# Comparison of BCA & BRI Stock Price Movement

*MSwM Implementation*

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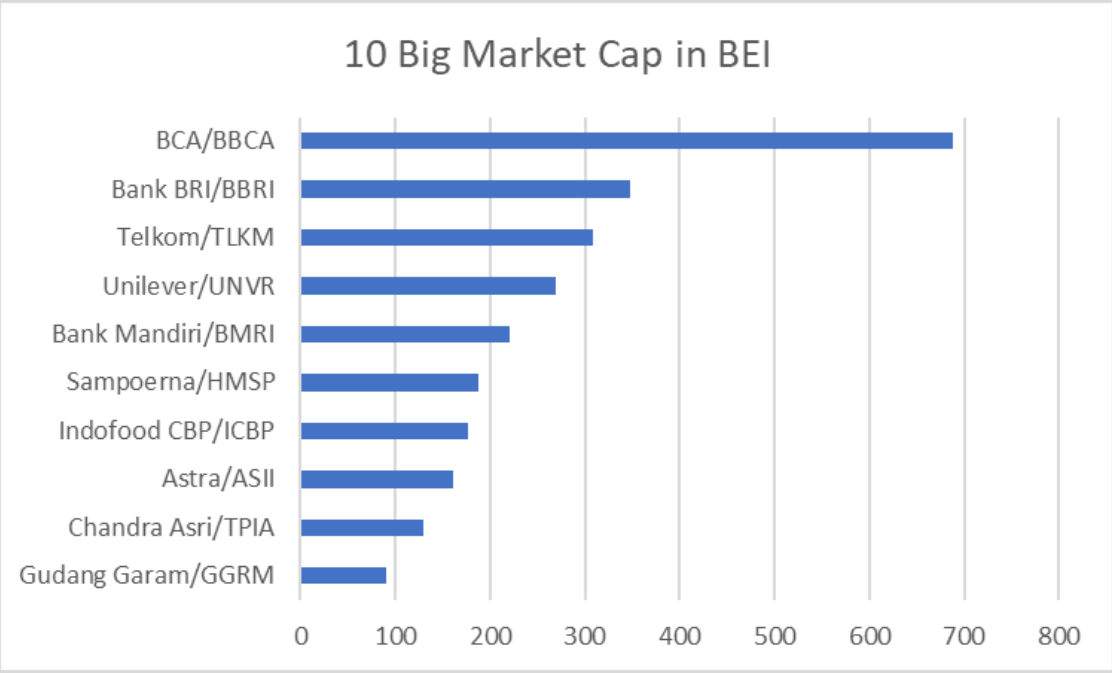
# Introduction



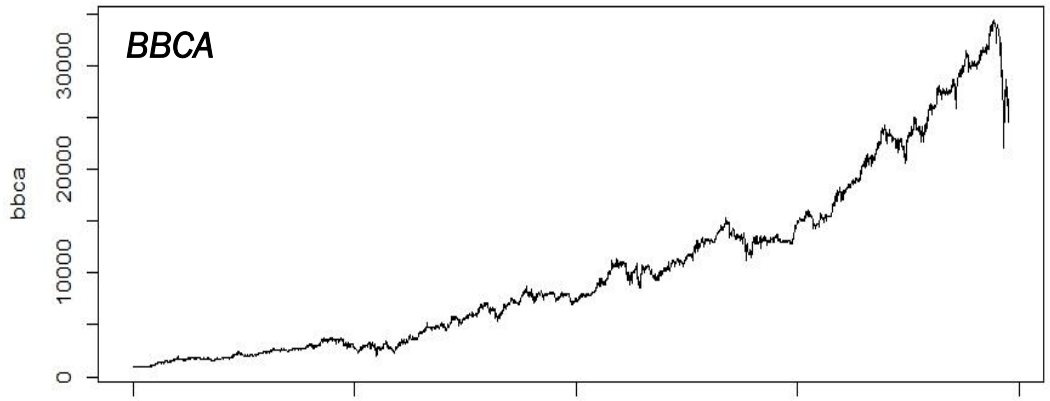

*source: www.cnbcindonesia.com*

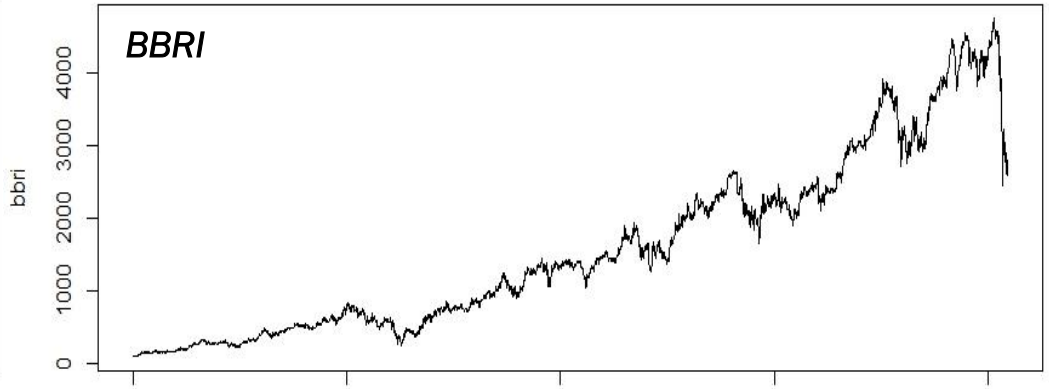
BCA & BRI are the biggest 2 player in Jakarta Composite Index (JCI).

In order to analyze which one is safer and have better performance for long term investment, some analysis through MSwM method will be run to stock price data from both company.

# Data Preparation

Time Series Plot of BBCA & BBRI




Stationery checking through ADF Test

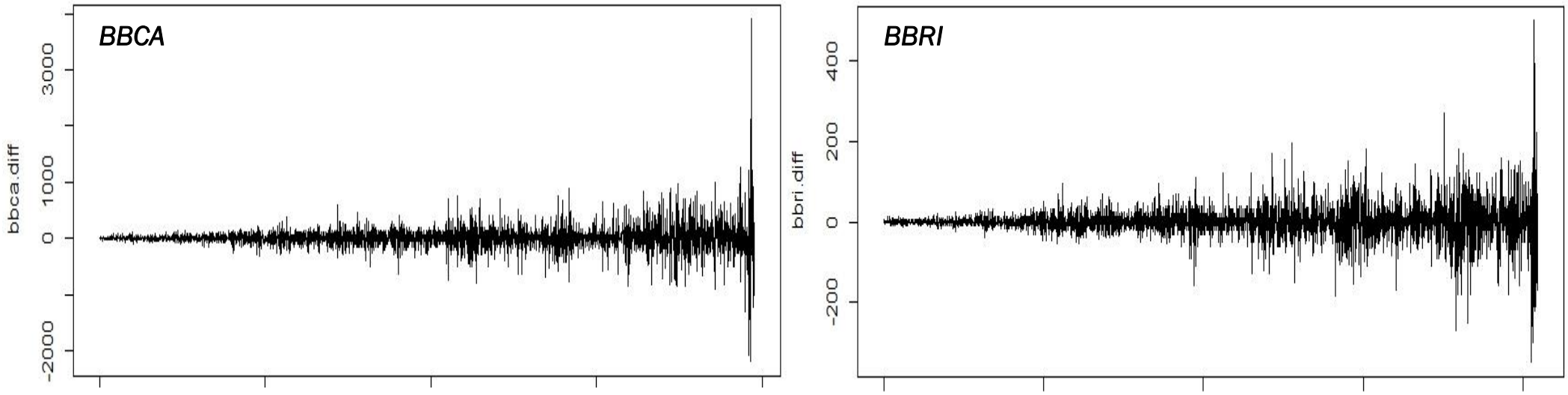
| Emiten | P-value | Decision | Remarks |
|---|---|---|---|
| BBCA | 0.5643 | Failed to reject H0 | Not stationaire |
| BBRI | 0.1812 | Failed to reject H0 | Not stationaire |

H0: data is not stationer
H1: data stationer
P-value < alpha (0.05) → reject H0

Conclusion:
Both stock price data are not stationer, need to do differencing in lag 1

# Data Preparation

Time series plot after differencing data in lag 1




Stationery checking through ADF Test

| Emiten | P-value | Decision | Remarks |
|---|---|---|---|
| BBCA diff1 | 0.01 | Reject H0 | Stationer |
| BBRI diff1 | 0.01 | Reject H0 | Stationer |

# Data Preparation

Linearity checking through Terasvirta test

| Emiten | P-value | Decision | Remarks |
|---|---|---|---|
| BBCA diff1 | 7.06E-09 | Reject H0 | Non Linear |
| BBRI diff1 | 0.0004847 | Reject H0 | Non Linear |

H0: data pattern is linier
H1: data pattern is not linier
P-value < alpha (0.05) → reject H0

Conclusion:
Both stock price data are not linier, indicating data is not really stationer, and have mixture distribution

Mixture distribution checking through Mathematica software

| Emiten | Distribution 1 | Distribution 2 | Comp |
|---|---|---|---|
| BBCA diff1 | N(8.79322, 106.087) | N(88.3626, 1103.33) | (0.869, 0.131) |
| BBRI diff1 | N(7.37703, 113.115) | N(0.09303, 15.2778) | (0.2622, 0.7377) |

Based on output of mathematica, each data has 2 different normal distribution, which fulfill the condition to analyze through MSwM method.

# Choosing the best MSwM model BBCA

| AR model | Regime | Variable | P-value | AIC |
|---|---|---|---|---|
| AR(1) | 2 | lag1 - k1 | < 2.2e-16 | 50210.27 |
| | | lag1 - k2 | 0.9702 | |
| | 3 | lag1 - k1 | 0.6564 | 49303.14 |
| | | lag1 - k2 | 0.6606 | |
| | | lag1 - k3 | 3.42E-05 | |
| | 4 | lag1 - k1 | 0.594 | 49032.98 |
| | | lag1 - k2 | 0.0006863 | |
| | | lag1 - k3 | 0.8868 | |
| | | lag1 - k4 | 0.083988 | |

| AR model | Regime | Variable | P-value | AIC |
|---|---|---|---|---|
| AR(2) | 2 | lag1 - k1 | 0.89364 | 50208.33 |
| | | lag2 - k1 | 0.059972 | |
| | | lag1 - k2 | 0.004779 | |
| | | lag2 - k2 | 0.165533 | |
| | 3 | lag1 - k1 | 7.06E-01 | 49303.21 |
| | | lag2 - k1 | 0.152 | |
| | | lag1 - k2 | 0.7138 | |
| | | lag2 - k2 | 0.3762 | |
| | | lag1 - k3 | 2.40E-05 | |
| | | lag2 - k3 | 0.1374 | |
| | 4 | lag1 - k1 | 0.3873 | 49041.83 |
| | | lag2 - k1 | 0.1457 | |
| | | lag1 - k2 | 0.7522 | |
| | | lag2 - k2 | 0.6762 | |
| | | lag1 - k3 | 0.00066 | |
| | | lag2 - k3 | 0.860844 | |
| | | lag1 - k4 | 0.050891 | |
| | | lag2 - k4 | 0.179466 | |

| AR model | Regime | Variable | P-value | AIC |
|---|---|---|---|---|
| AR(3) | 2 | lag1 - k1 | 0.000949 | 50209.65 |
| | | lag2 - k1 | 0.088325 | |
| | | lag3 - k1 | 0.000872 | |
| | | lag1 - k2 | 0.93465 | |
| | | lag2 - k2 | 0.05992 | |
| | | lag3 - k2 | 0.32056 | |
| | 3 | lag1 - k1 | 0.5391 | 49297.96 |
| | | lag2 - k1 | 0.2922 | |
| | | lag3 - k1 | 0.3342 | |
| | | lag1 - k2 | 0.5349 | |
| | | lag2 - k2 | 0.127 | |
| | | lag3 - k2 | 0.1648 | |
| | | lag1 - k3 | 9.97E-06 | |
| | | lag2 - k3 | 0.040413 | |
| | | lag3 - k3 | 0.003273 | |
| | 4 | lag1 - k1 | 0.001424 | 49059 |
| | | lag2 - k1 | 0.597499 | |
| | | lag3 - k1 | 0.012599 | |
| | | lag1 - k2 | 0.04142 | |
| | | lag2 - k2 | 0.122008 | |
| | | lag3 - k2 | 0.478759 | |
| | | lag1 - k3 | 7.32E-01 | |
| | | lag2 - k3 | 0.497 | |
| | | lag3 - k3 | 0.4438 | |
| | | lag1 - k4 | 0.367 | |
| | | lag2 - k4 | 0.13163 | |
| | | lag3 - k4 | 0.08682 | |

Based on simulation with model AR(1), AR(2), and AR(3), and 4 regimes, all of the model has at least 1 significant variable.

The best model is the model with the lowest AIC number, which for BBCA is **AR(1) K4.**

# Choosing the best model BBRI

| AR model | Regime | Variable | P-value | AIC |
|---|---|---|---|---|
| AR(2) | 2 | lag1 - k1 | 0.96961 | 38774.22 |
| | | lag2 - k1 | 0.02788 | |
| | | lag1 - k2 | 2.20E-16 | |
| | | lag2 - k2 | 7.11E-05 | |
| AR(3) | 2 | lag1 - k1 | 0.04259 | 38765.4 |
| | | lag2 - k1 | 4.54E-05 | |
| | | lag3 - k1 | 2.20E-16 | |
| | | lag1 - k2 | 0.666396 | |
| | | lag2 - k2 | 0.026075 | |
| | | lag3 - k2 | 0.001579 | |

Simulation using the same AR model and number of regime to BBRI stock price data, it is found that AR(1) is not significant to any regimes. While AR(2) and AR(3) are only significant to regime 2.
Then the best model for BBRI is **AR(3) K2** with the smallest AIC.

# Run Length Summary

BBCA

| Statistics | Regime 1 | Regime 2 | Regime 3 | Regime 4 |
|---|---|---|---|---|
| Maximum of Run Length | 8 | 53 | 173 | 94 |
| Minimum of Run Length | 1 | 1 | 1 | 1 |
| Numer of Runing | 101 | 201 | 69 | 166 |
| Average Run Length | 2 | 73 | 24 | 143 |

| Prob | Regime 1 | Regime 2 | Regime 3 | Regime 4 |
|---|---|---|---|---|
| **Regime 1** | 53% | 46% | 0% | 0% |
| **Regime 2** | 5% | 88% | 1% | 7% |
| **Regime 3** | 1% | 1% | 90% | 8% |
| **Regime 4** | 1% | 7% | 4% | 88% |

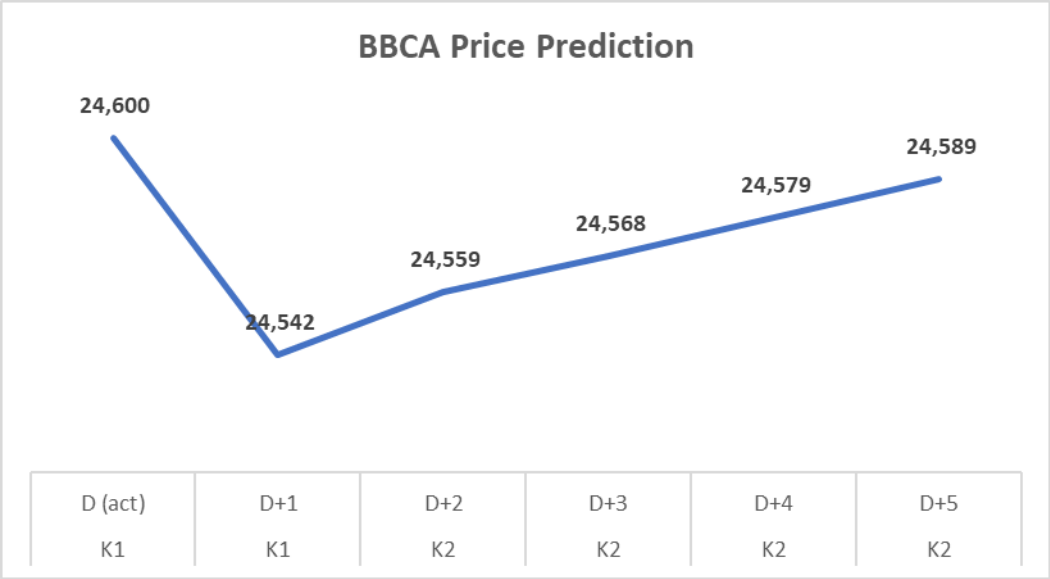
BBRI

| Statistics | Regime 1 | Regime 2 |
|---|---|---|
| Maximum of Run Length | 87 | 978 |
| Minimum of Run Length | 1 | 1 |
| Numer of Runing | 257 | 257 |
| Average Run Length | 6 | 10 |

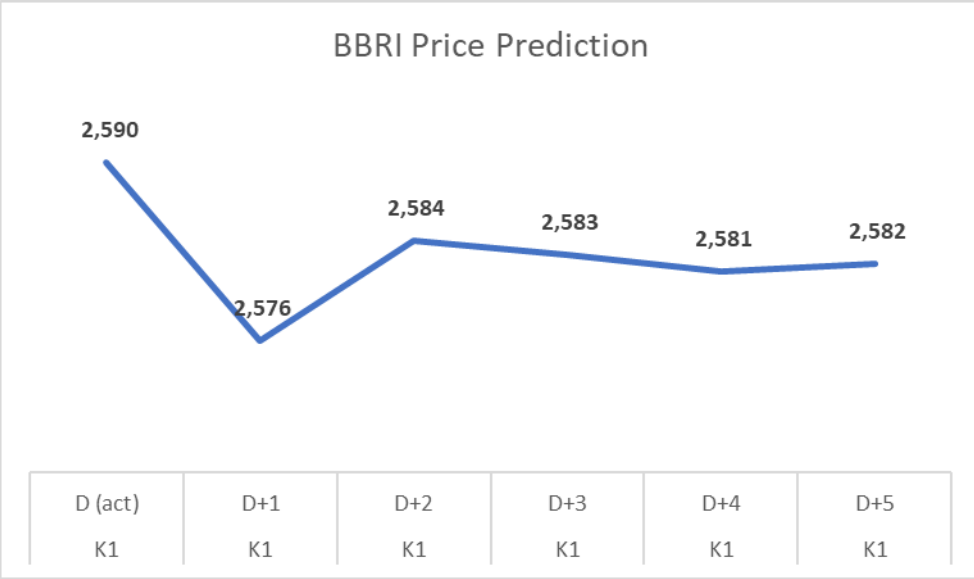
| Prob | Regime 1 | Regime 2 |
|---|---|---|
| **Regime 1** | 84% | 16% |
| **Regime 2** | 10% | 90% |

Based on the output above, it can be said that BBRI price movement is more fluctuates compare to BBCA, since even though BBRI has lesser regime than BBCA, but the average run length of BBRI is faster than BBCA, which means BBRI price trend is tend to change more often than BBCA.
Therefore BBCA should be safer place to invest for long term since the fluctuation is minimum, and the risk also minimum.

# 1 week ahead price prediction




The last data of BBCA price is in regime 1.
Regime 1 average run length is only 2 days, therefor, the 3rd day prediction, the regime is switched to regime 2, the biggest probability to switch after regime 1.




The last data of BBRI price is in regime 1.
Regime 1 average run length is only 6 days, therefore the forecast for the next 1 week is keep using regime 1 coefficient.