2013) investigates the relationship between *net interest margin* and *firm performance* in developing countries. Lestari (2021) discusses the factors that influence interest rates for Indonesian banks.

The *Loan to Deposits Ratio* (LDR) is a ratio used by banks to measure their intermediary capabilities. However, Manurung (2020) states that banks can distribute their funds so that this *LDR* ratio should not exceed 92%, because banks must provide funds for other banking activities such as foreign exchange transactions, investments in bonds, fund transfer

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transactions, etc. Research on *LDR* varies greatly, but the relationship between this ratio and investment decisions is very limited. Research on *LDR* in relation to other factors varies greatly. Lubis et al. (2019) conducted research on the effect of *LDR* on *ROA*. Abdurrohman et al. (2020) conducted research on the effect of *LDR* on *ROA*. Putri and Suardikha (2019) discussed the effect of *LDR* on bank profitability. Tantowi and Simnajuntak (2020) also conducted research on the effect of *LDR* on *ROA*. Fanesha et al. (2021) studied the effect of *LDR* on *ROA*. Setianingsih et al. (2023) studied the effect of *LDR* on *ROA*. Ugli (2025) discussed the factors that influence the Loan to Deposit Ratio.

Nowadays, banks are competing to serve their customers, who have traditionally been centered on branch offices, and there has been a change in customer service. This action is inseparable from the development of technology, namely through the technology owned by customers, namely *mobile telecommunications*. Laudon and Laudon (2004) define information technology as a combination of hardware, software, and networks that collect, store, process, and transmit information electronically. According to Wilkinson and Cerullo (1997), information technology investment is the amount of company funds used to invest in information technology, both *hardware* and *software*. Information technology has the ability to meet the information needs of the business world quickly, timely, relevantly, and accurately. Schniederjans et al. (2010) state that information technology investment is a decision to invest in allocating all resources (*hardware, software, software applications, and human resources*) to manage information systems. Zanaria (2017) states that the utilization of information technology is what information system users expect to do their jobs or the behavior they exhibit when using technology at work. Halim et al. (2020a) discuss *EITSP* with bank performance.

Halim et al. (2020b) conducted research on *the of EITSP* with bank performance in Indonesia moderated by *size*. Srivastav and Jain (2024) studied the influence of information technology assessment on investment decision choices. Abu-Taleb & Nilson (2021) discussed the influence of social media on investment decisions. Supriyadi et al. (2023) discussed the influence of Financial Technology (Fintech) on Banking Profitability in Indonesia.

Noise on the stock exchange can be defined as interference or noise that occurs on the exchange when an investor decides to buy or sell certain stocks. This noise is caused by the large amount of information entering the exchange, which confuses investors when conducting stock transactions, causing them to sell when they actually want to buy, or vice versa, buying stocks when they should be selling. *Noise* was first introduced by Black (1981). This *noise* is always measured by stock volatility (Feng et al., 2014). Research on this *noise* in relation to *PBV* and investment decisions is still very limited. Truemann (1988) states that investors are very fond of *trading* stocks when there is *trading noise* on those stocks. Ye and Tan (2021) stated in their research results that *noise* trading often occurs in the Chinese stock market and that market returns are more volatile in good markets than in bad markets. Gao and Ladley (2021) discussed the existence of *noise* trading and market stability. Khasawneh and Abdel (2017) discussed *noise trading* in small markets such as the Amman Stock Exchange. Dai et al. (2025) discuss the actions that must be taken so that *noise traders* can survive in the market in the long term, even though previous findings indicate that *noise traders* cannot survive in the long term. Herve et al. (2019) discuss the influence of *noise traders* and *smart investors* on *stock returns* and volatility.

Size is a variable that indicates the size of a company within a group of companies. *Size* became a variable that was taken into account in financial research after Banz (1981) published his research on *size* as measured by a company's market capitalization. *Size* is often used as an independent variable or a moderating variable. In this paper, *size* is used as a moderating variable in the research framework. Amelinda et al. (2023) investigated the role of *size* as a *moderating* variable in financial research. Mahmood et al. (2019) conducted research on *the effect* of moderating variables of company *size* and *leverage* on working capital in China. Badara (2016) investigated the moderating effect of company *size* on the relationship between board structure and bank financial performance. Muigai and Muriith (2017) conducted a study on the moderating effect of company *size* on capital structure and corporate *financial distress*. Mahanani & Kartika (2022) discussed the influence of *size* on company value. Prasetyo et al. (2024) discuss the effect of *size* on *price to book value* for Indonesian banks. Rahayu and Utami (2020) discuss investment decisions, profitability, and *size* on *price to book value*.

III. METHODOLOGY

This sub-section will explain the method used in this research. This sub-section comprises Panel Data Model, Operational Variables, and Sources of Data.

MODEL

This research uses three models where the dependent variable is Price to Book Value (PBV). The first model is the PBV model influenced by independent variables without moderating variables. The second model includes the moderating variable *Size* without considering its interaction. The third model is a complete model that shows the interaction of moderating variables with independent variables so that moderating variables can be stated. The complete model is as follows:

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$$\begin{aligned} PBVi,t = & a_0 + b_1 NIMi,t + b_2 LDRi,t + b_3 EITSPi,t + b_4 NOISEi,t + b_5 SIZEi,t + b_6 PDMCt \\ & + b_8 (SIZEi,t * NIMi,t) + b_9 (SIZEi,t * LDRi,t) + b_{10} (SIZEi,t * EITSPi,t) \\ & + b_{11} (SIZE(i,t) * NOISE(i,t)) + \epsilon \end{aligned} \quad (1)$$

Panel Data Model

This research uses a Panel Data Model to estimate the relationship between some independent variables to determine Price to Book Value as a dependent variable with Margin Interest, Loan to Deposits Ratio (LDR), Enterprise Information Technology, Noise, COVID, and Size as moderation variables. The Panel Data Model is appropriate for small data, which is a short time series, and small companies as samples. Besides that, the panel data model also shows time and cross-section as samples. Gujarati (2003), Wooldridge (2002), Greene (2008), Biorn (2017), Sul (2019), and Manurung (2024b) stated that the panel data model is as follows:

a. Pooled Data Model

The pooled data model is a model that combines all data together and is as follows:

$$Y_{i,t} = \beta_1 + \beta_2 X_{2i,t} + \beta_3 X_{3i,t} + \mu_{i,t} \quad (2)$$

$$i = 1, 2, \dots, k; t = 1, 2, \dots, n$$

X's are non-stochastic and $E(\mu_{it}) \sim N(0, \sigma^2)$

b. Fixed Effect Model

(3)

FEM is a model in which μ_i and X's are assumed to be correlated.

$$Y_{i,t} = \beta_1 + \beta_2 X_{1i,t} + \beta_3 X_{2i,t} + \mu_{i,t}$$

$$i = 1, 2, \dots, k; t = 1, 2, \dots, n$$

c. Random Effect Model (REM)

REM is a model in which ϵ_i and X's are assumed to be uncorrelated.

$$Y_{i,t} = \beta_1 + \beta_2 X_{1i,t} + \beta_3 X_{2i,t} + \mu_{i,t} \quad (4)$$

$$\beta_1 \beta_i = \beta_1 + \epsilon_i$$

$$i = 1, 2, \dots, k; t = 1, 2, \dots, n$$

μ_i is a random error with a mean value of zero and variance of $\sigma \epsilon^2$.

Judge (1982), Wooldridge (2002), Biorn (2017), Sul (2019), and Manurung (2024b) stated that how we choose FEM or REM is as follows:

When T (the number of time series data points) is large and N (the number of cross-sectional units) is small, FEM may be preferable. When N is large and T is small, if we strongly believe that the individual, or cross-sectional, units in our sample are not random drawings from a larger sample, FEM is appropriate. If the cross-sectional units in the sample are regarded as random drawings, the REM is appropriate. When individual error component ϵ_i and one or more regressors are correlated, FEM is an unbiased estimator. REM estimators are more efficient than FEM estimators when N is large and T is small and if the assumptions underlying REM hold.

IV. RESEARCH DATA

The unit of analysis in this research is telecommunications companies listed on the Indonesia Stock Exchange. There are 17 bank companies that were purposively selected as the unit of analysis, with annual reports from 2015 to 2024. The data was collected from several sources. Most of the data is on a yearly basis for the period 2015 to 2024. All data was collected from the websites of the banks and the Indonesia Stock Exchange.

This research will present descriptive analysis and causal analysis, which will be explained later.

V. FINDINGS AND DISCUSSION

Descriptive Analysis

The central values of this dissertation research are the minimum, maximum, average, skewness, kurtosis, and Jarque Bera values. This information can be seen in Table 1 below.

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TABLE 1 : CENTER VALUE OF RESEARCH VARIABLE.

	PBV	NIM	LDR	EITSP	Noise
Minimum	0.188653	0.4700	32.680	0.001215	0.0400
Maximum	16.75218	9.3000	135.46	0.93362	1.3014
Average	1.247769	4.8089	83.878	0.206077	0.4092
Standard					
Deviation	1.554493	1.7876	13.109	0.170549	0.2055
Skewness	6.331868	-0.1833	-0.5943	1.554399	1.6118
Kurtosis	58.54315	0.1157	3.4528	3.288146	3.5499
Jarque Bera	22,988.33	59.8775	11.4596	69.04584	75.7460

Source: Processed by the researcher

In this study, the main dependent variable used is investment decision, where a value of zero indicates not buying shares and a value of one indicates buying bank shares. Therefore, the central value of this variable does not need to be analyzed because it does not provide any further meaning.

The intermediate variable is both an independent and dependent variable in this study. The intermediate variable in this study, *Price to Book Value*, is a variable that represents company performance and is also used to purchase bank shares. The minimum value is 0.1886x; the maximum value is 16.75x, the average is 1.248x, and the standard deviation is 155.45%. This figure indicates that the PBV value varies greatly for the 17 research samples and the average is very close to the minimum value. The Jarque Bera value is very high and it can be stated that the PBV variable has a normal distribution.

The NIM variable is a variable that indicates the performance and profitability of the bank concerned. The minimum value is 0.47%; the maximum value is 9.3%, the average is 4.81%, and the standard deviation is 178.76%. This figure indicates that the NIM value varies greatly for the 17 research samples, and the average is the central value or in the middle of the minimum and maximum values. The Jarque Bera value is very high, and it can be stated that the NIM variable has a normal distribution.

The LDR variable is a variable that indicates a bank's ability to act as an intermediary between surplus institutions or units and deficit institutions or units. LDR is the ratio of loans granted to customers to the amount of funds collected by the bank. This ratio is expected to be a maximum of 100%, but previous studies have shown that this ratio only ranges around 90% due to other activities. The minimum value is 32.68%; the maximum value is 135.46%, the average is 83.878%, and the standard deviation is 13.109%. These figures indicate that the LDR value varies greatly for the 17 research samples, and the average is the expected LDR ratio value, which tends to vary around the expected LDR value. The Jarque Bera value is very high, indicating that the LDR variable has a normal distribution.

The EITSP variable is a variable value that indicates bank spending on information technology. Banks are currently highly dependent on information technology, and almost all banks have information technology to serve their customers. As described, this expenditure value is divided by *total assets* because it is adjusted to the value of the independent variable (intermediate variable), which is the bank's performance ratio and also the profitability of the bank concerned. The minimum value is 0.12%; the maximum value is 93.36%, the average is 20.61%, and the standard deviation is 17.05%. These figures indicate that the EITSP value varies greatly for the 17 research samples, and the average is a value that ranges around the minimum value. The Jarque Bera value is very high and it can be stated that the EITSP variable has a normal distribution.

The *Noise* variable is a variable that indicates stock activity on the exchange, where there is a lot of information and confusion when making investment decisions on these bank stocks. The measurement of this *noise* information uses the standard deviation value of stock prices on the exchange. The minimum value is 4%; the maximum value is 130.14%, the average is 40.92%, and the standard deviation is 20.55%. These figures indicate that the *Noise* value varies greatly for the 17 research samples, and the average is very close to the minimum value. The Jarque Bera value is very high and it can be stated that the *Noise* variable has a Normal distribution.

Bank *size* is used as a moderating variable in this dissertation research. Bank *size* is measured using the *size* introduced by Bank Indonesia, which has undergone changes through a Bank Indonesia Circular Letter. It turns out that the bank *size* in this research sample varies greatly because large banks can be counted on one hand, and bank *size* 3 is also balanced with *size* 4, while the rest is represented by banks with *sizes* 2 and 1. However, this bank *size* cannot be said to be a bank with a normal distribution.

In this study, the COVID-19 variable was included as an independent variable to distinguish between the periods when COVID-19 was present and when it was not, symbolized by 0 and 1. As a result, central data analysis was not necessary in this study.

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Causal Analysis

This sub-chapter discusses the variables that influence the PBV (*price to book value*) variable, which is an intermediate variable in this study. The research model was created with and without moderation. The research moderation used is *the size* of the bank currently using this capital. The research model always uses *the Fixed Effects Model* (FEM), which is one of the panel data models. This action was taken because the data was collected *purposively* with an emphasis on information technology expenditure data, which amounted to 17 companies. The independent variables in this study are NIM, LDR, EITSP, *Noise*, and COVID-19, and a variable *size* as a moderating variable. Equation (4.1) is a mathematical model of PBV influenced by NIM, LDR, EITSP, *Noise*, and COVID-19.

$$\begin{aligned} \text{PBV}_{i,t} = & 0.2969 - 0.01897 \text{ NIM}_{i,t} + 0.0039 \text{ LDR}_{i,t} + 0.7128 \text{ EITSP}_{i,t} + 1.3454 \text{ NOISE}_{i,t} \\ & (0.6663) (0.3957) (0.283) \quad (0.00) \\ & + 0.0481 \text{ COVID-19}_{(i,t)} \quad (1) \\ & (0.5535) \end{aligned}$$

$R^2 = 33.92\%$, $F = 9.7574$, Numbers in parentheses are probability values

The coefficient of determination is 0.3392 or 33.92%, which states that the variables NIM, LDR, EITSP, NOISE, and COVID-19 together influence PBV fluctuations by 33.929%, with the remainder influenced by other factors. The F value of 9.7574 indicates that this value is greater than the $F_{(table)}$ value and leads to the conclusion that model (1) is highly suitable and can be used to examine the effect of independent variables on the dependent variable PBV. As described earlier, the first model analyzed was the effect of the variables NIM, LDR,

Noise, EITSP, and COVID-19 on PBV. This model is shown in Equation 4.1. In equation (4.1), the *Noise* variable significantly and positively affects PBV at a significance level of 1%. If *Noise* increases by 1 unit, PBV also increases by 1.3454 units. This result is almost the same as equation (1). If PBV continues to increase, there is a possibility that investors will not buy the shares of the company concerned. The increase in fluctuating stock prices is indicated by an increase in noise as measured by the volatility of the stock. As a result, the shares in question are decided not to be purchased because the share price has increased. On the other hand, equation (1) shows that the variables NIM, LDR, EITSP, and COVID-19 do not significantly affect PBV at a significance level of 10%. The results of this study support previous studies, namely Hartini et al. (2023), Sutrismi et al. (2023), and Jamil (2017), Karmawan and Dewi (2025), Fatikhah and Ginting (2025), Nawawi (2024), Rahayu et al. (2023), and Rahayu and Utami (2020).

Furthermore, the *Size* variable was included as an independent variable because the *size* variable will be tested as a moderating variable in this study. The model is shown in equation (4.2) as follows:

$$\begin{aligned} \text{PBV}_{i,t} = & 0.6989 - 0.0313 \text{ NIM}_{i,t} + 0.0035 \text{ LDR}_{i,t} + 0.4825 \text{ EITSP}_{i,t} + 1.3282 \text{ NOISE}_{i,t} \\ & (0.4968) (0.4403) (0.5139) \quad (0.00) \\ & - 0.016 \text{ COVID-19}_{i,t} - 0.0841 \text{ SIZE}_{i,t} \quad (2) \\ & (0.8684) \quad (0.3632) \end{aligned}$$

$R^2 = 33.94\%$, $F = 8.6158$, Numbers in parentheses are probability values

The coefficient of determination is 0.3394 or 33.94%, which states that the variables NIM, LDR, EITSP, NOISE, and COVID-19 together influence PBV fluctuations by 33.94%, with the remainder influenced by other factors. The F value = 8.6158 indicates that this value is greater than the $F_{(table)}$ value and leads to the conclusion that model (2) is highly suitable or can be declared a model and can be used to see the effect of independent variables on the dependent variable PBV.

The previous description shows that the second model analyzed is the effect of the variables NIM, LDR, *Noise*, EITSP, COVID-19, and *size* on PBV. This model is shown in Equation (2). In equation (2), the *Noise* variable significantly and positively affects PBV at a significance level of 1%. If *Noise* increases by 1 unit, PBV also increases by 1.3282. This coefficient value is smaller than the coefficient value in equation (1). If PBV continues to increase, there is a possibility that investors will not buy the shares of the company concerned. The increase in fluctuating stock prices is indicated by an increase in *noise* as measured by the volatility of the stock. As a result, the stock in question is decided not to be purchased because the stock price has increased. On the other hand, equation (2) shows that the variables NIM, LDR, EITSP, and COVID-19, as well as the variable *Size*, do not significantly affect PBV at a significance level of 10%.

Then, PBV is also estimated and the influence of the variables NIM, LDR, *Noise*, EITSP and COVID-19 is observed, while including *size* as a moderating variable and testing the *size* variable as a moderating variable. The results are shown in equation (3) below.

$$\text{PBV}_{i,t} = 0.269 - 0.0156 \text{ NIM}_{i,t} - 0.0081 \text{ LDR}_{i,t} + 0.485 \text{ EITSP}_{i,t} + 3.9000 \text{ NOISE}_{i,t}$$

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(0.8968) (0.5997) (0.8261) (0.0)

+ 0.007382 SIZE_{i,t} + 0.1108 PDMC_t – 0.0376 (SIZE_{i,t} *NIM_{i,t})
(0.9901) (0.2205) (0.3927)

+ 0.0085 (SIZE_{i,t} *LDR_{i,t}) – 0.0711 (SIZE_{i,t} *EITSP_{i,t}) –
(0.123) (0.9287)

- 1.3836 (SIZE_{i,t} *NOISE_{i,t}) (3)
(0.0)

R² = 38.21%, F = 14.247, Numbers in parentheses are probability values

In Model (3), the coefficient of determination (R²) is 38.21% and the F_{ob} value is 14.247. The coefficient value of 38.21% indicates that all variables together explain 38.219% of the fluctuations in the PBV variable, with the remainder being explained by other factors. This result is quite good, as there are still other factors that explain it. This fairly large value indicates that model (3) is very suitable for the model. Finally, the effect of each variable (NIM, LDR, *Noise*, EITSP, and COVID-19) on PBV, known as partial variable analysis, is discussed. The *Noise* variable positively and significantly affects the PBV variable at a 1% significance level. This result is the same as the results of equations (1) and (2). If the *noise* variable increases by one unit, it will increase the PBV variable by 3.900 units. This study supports previous studies. As described earlier, the *size* variable is included as a moderating variable.

Consequently, this study examines the moderating effect of the *size* variable. The interaction between *size* and the independent variable serves as a benchmark for examining the effect of *size* as a moderating variable. The interaction between *size* and *noise* has a negative effect on PBV. This interaction indicates that *size* weakens the relationship between *noise* and PBV. The *size* variable becomes a pure moderating variable because *size* does not significantly affect PBV (Sharma, 1981 and Manurung, 2024). The interaction between *size* and Covid-19 has a positive effect on the dependent variable PBV. The *size* variable becomes a pure moderating variable for PBV because the *size* variable does not significantly affect PBV (Sharma, 1981 and Manurung, 2024). This *size* moderating variable strengthens the relationship between Covid-19 and PBV.

In model (2), it was found that the NIM variable did not significantly affect the dependent variable PBV at a significance level of 10%. The independent variable LDR also did not significantly affect the dependent variable PBV at a significance level of 10%. The independent variable IETSP also does not significantly affect the dependent variable PBV at a significance level of 10%. The variable *size* as a moderating variable also does not significantly affect the dependent variable PBV at a significance level of 10%. The insignificance of the independent variable *size* affecting the dependent variable PBV will provide a statement that the significant interaction test will prove to be a pure moderating variable. The results of this study support previous studies, namely Hartini et al. (2023), Sutrismi et al. (2023), and Jamil (2017), Karmawan and Dewi (2025), Fatikhah and Ginting (2025), Nawawi (2024), Rahayu et al. (2023), and Rahayu and Utami (2020).

VI. CONCLUSION

This study found that the noise variable statistically significantly affects the Price to Book Value variable. The Noise variable consistently significantly affects Price to Book Value without including Size as a moderating variable, as well as when including the Size variable as a moderating variable. Size is considered a moderating variable because the interaction between size and Noise significantly affects Price to Book Value.

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