


Causal Influence between the JSX Composite Index and the FTSE Straits Times Index in Time Series

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Information Articles	Abstract
<p>Article history: Received October 9, 2022 Revised October 26, 2022 Accepted December 22, 2022 Available online December 30, 2022</p> <p>Keywords: JCI; JSX Composite Index; FTSE Straits Times Index.</p> <p>JEL Classification: R53; G12</p> <p>Copyright (c) 2022 Susila This is an open-access article under the CC - BY NC SA license</p> 	<p><i>This research analyzes the causal influence between the JSX Composite Index and the FTSE Straits Times Index. The data used in this study is a monthly period time series data. The period for the JCI to be observed is January 2015 to June 2022. The VAR method was used to analyze the causal influence of the two indices. The analysis results show that the appropriate VAR model is VAR (1,4,5), RMSE value of 212.15 for the JSX Composite Index and 123.76 for the FTSE Straits Times Index. Based on the analysis results using the VAR model, information is obtained that the two indices influence each other. The value of the JSX Composite Index formed in the current period is controlled by the value of the JSX Composite Index and the FTSE Straits Times Index in the previous period. Likewise, for the FTSE Straits Times Index, the results show that the value of the FTSE Straits Times Index formed in the current period is influenced by the value of the JSX Composite Index and the FTSE Straits Times Index in the previous period.</i></p>

INTRODUCTION

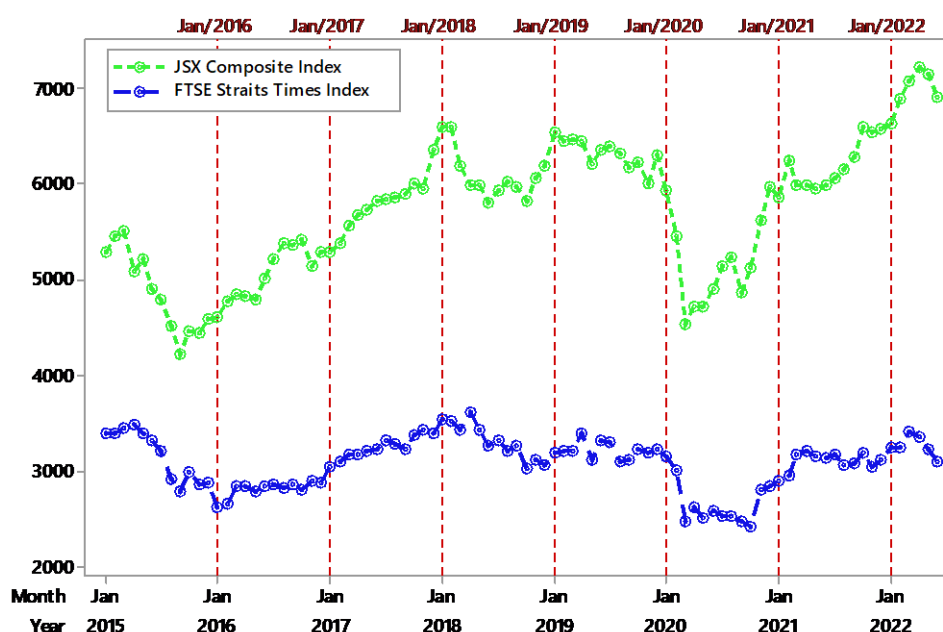
The Composite Stock Price Index (IHSG) is an index that is used as a benchmark for the performance of stocks on the stock market in a country. JCI can be used as an indicator that can be used to determine the development of a country's economy; running a government takes several funds that are used to carry out economic activities in the country. One source of funds that the government can use is taxes. Tax sources can come from individual and corporate taxes (Dewi et al., 2020) . The size of the tax revenue depends on the ongoing economic activity. Suppose a country's economy is categorized as good. In that case, it will be followed by an increase in tax revenue to boost a country's economic growth, and a certain amount of capital is needed (Naseriman et al., 2022) . The stock market is a source of funds that can be used as capital. The stock market's activity is the sale and purchase transaction of share ownership in a company. The stock price index movement can be seen based on the JCI movement.

Indonesia's JCI is listed under the JSX Composite Index in international trade. The combined index shows the size of the ups and downs of the stock index values in the Indonesian stock market. Many factors influence a country's fluctuation of the JCI ups and downs. One of the factors that influence the rise and fall of the JCI is macroeconomic conditions. Several macroeconomic factors can affect the rise and fall of the JCI figures, namely

inflation, the rupiah exchange rate, and interest rates (Banuarea et al., 2022) . Apart from macroeconomic factors, other factors that can affect the rise and fall of the JCI figures are the JCI from adjacent countries (Adnyana & Nurwulandari, 2022) . Geographically, the location of the territory of Indonesia is adjacent to the region of Singapore. Singapore has the highest per capita Gross Domestic Product (GDP) value in ASEAN, with a value of USD 72,794 as of December 2021. Singapore's economic conditions can affect the economies of neighboring countries, including Indonesia. The economies of Indonesia and Singapore are mutually correlated and influential (Wijaya, 2021) .

The economic linkages between Indonesia and Singapore impact the JCI of the two countries. Singapore's JCI is listed under the FTSE Straits Times Index symbol in international trade. The current phenomenon is that fluctuations in the JSX Composite Index and the FTSE Straits Times Index have almost the same pattern.

Figure 1. Time Series Plot JSX Composite Index and FTSE Straits Times Index



Source : www.marketwacth.com , 20 22

Figure 1 shows the time series plot of the JSX Composite Index and the FTSE Straits Times Index for January 2015 to June 2022. The patterns formed from the JSX Composite Index and the FTSE Straits Times Index throughout that period have the same characteristics. At the beginning of 2020, there was a sharp decline in both indices due to the COVID-19 outbreak during that period. Investors were afraid of the impact of the COVID-19 epidemic, so many investors withdrew their funds. The JSX Composite Index has been corrected by 28.27 % since the beginning of 2020, and the FTSE Straits Times Index has been updated by 18.95%. In mid-2020, both index prices began to creep up again. At that moment, investors started to believe

that companies that take the floor on the stock market could grow and provide returns for investors. The responses from the two indices to the events were almost the same.

Several studies examine the relationship between the JCI, namely [Utama & Artini \(2015\)](#). In their research, they analyzed the influence of the JCI from several countries on the JSX Composite Index. One of the IHSGs of several countries used as an indicator is the FTSE Straits Times Index. The results of their research show that the FTSE Straits Times Index has a significant effect on the JSX Composite Index. Other studies analyze the impact of the JSX Composite Index on the FTSE Straits Times Index, namely [Nugroho & Nofrian \(2022\)](#). Their research examines Indonesia's macroeconomic influence on the FTSE Straits Times Index. One of Indonesia's macroeconomic indicators used is the JSX Composite Index. Their research found that the JSX Composite Index affected the FTSE Straits Times Index. Previous studies show that the FTSE Straits Times Index and the JSX Composite Index are mutually influential.

The weakness of the previous research is that it has not analyzed the relationship or causal influence of the two IHSGs. Previous studies used multiple linear regression analysis methods. This method cannot answer the causal relationship between the two indices. The subsequent weakness of prior research is that it only examines whether it has an effect; it has not yet analyzed its connection to a time series. The value of the JCI influences the current ups and downs of the JCI in previous periods ([Rismawati & Sugiman, 2022](#)). JSX data is recorded in an orderly manner by the stock exchange, so from this data, the linkage of the time series of the JSX Composite Index with the FTSE Straits Times Index can be seen.

Based on this background, this study aims to analyze the causal influence between the JSX Composite Index and the FTSE Straits Times Index. The economic linkages of Indonesia and Singapore are interdependently caused by the geographical locations of the two countries being close to each other; this will lead to a causal relationship from the JCI of the two countries. The size of the last index value can influence the JCI linkage. So this study also aims to analyze the multivariate time series of the two IHSGs. The Vector Autoregressive (VAR) analysis method was used to answer the objectives of this study. VAR is a method that can answer the causal relationship of several time series data ([Handayani et al., 2022](#)).

RESEARCH METHODS

The data is secondary data sourced from the MarketWatch web, www.marketwacth.com. The data used is monthly time series data from the JSX Composite Index and the FTSE Straits Times Index. The period used in this study is January 2015 to June 2022. *This study's* JSX Composite Index is denoted by $y_{1,t}$, and $y_{2,t}$, represents the FTSE Straits Times Index. The VAR method is used to analyze the two series' causal influence. VAR is a generalization of the univariate *Autoregressive* (AR) model. The general model for VAR(p) is as follows ([Hardani et al., 2017](#)):

$$\dot{y}_t = \Phi_1 \dot{y}_{t-1} + \dots + \Phi_p \dot{y}_{t-p} + e_t$$

$$\begin{aligned} \dot{y}_t &= \sum_{i=1}^p \Phi_i \dot{y}_{t-i} + \mathbf{e}_t \\ \Phi(B)\dot{y}_t &= \mathbf{e}_t, \end{aligned} \tag{1}$$

where \dot{y}_t is a vector of size $m \times 1$ of the variable at the t time, Φ_p is a matrix of size $m \times m$ of the path parameter, B is the backshift operator, and \mathbf{e}_t is a vector of size $m \times 1$ of the error at the t -th time. The stages of VAR analysis are conducting data stationarity tests, guessing the order model using the Sample Correlation Matrix Function (MACF), parameter estimation, and carrying out parameter significance tests using the t-test (Susila et al., 2022). Conducting error normality tests using the Shapiro-Wilk test (Tongkeles et al., 2022), conducted a white noise test, and saw the model's goodness using the Root Mean Square Error (RMSE). Based on the model obtained, the causal influence of the two-time series data can be analyzed to facilitate the interpretation of the causal relationship between the two series. It is easier to establish a model for each series in advance.

RESULTS AND DISCUSSION

Pearson Correlation Test

Pearson correlation is used to determine the relationship between the JSX Composite Index and the FTSE Straits Times Index. This test is an initial indication of the relationship between the two indices.

Table 1. Data Correlation of JSX Composite Index and FTSE Straits Times Index

Variable	Correlation coefficient	P-Value
JSX Composite Index - FTSE Straits Times Index	0.62	0.00

The correlation coefficient in Table 1 is 0.62, with a p-value of 0.00. The number 0.62 shows a strong positive relationship (Saputra et al., 2017) between the two indices, and a p-value of 0.00 indicates that the two indices have a significant relationship.

Data Stationarity Test

1. Test for Stationarity of Data in Variance

Data can be categorized as fulfilling the stationary variance if the rounded value is 1. Table 2 is the result of testing the data stationarity in conflict.

Table 2. Box-Cox Test Results

Variable	Rounded Value	Transformation
JSX Composite Index	2	X ²
FTSE Straits Times Index	2	X ²

The results of the Box-Cox test showed that the rounded values of the JSX Composite Index and the FTSE Straits Times Index did not meet the

stationarity conditions in variance. So for the JSX Composite Index and FTSE Straits Times Index data in the process of VAR analysis changed in the form X^2 .

2. Test the Stationarity of the Data in the Mean

Apart from fulfilling stationarity in the variance, the data must satisfy the stationarity conditions in the mean. The data is said to be stationary in the standard if the values of Prob<Rho and Prob<Tau are less than 0.05.

Table 3. Dicky-Fuller test of research data without differentiation

Variable	Type	Rho	Prob<Rho	Tau	Prob<Tau
JSX Composite Index	Zero Mean	0,25	0,74	0,31	0,77
	Single Mean	-4,95	0,43	-1,33	0,61
	Trend	-10,69	0,37	-2,25	0,45
FTSE Straits Times Index	Zero Mean	-0,43	0,58	-0,64	0,44
	Single Mean	-9,18	0,15	-2,21	0,20
	Trends	-9.03	0.48	-2.17	0.50

It can be seen in Table 3 the Prob<Rho and Prob<Tau values are more than 0.05. So it can be concluded that the index data does not meet the stationary conditions in the mean. To overcome this condition, differencing one is carried out for both data.

Vector Autoregressive Analysis (VAR)

The inference method used in this study is VAR. The VAR method can capture the phenomenon of influence between the two indices in a time series.

1. VAR Model Indication

The determination of the VAR order in this study used the MPACF. Figure 2 is the MPACF of the data of the two indexes. Based on Figure 2, an initial indication was obtained that the order of the VAR model formed was VAR (1,4,5). It should be remembered that the data used in the model indication stage has differed 1.

Figure 2. MPACF from JSX Composite Index and FTSE Straits Times Index data

Variable/ Lag	1	2	3	4	5	6	7	8	9	10	11	12
y1t	-
y2t	+-	+

Based on the results of the MPACF. Initial indications are that the value of the JSX Composite Index, in the current period is influenced by the value of the FTSE Straits Times Index in the previous five periods; This can be seen from the minus sign (-), which shows the influence of the FTSE Straits Times Index series on the JSX Composite Index. For early indications, the value of the FTSE Straits Times Index is influenced by the value of the FTSE Straits Times Index and the JSX Composite Index in the previous period. The value of the JSX Composite Index for the last four periods affects the current value

of the FTSE Straits Times Index. You can see that the FTSE Straits Times Index has a plus sign (+) which shows the influence of the JSX Composite Index series on the FTSE Straits Times Index. Influence analysis using the MPACF is still not detailed because it has not seen the effect of differencing one and the magnitude of the causal influence of each JCI index.

2. VAR Parameter Estimation and t-Test

Table 4 is the result of parameter estimation from the VAR model and the test results. Based on the indicated results of the VAR model using MPACF, it was found that the VAR model formed was VAR (1,4,5). Lag can be said to have a significant effect if the p-value from the t-test results shows less than 0.05 (Susila, 2020). Not all lags from the VAR model have a substantial impact, with an alpha level of 0.05. Therefore, a restriction process that is not significant is carried out.

Table 4. Parameter Estimation Results and Test t

Variable	3rd lag variable	Estimation	Std Error	T Ratio	P-Value
$y_{1,t}$	$y_{1,(t-1)}$	-	-	-	-
	$y_{2,(t-1)}$	-	-	-	-
	$y_{1,(t-4)}$	-	-	-	-
	$y_{2,(t-4)}$	-	-	-	-
	$y_{1,(t-5)}$	-	-	-	-
	$y_{2,(t-5)}$	-0,67	0,28	-2,39	0,02
$y_{2,t}$	$y_{1,(t-1)}$	0,08	0,03	2,48	0,01
	$y_{2,(t-1)}$	-0,35	0,10	-3,38	0,00
	$y_{1,(t-4)}$	0,07	0,03	2,50	0,01
	$y_{2,(t-4)}$	-	-	-	-
	$y_{1,(t-5)}$	-	-	-	-
	$y_{2,(t-5)}$	-	-	-	-

It can be seen in Table 4 the t-th lag affects the current period index value. The JSX Composite Index and the FTSE Straits Times Index have a causal influence on each other. The JSX Composite Index influences the FTSE Straits Times Index and vice versa; the FTSE Straits Times Index influences the JSX Composite Index. The magnitude of the causal influence of each variable can be seen more clearly if the mathematical model has been written.

3. VAR Assumption Check

Two assumptions must be met in the VAR model: the error must have a multivariate normal distribution and must meet white noise conditions. For the normal multivariate test, the Shapiro-Wilk test was used. Based on the Shapiro-Wilk test results, the test statistic value was 0.98, and the p-value was 0.15. The p-value obtained is more significant than 0.05, so it can be concluded that the errors have a multivariate normal distribution (Susila & Pradhani, 2022).

This study uses the minimum lag AR and MA criteria from the error for the white noise test. The error is said to meet the white noise condition if the

minimum value of the AR and MA lags lies at lag 0 (Gusnadi et al., 2015) (Susila, 2022). Table 5 shows the VAR model's minimum AR and MA error values (1,4,5). Based on Table 5, it can be seen that the smallest value presented is 55.92. This number lies in AR(0) and MA(0), so it can be concluded that the error meets the white noise condition.

Table 5. Minimum Value Criteria AR and MA

lag	MA(0)	MA(1)	MA(0)	MA(1)	MA(0)	MA(1)
AR(0)	55,92	56,09	56,12	56,16	56,24	56,35
AR(1)	55,99	56,16	56,19	56,25	56,31	56,37
AR(0)	56,06	56,20	56,28	56,35	56,42	56,51
AR(1)	56,09	56,24	56,33	56,44	56,53	56,60
AR(0)	56,16	56,28	56,39	56,49	56,63	56,72
AR(1)	56,30	56,39	56,51	56,62	56,70	56,81

The results of testing the assumptions of the formed VAR model (1,4,5) found that the model met the required assumptions so that the VAR model (1,4,5) is feasible to use to analyze the causal effects JSX Composite Index with FTSE Straits Times Index.

4. VAR models

The VAR models that are suitable for the JSX Composite Index and the FTSE Straits Times Index are as follows:

$$\left(\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 0 & 0 \\ 0,08 & -0,35 \end{bmatrix} B - \begin{bmatrix} 0 & 0 \\ 0,07 & 0 \end{bmatrix} B^4 - \begin{bmatrix} 0 & -0,67 \\ 0 & 0 \end{bmatrix} B^5 \right) x \begin{bmatrix} (1-B)y_{1,t}^* \\ (1-B)y_{2,t}^* \end{bmatrix} = \begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix}, (2)$$

with,

$$y_{1,t}^* = y_{1,t}^2 \text{ and } y_{2,t}^* = y_{2,t}^2.$$

The equation is formed based on the parameter estimation results and the t-test results in Table 4.

5. Model Kindness

Root Mean Square Error (RMSE) indicates the model's goodness.

Table 6. RMSE value

Kindness Criteria	$y_{1,t}$	$y_{2,t}$
RMSE	212.15	123.76

The RMSE value for each series is presented in Table 6. The RMSE value for the JSX Composite Index is 212.15, and the RMSE value for the FTSE Straits Times Index is 123.76.

Influence of Qualified JSX Composite Index with FTSE Straits Times Index

Based on the test results, it was found that the FTSE Straits Times Index and JSX Composite had a causal influence. It can be seen in the results of the t-test that the FTSE Straits Times Index has a significant effect on the JSX Composite. The results obtained in this study support the results of Utama & Artini (2015) research, which suggests that the size of the FTSE Straits Times

Index value can affect the value of the JSX Composite. Therefore, investors must pay attention to the movement of the FTSE Straits Times Index if they wish to invest their capital in stocks traded on the Indonesian stock market.

The results of the t-test also show that the JSX Composite Index significantly affects the FTSE Straits Times Index. The results obtained in this study support the results of research from [Nugroho & Nofrian \(2022\)](#) . Their research showed that the value of the JSX Composite Index influenced the size of the FTSE Straits Times Index. The results of this study are expected to be a consideration for investors who wish to invest their capital in stocks on the Singapore stock market. Investors should pay attention to the movement of the JSX Composite Index.

This study also shows that the current JCI is influenced by the JCI of previous periods. It can be seen that the results of the t-test show that the lag of the last JCI has a significant influence on the size of the current JCI value. The results of this study support the results of research from [Rismawati & Sugiman \(2022\)](#) . Apart from paying attention to the causal influence of the FTSE Straits Times Index and the JSX Composite Index, investors must pay attention to the size of the previous value of the index. The size of the last index can be used to predict the value of the JCI in the future.

For a more in-depth discussion of the causal influence of the JSX Composite Index and the FTSE Straits Times Index in the time series obtained in this study, it can be explained by equations (3) and (4). Mathematical equation (2) can be further clarified in the mathematical equation for each JCI index shown by equations (3) and (4). The mathematical equation for the JSX Composite Index is presented in equation (3) as follows:

$$y_{1,t}^* = y_{1,t-1}^* - 0,67y_{2,t-5}^* + 0,67y_{2,t-6}^* + e_{1,t} \dots\dots\dots(3)$$

can be obtained from the JSX Composite Index equation, namely, the price index formed for the current period is influenced by the value of the previous month's JSX Composite Index, the value of the FTSE Straits Times Index for the previous five months, and the value for the FTSE Straits Times Index for the previous six months. The value of the FTSE Straits Times Index for the previous five months will reduce the value of the JSX Composite Index formed for the current period. The value of the FTSE Straits Times Index for the previous six months will add to the JSX Composite Index formed for the current period. Investors who invest in shares on the Indonesian stock exchange must pay attention to the movement in the value of the FTSE Straits Times Index 5 and 6 in the previous months. The previous month's JSX Composite Index value will have the greatest influence on the current period's JSX Composite Index value.

The mathematical equation for the FTSE Straits Times Index is presented in equation (4) as follows:

$$y_{2,t}^* = 0,65y_{2,t-1}^* + 0,08y_{1,t-1}^* - 0,08y_{1,t-2}^* + 0,35y_{2,t-2}^* + 0,07y_{1,t-4}^* - 0,07y_{1,t-5}^* + e_{1,t} \dots\dots\dots(4)$$

Information is obtained from the FTSE Straits Times Index equation; the price index formed for the current period is influenced by the previous

month's FTSE Straits Times Index value, the last month's FTSE Straits Times Index value, the previous month's JSX Composite Index value, the last month's JSX Composite Index value, the value of the JSX Composite Index for the last four months, and the value for the JSX Composite Index for the previous five months. The value of the FTSE Straits Times Index and JSX Composite Index in the last month will add to the value of the FTSE Straits Times Index formed in the current period. The weight of the FTSE Straits Times Index for the previous two months will reduce the value of the FTSE Straits Times Index included for the current period. Conversely, the value of the JSX Composite Index for the previous two months will increase the value of the FTSE Straits Times Index formed in the current period. The value of the JSX Composite Index for the last four months will add to the FTSE Straits Times Index included for the current period. The value of the JSX Composite Index for the previous five months will reduce the value of the FTSE Straits Times Index formed in the current period. The last month's FTSE Straits Times Index value will influence the current period's FTSE Straits Times Index value. The causal relationship between the two JCI can be a consideration for investors who invest in shares on the Singapore Stock Exchange.

CONCLUSION

Based on the analysis results, information is obtained that the JSX Composite Index and the FTSE Straits Times Index correlate and are interrelated. The inferential analysis results show a causal influence between the JSX Composite Index and the FTSE Straits Times Index. The value of the JSX Composite Index formed for the current period is influenced by the value of the previous month's JSX Composite Index, the value of the FTSE Straits Times Index for the last five months, and the value of the FTSE Straits Times Index for the previous six months. The FTSE Straits Times Index value formed in the current period is influenced by the previous month's FTSE Straits Times Index value, the last two month's FTSE Straits Times Index value, the previous month's JSX Composite Index value, the last two month's JSX Composite Index value, the previous four month's JSX Composite Index value, and the value of the last five months JSX Composite Index. In general, the results of this study prove that the JCI of a country will mutually influence the JCI of other countries close to it.

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