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Exploring the nexus between sectoral stock market fluctuations and macroeconomics changes before and during the COVID-19 pandemic

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ABSTRACT

Investors may find it challenging to invest due to economic fluctuations during COVID-19. This study aims to examine the relationship between economic fluctuations and the Indonesian sectoral stock market in the consumer goods sector (CGI), basic industrial and chemical sector (BIC), and miscellaneous industry (MSI), both before and during the COVID-19 pandemic in Indonesia. The monthly time-series data used in the empirical approach cover the period from January 2008 to December 2020. The analysis used forecast error variance decomposition, vector autoregression, impulse response function analysis, and causality investigation. The econometric results showed that previous period shocks in each industrial sector stock market had a disadvantageous effect on future stock market earnings. Additionally, while the CGI stock market positively affects the Rupiah exchange rate, the MSI industrial sector is negatively impacted by inflationary pressures. Also connected to the MSI stock market are fluctuations in inflation. Conversely, the exchange rate affects MSI and CGI. Furthermore, for the CGI and BIC stock markets, a one-way causation relationship is observed. Another notable result was that all three industrial sectors responded positively when inflation and exchange rates were disrupted. It implies that, for convenience, investors will seek out other areas of the stock market. Therefore, a quick government response is needed to handle the economy during economic fluctuations accompanied by the COVID-19 pandemic so that it does not have an impact on the future.

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1. Introduction

Investment activities are the backbone of developing economies worldwide. According to conventional thinking, investing now promotes future economic growth (Sawulski et al., 2023). The number of investment activities reflects the state of the global economy between countries. The world's macroeconomic fluctuations can be influenced by a global shock (Fitriana et al., 2023a). COVID-19 is one such pandemic that has impacted global macroeconomics (Fitriana et al., 2023b; McKibbin & Fernando, 2021). The sectoral economy is one of the concerns for investment activities (Defrizal et al., 2021). Indonesia's stock market is significant for investment as it operates with an open economic system (Muna & Khaddafi, 2022). The market comprises nine sectoral stock indices, each with different industrial trade index value based on the stock market capitalisation. The main topic of this study is the performance of Indonesia's sectoral stock indices during the COVID-19 pandemic and the crisis.

There are 35 indices on the Indonesian stock market, as per the BPS report of 2019. One of these is the sectoral index, which is divided into 9 important sectors in Indonesia. The industrial trade value of

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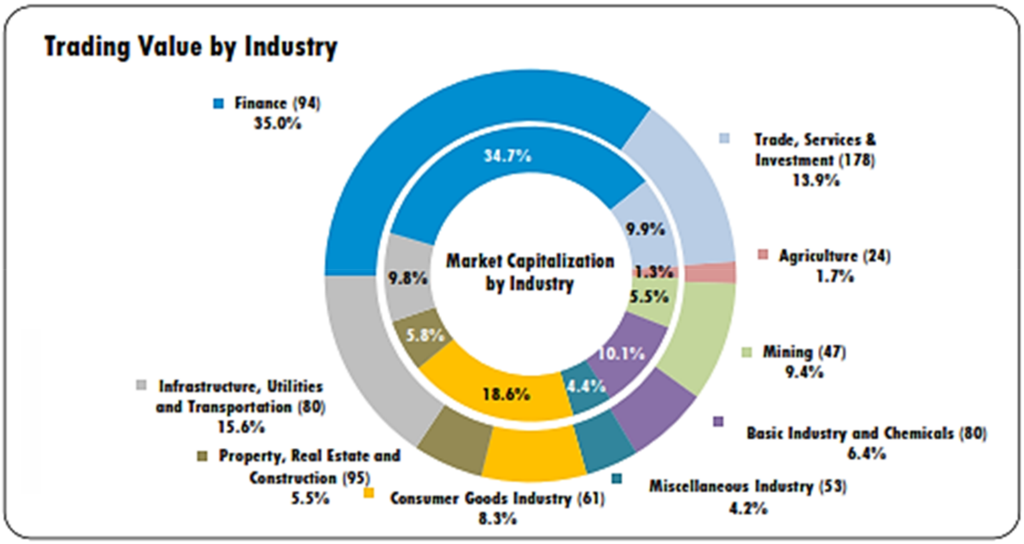

Figure 1. The value of industrial trade in 9 sectors in 2019.

each sector in the stock market is shown in Figure 1, which indicates that every sector has a different industrial trade value. The financial sector had the highest industrial trade value at 35%, with an industrial market capitalisation of 34%. On the other hand, the various industry sectors had the lowest industrial trade value at 4.2%, with an industrial market capitalisation of 4.4%. The infrastructure, utilities, and transportation sectors had an industrial trade value of 15.6%, the trade, service, and investment sector of 13.9%, the mining sector of 9.4%, the consumer goods industry of 8.3%, Basic and Chemical Industries by 6.4%, and the property, real estate, and construction sectors by 5.5%. The difference in trading value is related to the number of shares that investors are interested in the primary and secondary markets and the associated risks.

During a certain period, the stock market in different sectors showed fluctuations. Figure 1 indicated that the agriculture sector index was dominating, which is very reasonable since Indonesia is primarily an agricultural country. On the other hand, the property sector index had the lowest rank. It shows that as a developing country, Indonesia is still prioritising investment in the real sector rather than the luxury sector. Inflation is one of the indicators that measure the changes in prices of a particular group of commodities continuously over a certain period. The fluctuations in inflation can significantly impact the real sector. In cases of hyperinflation, community purchasing power is affected, which ultimately impacts the aggregate demand and supply, leading to market equilibrium.

The speed at which inflation reaches its equilibrium level is called persistence. The empirical results show that the pressure for inflationary sources comes from food commodities and housing, water, electricity, gas, and fuel commodities. Inflation in food consumption can significantly affect food security (Suriani & Sartiyah, 2020). Bilici and Çekin (2020) demonstrates a notable rise in inflation persistence, highlighting the efficacy of monetary policy in ensuring price stability. Analysis of Indonesia's inflation rate indicates a consistent decline since early 2020.

The events that transpired between July 2020 and October 2020 revealed real-life conditions that deviated from existing theories (Suriani & Ridzqi, 2019). It was observed that a decrease in prices led to an increase in aggregate demand due to the higher purchasing power of the people, resulting in a rise in national output (gross domestic product). However, despite this observation, official data released by the Indonesian Central Bureau of Statistics on November 5, 2020 confirmed that Indonesia had entered a recession in the third quarter of 2020 with negative economic growth contracted at -3.49% (YoY). Sembiring-Kembaren (2020) also explained that the second contraction in the economic growth trend occurred after the second quarter of -5.32%.

The data in Figures 2 and 3 shows that the growth trend in the inflation rate decreases until October 2020, and GDP growth also has a downward trend to negative. This condition can occur because of the COVID-19 pandemic at the end of 2019 (Alam et al., 2021). Its spread has spread globally in early 2020

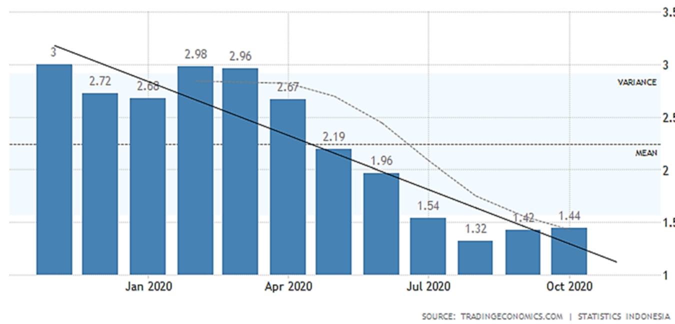

Figure 2. Inflation rate trends in Indonesia for November 2019 to October 2020.

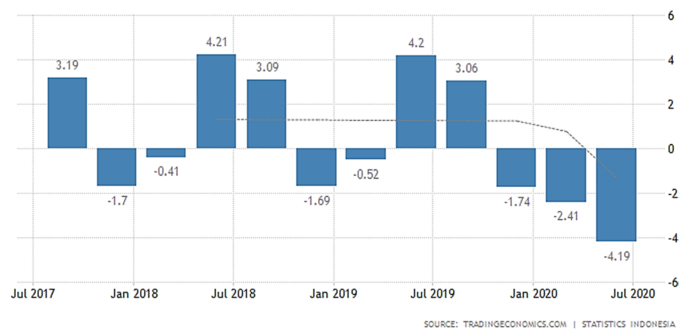

Figure 3. GDP growth rate trend from July 2017 to July 2020.

and has an impact on sectoral stock market returns (Alomari et al., 2022). If macroeconomic activity is disrupted, the economy will not be stable. It may have an effect on all macroeconomic variables, particularly the exchange rate, which is closely related to investment activities of stock prices (Alam & Uddin, 2009).

Research on the sectoral stock market focuses on the connections between the market and economic growth (Hismendi et al., 2021), policy uncertainty and the market (Si et al., 2021), the market and pandemics (Adekoya et al., 2022; Alomari et al., 2022), herding behaviour (Viona et al., 2023) and the market for stocks in the global health sector (Ye & Geng, 2021). During the pandemic, there have been significant changes in the country’s economy. The industrial sector related to essential public needs is particularly noteworthy and presents an opportunity for entrepreneurs to generate profits, contributing to economic development (Kritikos, 2014). Surviving in crisis situations like the ongoing pandemic poses a challenge for companies operating in the consumption, basic, and miscellaneous industries. This study focuses on investment activities within these sectors’ stock markets and their ability to meet domestic community needs amid crises such as COVID-19. Though not dominating the market, this research explores whether these three sectors can withstand the challenges posed by crisis events and the current pandemic situation.

In today’s global economy, the competition in the investment market is higher than ever. The value of the stock market and the capital market is of significant concern to investors. Therefore, it is crucial to pay attention to government policies that support economic development in various sectors. Before investing, it is also essential to consider the macroeconomic conditions of a country. If the macroeconomy is stable and favourable, it means that the development activities in that country are suitable, which leads to economic growth. On the other hand, if macroeconomic conditions are unstable, a country’s economy gets disturbed. Inflation is one of the macroeconomic variables that policymakers consider. According to a survey on inflation uncertainty by Breach et al. (2020), inflation risk is significant for nominal Treasury yields. It was demonstrated that during the 1980s, the decomposition of goods was caused by varying inflation and accurate risk premiums, which were significant and positive. However, after 2008, they became small and negative.

The inflation rate refers to the percentage change in prices over a given period, usually a month or a year. This percentage shows how fast prices have increased during that time. Inflation measures the price changes that happen repeatedly over time for a group of goods. Inflationary changes can have a negative impact on the real economy. In case of hyperinflation, it can significantly affect the purchasing power of the community as a whole. It affects the aggregate demand and ultimately affects the aggregate supply to achieve market equilibrium. The speed at which inflation moves towards its equilibrium level is referred to as its persistence.

The previous discussion about sectoral stock markets and stock market reaction has been carried out by several researchers, such as Hismendi et al. (2021), Defrizal et al. (2021), Nguyen and Pham (2018), and Ng et al. (2017). Also, discussion about stock market liberalisation for technological innovation (Alavi et al., 2016) and the macroeconomic effect variables on the stock market (Hsing, 2011) have been carried out. Previously, studies analysed the relationship between the stock market index and economic fluctuations. However, this study aims to examine the relationship between Indonesia's sectoral stock indexes and economic fluctuations during shocks. The study will focus on the response time and composition of shocks between the variables. Specifically, this research will analyse three sectoral stock indexes - Basic Industry & Chemicals (BIC), Miscellaneous Industry (MSI), and Consumer Goods Industry (CGI), which have not been studied before.

The expected contribution of this research is to determine the resilience of these three industry sectors during a shock. This information will help these industries continue to meet the needs of the Indonesian people, even during frequent economic fluctuations, crises, and pandemics such as COVID-19. This research will also help investors understand the resilience of the sectoral stock market and make more profitable investments.

To support the research findings, the study will analyse the causality between the studied variables, focusing on the rapid response to shocks in inflation and the exchange rate. The causality test will help establish a causal relationship between the variables. The content stages of this study will begin by discussing the urgency of this research, followed by a literature review and analytical methods, the results of the study, and a concrete analysis. Finally, the study will conclude with a summary of the key findings.

2. Literature review

Institutional investment activities frequently impact financial markets and actual economic activity (Bond et al., 2012; Naik et al., 2021; Nofsinger, 2005; Woolridge & Snow, 1990). Debt instruments, commercial securities, shares, bonds, proof of debt, CIUs, SFCs, and other derivatives of securities are all considered to be securities. The stock market, however, still constitutes a portion of the capital market. It is possible to trade shares of publicly traded companies on a stock market. By offering shares to the public in an initial public offering, businesses can raise capital on the primary market (IPO). The primary market is the section of the capital market where issuers directly issue and offer equity-backed securities for sale to investors. Securities that have never been traded are bought by investors. Only stock transactions and derivatives are conducted on the stock exchange. An efficient market is one in which information spreads quickly and is reflected in stock prices, also known as market rationality (Yalçın, 2010).

The Indonesia Stock Exchange currently has 35 stock indices. The stock index is a statistic that is evaluated on a regular basis and represents the overall price movement of a selection of stocks made using particular criteria and methodology. The goals and benefits of the stock index include measuring market sentiment, creating passive investment products like Index Funds and Index ETFs as well as derivative products, acting as benchmarks for active portfolios, serving as proxies for asset classes in asset allocation, measuring and modelling returns on investment (return), systematic risk, and risk-adjusted-performance.

Macroeconomic factors and stock market factors are closely related to each other. How much influence does the macroeconomy have on the stock market? In 2017, Milani conducted a study using a New-Keynesian general equilibrium model to analyse the quantitative effects of interactions between the stock market, macroeconomic factors, and monetary policy. The model includes a wealth effect resulting from changes in asset prices that affect consumption. The research refutes the rational expectations hypothesis and suggests that economic agents develop nearly rational expectations over time based on their observed economic model.

Airaudo (2013) analysed a New-Keynesian DSGE model that included limited asset market participation (LAMP) to determine if monetary policy should respond to stock prices, in terms of the determinacy and learnability of the Rational Expectations Equilibrium (E-stability) (REE). They found that when the degree of

LAMP is high enough to create an inverted aggregate demand channel for the transmission of monetary policy, interest rate regulation that allows a positive reaction to stock prices facilitates both the determinacy and the E-stability of the basic REE. This implies that policy rules based on stock prices perform better than traditional rules based on output in terms of equilibrium determinacy and overall welfare.

Bjørnland and Leitemo (2009) used structural vector autoregressive (VAR) methods to measure the dependence on US monetary policy. They resolved the simultaneity problem of detecting economic and stock price shocks by using a combination of short-run and long-run limits while maintaining the qualitative traits of a monetary policy shock as described in the literature. They found a significant correlation between interest rate policy and absolute stock values due to a change in monetary policy that accurately predicted the federal funds rate by 100 basis points. The interest rate rises by almost four basis points for every percentage point that actual stock prices rise.

Lawal et al. (2018) conducted a study to analyse the impact of interactions between monetary and fiscal policies on the behaviour of the Nigerian stock market. The study also looked at the effect of policy interaction volatility on the stock market. The findings revealed that the interaction of monetary and fiscal policy has a significant impact on Nigeria's stock market returns, using the ARDL and EGARCH models. The study identified five potential ways that monetary policy could influence stock market returns, which are the interest rate hypothesis, the credit hypothesis, the wealth effect hypothesis, the exchange rate hypothesis, and the monetary hypothesis.

Hsing (2011) carried out research to explore the impact of various economic factors on the South African stock market index. The study found that the money supply to gross domestic product ratio, the real GDP growth rate, and the US stock market index have a positive effect on the stock market index. However, the government deficit to GDP ratio, domestic real interest rates, and the effective exchange rate are considered negative factors in the Exponential GARCH Model. Therefore, the government is required to maintain economic expansion, fiscal responsibility, a high money supply ratio to GDP, low accurate interest rates, and low inflation rates to keep the stock market stable. Rahmayani and Oktavilia (2021) stated that the long-term lull in Indonesia's stock market is due to the higher cumulative total COVID-19 cases. Ahmad et al. (2021) found that stocks in consumer staples, healthcare, telecommunications, utilities, and financials attracted the most attention during the COVID-19 pandemic, and different industries in the sample countries reacted to the outbreak differently.

Regression analysis was used by Vithessonthi and Techarongrojwong (2012) to look at how monetary policy impacts stock prices. The expected shift in the buyback rate has a negative effect on stock returns at the market level. Contrarily, the findings reveal that the unanticipated change in the repurchase rate has no impact on stock returns. However, it is possible to observe at the firm level how the unexpected shift in the repurchase rate has impacted stock returns. The researchers also discovered that there was an asymmetry in the stock market's reaction to a change in the repurchase rate. Even though it is considered good news, an unexpected change in the buyback rate has a negative effect on stock returns. Together, the evidence supports the notion that monetary policy announcements have a significant impact on stock prices and advances the question of whether the credibility of the monetary authority influences the stock market's reaction to monetary policy actions.

This study focuses on analysing the stock market response to economic fluctuations caused by inflation and changes in exchange rates, specifically for the consumption industry, basic industry, and miscellaneous industry during the pandemic. The study will test and analyse causality to explain the relationship between sectoral stock market conditions and monetary policy to control inflation and exchange rates. The findings of this research can contribute to the enrichment of knowledge in the field of investment when shocks occur. The consumption industry, basic industry, and miscellaneous industry are essential for meeting the basic needs of the community, such as food and clothing. This shows the strength and resilience of the sectoral stock market as an alternative to government policies to maintain the economy in times of global shocks.

3. Materials and methods

The research methodology used in this study is quantitative in nature. The study is based on monthly data from January 2008 to December 2020 (158 data points) and focuses on sectoral stock variables, specifically the stock indices of the Basic, Industry & Chemicals, Consumer Goods, and Miscellaneous Industries sectors. These variables are used to measure the real sector economy using index units. The study focuses on the three stock sectors mentioned above as they are crucial in analysing activities related to public consumption needs. Consumption plays a significant role in determining the demand for goods and services in society (Suriani et al., 2021). Exchange rate and inflation variables are also used in the study to measure the change in the value of Rupiah currency relative to the dollar and the rate of price fluctuation, respectively.

The quantitative research methodology used in this study employs vector autoregression (VAR) modelling. The VAR Model is advantageous as it is a simple model that does not require distinguishing between endogenous and exogenous variables. Estimation is straightforward and can be applied to each equation individually using the OLS method. In most cases, the forecast results obtained through this method outperform those obtained through even the most complex simultaneous equation models. The study aims to explore the interrelationship (reciprocity) between economic variables and the formation of a structured economic model. Holtz-Eakin et al. (1988) formed the specific bivariate autoregression equation model (VAR) can be written as follows:

$$y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i y_{t-1} + \sum_{i=1}^{m} \alpha\delta_i x_{t-1} + \varepsilon_t, \quad (1)$$

If Equation (1) is transformed, the equation model for this study SS are devoted to three industrial sectors, namely BIC (Basic Industry & Chemicals), MSI (Miscellaneous Industry), and CGI (Consumer Goods Industry). The formula can be written as follows:

$$SS_t = \alpha_1 + \gamma_1 \sum SS_{t-i} + \gamma_2 \sum INF_{t-i} + \gamma_3 \sum ER_{t-i} + \varepsilon_t, \quad (2)$$

However, if the unit root test results show stationary data at the first difference and cointegrated, then the model chosen is the VECM model or called limited VAR. Change is indicated by Δ (the first difference vector). The results of the unit root test indicate that it is stationary at the first difference and has not cointegrated, so the best model is VAR at this point (see test results in Tables 1 and 3). So the best model in this research is VAR at I(1) model and can be written in the new equation formed as follows:

$$\Delta BIC_t = \alpha_1 + \gamma_1 \sum \Delta BIC_{t-i} + \gamma_2 \sum \Delta MSI_{t-i} + \gamma_3 \sum \Delta CGI_{t-i} + \gamma_4 \sum \Delta INF_{t-i} + \gamma_5 \sum \Delta ER_{t-i} + \varepsilon_t, \quad (3)$$

$$\Delta MSI_t = \alpha_1 + \gamma_1 \sum \Delta MSI_{t-i} + \gamma_2 \sum \Delta BIC_{t-i} + \gamma_3 \sum \Delta CGI_{t-i} + \gamma_4 \sum \Delta INF_{t-i} + \sum \Delta ER_{t-i} + \varepsilon_t, \quad (4)$$

$$\Delta CGI_t = \alpha_1 + \gamma_1 \sum \Delta CGI_{t-i} + \gamma_2 \sum \Delta BIC_{t-i} + \gamma_3 \sum \Delta MSI_{t-i} + \gamma_4 \sum \Delta INF_{t-i} + \gamma_5 \sum \Delta ER_{t-i} + \varepsilon_t, \quad (5)$$

$$\Delta INF_t = \alpha_1 + \gamma_1 \sum \Delta INF_{t-i} + \gamma_2 \sum \Delta BCI_{t-i} + \gamma_3 \sum \Delta MSI_{t-i} + \gamma_4 \sum \Delta CGI_{t-i} + \gamma_5 \sum \Delta ER_{t-i} + \varepsilon_t, \quad (6)$$

$$\Delta ER_t = \alpha_1 + \gamma_1 \sum \Delta ER_{t-i} + \gamma_2 \sum \Delta BCI_{t-i} + \gamma_3 \sum \Delta MSI_{t-i} + \gamma_4 \sum \Delta MSI_{t-i} + \gamma_5 \sum \Delta INF_{t-i} + \varepsilon_t, \quad (7)$$

Table 1. The unit root tests. Results.

Variables	ADF I(0)	ADF I(1)	PP I(0)	PP I (1)
BIC	−0.9132	−11.5121	−0.9132	−15.5106
	(0.7820)	0.0000)***	(0.3626)	(0.0000)***
CGI	−1.7733	−11.5121	−1.7718	−11.4822
	(0.3926)	(0.0000)***	(0.3933)	(0.0000)***
MSI	−1.8676	−10.9795	−1.8631	−10.8928
	(0.3469)	(0.0000)***	(0.3490)	(0.0000)***
INF	−2.4150	−7.7846	−2.0957	−8.0441
	(0.1393)	(0.0000)***	(0.2468)	(0.0000)***
ER	−1.0476	−12.2690	−0.9892	−12.2979
	(0.7353)	(0.0000)***	(0.7564)	(0.0000)***

Note: (.) is significant value and *** is level of significance (1%).

Table 2. The results of modulus value.

Root	Modulus
0.416079	0.416079
−0.261508	0.261508
−0.164015	0.164015
0.115371	0.115371
0.000901	0.000901

Note: No root lies outside the unit circle.

Table 3. The results of Johansen cointegration.

	T-Statistic		Critical value	
Null hypotheses	Trace	Max-Eigen	Trace	Max-Eigen
r = 0	54.3676	23.8731	60.0614	30.4396
r ≤ 1	30.4945	14.9149	40.1749	24.1592
r ≤ 2	15.5796	10.2033	24.2760	17.7973
r ≤ 3	5.3762	5.3762	12.3209	11.2248
r ≤ 4	2.69E-05	2.69E-05	4.1299	4.1299

For Equation (2), the variable SS is the dependent variable (sectoral shares). This research focuses on three equation models for dependent variables (BIC, MSI, CGI) for this sectoral stock. In addition, the error term is ε, and the variables t is period, and α are constants. The letters ER, IR, and INF stand for the exchange rate, interest rate, and inflation, respectively. The time-series analysis test stages for the VAR modelling will involve the data stationarity test, model stability test, best lag length test, cointegration test, and causality test. The upcoming tests are the Forecast Error Variance Decomposition Function and the Impulse Response Function. The Unit-Roots test for data stationarity employs the enhanced Dickey-Fuller and Phillips Perron techniques:

$$Y_t = \rho Y_{t-1} + \varepsilon_t \ -1 \leq \rho \leq 1, \tag{8}$$

The *εt* variable in Equation (6) represents the stochastic error term in the classical assumption, with the difference (variant) set to zero and *y* being the time-series. Additionally, if the value of at the first difference level is equal to 1, the data is considered non-stationary. Once the data is stationary, the stationary test is completed in the second difference test, which also serves as the continuation of the unit root test.

Then the model stability test is required in using time-series data. This test proves that the model is good, obtaining unbiased results. After testing the model stability condition (once the data is proven to be stationary), the data is tested again in the VAR system. We can see the stability test results in 2 (two) forms, namely in a modulus value table and a graph of the inverse roots of AR characteristic polynomial. The characteristics considered in the modulus value have a modulus value below 1. The model test is said to be stable, and if the modulus value is below 1, and if the modulus value is above 1, the model is to be unstable.

The characteristics of the inverse roots of the AR characteristic polynomial graph concerning the polynomial elements are shown from the circle's position. If the points are still in the circle, then the model is said to be stable. With the achievement of these characteristics, the model in the VAR system is categorised as stable so that the next test stage can be carried out, namely the determination of the optimal lag.

Since the lags of these variables are used as independent variables in the VAR Model, it is necessary to determine the ideal lag length. The optimal length of time is known as the optimal lag length, and it is used in time-series analysis to quantify how long a variable's influence lasts on other variables. In order to keep the estimation system free of autocorrelation issues, the Lag Length Optimal Test is also required. Since the optimum lag is employed in this simulation, it is assumed that the autocorrelation problem won't come up. In this study, the Schwarz information criterion, the sequentially modified LR test statistic, the Final prediction error, the Akaike information criterion, the Hannan-Quinn information criterion, and the Akaike information criterion are just a few of the existing criteria that are taken into account when determining the Optimal Lag Length.

In the case of two or more non-stationary time-series variables, cointegration is feasible. The long-term stability of the relationship depends on whether the time-series variables are cointegrated (Moosa & Vaz, 2016). The cointegration test developed by Johansen was employed in this study. At a confidence level of $\alpha = 5\%$, the trace statistical analysis used by the Johansen test results in a significance greater than the critical value. The probability value, which is less than 5%, denotes cointegration.

The vector autoregression model is then used for further analysis to ascertain the impact of inflation and exchange rates on the sectoral stock index. Using the Impulse Response Function, subsequent analysis quantifies how much the sectoral stock market reacts to inflation and exchange rate shocks. Sims (1980) started with the IRF function, which describes the future k-period expectation of the prediction error of one variable due to the innovation of another variable, to develop the impulse response concept. As a result, it is possible to state that the IRF can estimate how long the effect of a particular variable's shock will last on the system's current and future values of endogenous variables before the effect is lost or the system reaches equilibrium (convergent).

IRF only shows the sign of the dynamic multiplier, not showing the size of the influence and changes in the system. We use IRF to analyse how much the independent variable responds to the shock that occurs in the dependent variable. Consider the analysis results in this study are the limits of the asymptotic analytic in the form of a graph. FEVD evaluates the contribution of the independent variable to the dependent variable in the event of a future shock in the error term and strengthens the previous analysis results. FEVD is a VAR Model that, in the case where innovation variables are assumed to be uncorrelated, separates variations from various variables considered shock components or become innovation variables. The relationship between a shock's impact on one variable and the shock to other variables in the present and future periods will be shown using variance decomposition.

4. Empirical findings

For the validity of the data test, it is necessary to test the stationarity of the data. The Phillip-Perron and ADF tests were performed for errors that had structural autoregressive (DeJong et al., 1992). The selection of the appropriate analysis model for time-series data pays close attention to the unit root test results. A suitable model helps analyse the right results. The method used by PP and ADF needs to pay attention to the errors contained in the time-series data using the same hypothesis. The null hypothesis explains that the data is not stationary. The alternative view ensures that the information is statistically accepted if significant at 5% alpha. The data stationarity test's findings, which are presented in Table 1, demonstrate that while none of the data are stationary at level I(0), they are stationary at first difference I(1) when tested using ADF and PP. The data stationarity test's findings, which are presented in Table 1, demonstrate that while none of the data are stationary at level I(0), they are stationary at first difference I(1) when tested using ADF and PP.

After knowing the validity of the data followed by calculating the optimal lag, the result of the optimal lag test in this research is lag two. Ensure the model is used after the stationarity of data. The modelling will be shut down after the results of this test are known. Not enough is known from the results of the Unit-Roots test for choosing the suitable model. Hence, to make sure the results of this modelling can be used to analyse the regression results, it is necessary to test the stability of the model (stability of VAR Model). We can see this stability test from the modulus value (Hylleberg et al., 1990), which shows a value below one (Table 2).

The results of the cointegration test are then displayed in Table 3, which demonstrates that the Trace Statistic and Max-Eigen Statistics values are less than the critical values. The first difference data VAR Model is found to be the best model for this study, and the optimal lag is 2. Based on these findings, the lag should be 2. Cointegration testing comes next after the model's stability has been established.

Table 3 shows that all critical values are more significant than the t-statistic form Trace and max-eigenvalue. The next stage is the VAR estimation (Table 4) supported by the IRF test to analyse how big the variable's response is when a shock occurs in inflation and the exchange rate.

The VAR estimation results (Table 4) show that during the crisis and pandemic, the basic industrial sector consumption is influenced by the sector's condition in the previous period; the industry controls the miscellaneous industrial sector in the last two periods of inflation in the last two periods. Meanwhile, inflation in the last period affected the consumer goods industry sector. Inflation was also influenced by the condition of the consumer goods industry sector in the last two periods apart from itself (inflation from one to two previous periods). Apart from being influenced by itself in the previous two periods, the consumer goods industry sector also influenced the exchange rate in the last two periods.

The results of the IRF test shown in Appendix A show that the sectoral stock market responded negatively in the second period when there was a shock of inflation and exchange rates. The significance of the

Table 4. The results of the estimation model of a vector autoregression.

	DBIC	DMSI	DCGI	DINF	DER
DBIC(-1)	−0.226107	0.076070	−0.033381	−0.000682	−0.446448
	(0.10126)	(0.14866)	(0.18067)	(0.00125)	(0.80950)
	[−2.23300]**	[0.51169]	[−0.18476]	[−0.54380]	[−0.55151]
DBIC(-2)	0.053257	0.118502	−0.137710	0.000727	−0.431326
	(0.10106)	(0.14837)	(0.18031)	(0.00125)	(0.80791)
	[0.52699]	[0.79867]	[−0.76373]	[0.58115]	[−0.53388]
DMSI(-1)	0.068429	0.010276	0.023886	−0.000679	−0.749324
	(0.06892)	(0.10119)	(0.12297)	(0.00085)	(0.55097)
	[0.99289]	[0.10155]	[0.19425]	[−0.79574]	[−1.36002]
DMSI(-2)	0.025077	−0.194162	0.174762	−0.001241	0.013175
	(0.06895)	(0.10124)	(0.12303)	(0.00085)	(0.55125)
	[0.36368]	[−1.91788]**	[1.42048]	[−1.45449]	[0.02390]
DCGI(-1)	0.084436	0.049579	0.049641	0.000114	−0.181158
	(0.05531)	(0.08120)	(0.09868)	(0.00068)	(0.44217)
	[1.52660]	[0.61054]	[0.50303]	[0.16661]	[−0.40970]
DCGI(-2)	−0.080107	−0.031383	0.010004	0.001533	0.748173
	(0.05632)	(0.08268)	(0.10048)	(0.00070)	(0.45022)
	[−1.42246]	[−0.37956]	[0.09956]	[2.19893]**	[1.66181]*
DINF(-1)	−9.871645	−19.76286	−19.77492	0.444262	28.55991
	(6.57174)	(9.64854)	(11.7255)	(0.08134)	(52.5374)
	[−1.50214]	[−2.04828]**	[−1.68649]*	[5.46198]***	[0.54361]
DINF(-2)	6.144074	14.09414	16.34459	−0.149314	54.01678
	(6.61331)	(9.70958)	(11.7997)	(0.08185)	(52.8698)
	[0.92905]	[1.45157]	[1.38517]	[−1.82420]*	[1.02170]
DER(-1)	−0.007382	−0.025742	−0.016296	−3.71E-05	−0.081980
	(0.01154)	(0.01695)	(0.02059)	(0.00014)	(0.09227)
	[−0.63963]	[−1.51912]	[−0.79134]	[−0.26006]	[−0.88849]
DER(-2)	−0.001829	−0.007666	0.019543	3.89E-05	−0.186461
	(0.01154)	(0.01695)	(0.02059)	(0.00014)	(0.09227)
	[−0.15851]	[−0.45240]	[0.94905]	[0.27200]	[−2.02087]**
C	5.382584	4.642696	8.830304	−0.040728	44.99064
	(3.87868)	(5.69463)	(6.92045)	(0.04801)	(31.0079)
	[1.38774]	[0.81528]	[1.27597]	[−0.84841]	[1.45094]

Note: Standard errors in () & t-statistics in []. Included observations: 155 after adjustments. Level of significance ***(1%), **(5%), *(10%).

contribution of the variables studied during the shock can be seen from the results of the FEVD test in Table 5. In general, each variable shows a more dominant contribution when shock occurs on the variable itself. However, the Basic Industrial & Chemicals provides a dominant contribution compared to other variables to the Consumer Goods Industry, Miscellaneous Industry stock, and exchange rate industrial sectors.

The next test stage is the Granger Causality Test. The test demonstrates the continued importance of inflation and exchange rate shocks on the three sectoral stock market variables, along with the causal connection between the variables examined (Table 6). The findings show that there is a direct and one-way relationship between the Basic, Industry & Chemicals, Consumer Goods, Miscellaneous Industry Stock, and Consumer Goods Industries. However, the Consumer Goods Industry has a direct causal relationship with Basic, Industry & Chemicals. It indicates that if the consumer goods industry sector is disrupted (shock), it can affect the basic industrial sector.

The results of the IRF test shown in Appendix A show that the sectoral stock market responded negatively in the second period when there was a shock of inflation and exchange rates. After that, it reacts positively from the second to the eighth period and then goes towards equilibrium. This finding is corroborated by Olsen (1998), who explained that exchange rate fluctuations permanently affect stock price volatility. Meanwhile, the MSI variable reacts negatively in the second period, responds positively after the second period, and then reaches equilibrium. We can conclude that when an exchange rate shock occurs, the sectoral stock market takes longer to respond. The open economic system in Indonesia has created a high dependence on monetary conditions (on the stability of the Rupiah currency). This is one thing that the Central Bank of Indonesia has paid attention to that highlights the monetary authority's important role in shaping Indonesia's financial conditions (Juhro & Njindan Iyke, 2019).

Strong assumptions are not required while estimating the equations of a VAR; however, calculating impulse response functions (IRFs) or variance decompositions does necessitate establishing restrictions. The estimation results in Table 4 using the VAR Model (non-cointegrated) explain that in the short-term, stocks in the Basic Industry & Chemicals sector in the previous period have a negative effect on these stocks in the future. Over the last two periods, the Miscellaneous Industry stock index sector had a negative impact on the industry itself. Meanwhile, the Consumer Goods Industry sector in the previous two

Table 5. The outcomes of variance decomposition.

	Variance Decomposition of D(BIC)		Variance Decomposition of D(CGI)		Variance Decomposition of D(INF)		Variance Decomposition of D(ER)		Variance Decomposition of D(MSI)	
Period	D(BIC)	D(CGI)	D(CGI)	D(BIC)	D(INF)	D(CGI)	D(ER)	D(BIC)	D(MSI)	D(BIC)
1	100.00	0.00	83.86	16.14	99.89	0.00	79.41	18.00	62.24	18.10
2	94.04	3.27	81.67	15.84	98.94	0.02	77.15	18.35	57.89	18.79
3	92.46	4.79	80.06	15.52	95.77	1.14	74.23	17.79	58.05	18.45
4	92.33	4.79	80.03	15.49	95.12	1.61	74.17	17.79	57.58	18.58
5	92.14	4.89	79.88	15.46	94.83	1.73	74.16	17.77	57.58	18.58
6	92.12	4.91	79.87	15.46	94.77	1.74	74.16	17.77	57.58	18.57
7	92.12	4.91	79.86	15.46	94.76	1.74	74.15	17.77	57.58	18.57
8	92.12	4.91	79.86	15.46	94.76	1.74	74.15	17.77	57.58	18.57

Table 6. The results of Granger causality testing.

Variables	DMSI	DBIC	DCGI	DINF	DER
DMSI	–	2.14669 (0.1205)	0.65220 (0.5224)	0.42379 0.6554	2.35173 (0.0988)*
DBIC	1.00758 (0.3676)	–	0.27888 (0.7570)	0.69069 (0.5028)	0.59086 (0.5552)
DCG1	0.40038 (0.6708)	3.64979 (0.0284)**	–	1.76862 (0.1742)	2.40050 (0.0942)*
DINF	2.59091 (0.0783)*	1.42542 (0.2437)	1.99230 (0.1400)	–	0.02066 (0.2461)
DER	2.04738 (0.1327)	0.82394 (0.4407)	1.11151 (0.3318)	0.02066 (0.9796)	–

Note: **,* is significant at the level 5 percent and 10 percent.

periods had a positive effect on Inflation. However, Inflation in one previous period had a positive impact on itself. But in the last two periods, it positively affected itself. Likewise, the Consumer Goods Industry sector positively impacted the exchange rate in the two previous periods. However, the exchange rate of the last two periods had a negative effect on the exchange rate itself.

The short-term integration of stock market capitalisation with the global economy (international trade) is supported by the estimation results of the VAR Model. The only stock sector that is negatively impacted by inflation is the Miscellaneous Industry; the other two industrial sectors are unaffected. The three industrial sectors of the stock market, however, are unaffected by the exchange rate. This result is comparable to studies by Megaravalli and Sampagnaro (2018). They discovered that in the short-term, the stock market is statistically unaffected by inflation or exchange rates. In the long-term, however, the stock market in ASEAN nations is negatively impacted by inflation while positively impacted by the exchange rate. The IRF test results showed that the three sectors interact with one another in response to a shock, particularly at the start of the period in which they responded favourably. That is, the need for commodities increases in each of these industrial sectors when a shock occurs in one of these industries. This confirms that the industrial sector is a community need that can complement each other. However, during shocks caused by inflation and exchange rates, these two industrial sectors (CGI and MSI) responded negatively, but the BIC industrial sector did not respond significantly. Of course, this shows that the basic industrial consumption sector is still needed to meet the basic needs of society. This implies that a shock in a sectoral stock will distract investors from looking at opportunities in other sectors. It is related to behavioural finance (Hu et al., 2021). When there is a positive shock to most of the stock market, the return on the index falls as investors become more risk-averse (Dahmene et al., 2021). The way investors interpret shock information can positively and negatively impact stocks (Fenner et al., 2020).

How significant is the contribution of the variables when the shocks from the results of this research show something unique? During inflation and exchange rate shocks, the contribution is more dominant than the variables themselves. However, there is a different contribution among sectoral stock markets when one of them is in shock. The results of the variance decomposition test (Table 5) show that when there is a shock, the dominant contribution is caused by the variable itself due to disturbed stability. However, the BIC industrial sector can be one of the causes of shocks in other industrial sectors. It can be said that the BIC industrial sector can survive in times of crisis and pandemics. The BIC industrial sector evidences this, that is not easy to respond to shocks due to fluctuations in inflation and exchange rates. However, if the stability of the BIC industrial sector is disturbed, it can affect other industrial sectors. We conclude that sectoral stock markets are prone to shock when a shock hits them. So, it is imperative to worry about the primary cause.

The results of the Granger Causality test show a causal connection between the stock markets in the BIC and CGI industrial sectors. This explains how the stock market might interconnect due to society's production demands. The condition of economic fluctuations shown by fluctuations in inflation has a one-way causal relationship to the stock market in the MSI industrial sector. This industry produces a variety of commodities needed by society. This causal relationship strengthens the regression results in the VAR Model, indicating that inflation has a short-term impact on the MSI industrial sector. The MSI industrial sector, on the other hand, only causally influences the exchange rate in one direction. The study's findings are in agreement with Yousaf et al. (2023), who explain that the exchange rate influences stock returns in sectoral industries. The difference with this research is that Yousaf et al. (2023) used exchange rate risk transmission for stock returns at various scales and has high coherence between Covid-19 and economic indicators that are predictive in the long-term (Qureshi, 2022). From the results of this research findings imply that changes in inflation have an impact on both the exchange rate and the stock market of the miscellaneous industry (MSI) sector. The test results then demonstrate that there is a one-way causal relationship between the exchange rate and the stock market of the consumer goods sector (CGI) industrial sector.

5. Concluding remarks

The purpose of this study is to investigate the correlation between economic fluctuations and the Indonesian sectoral stock market in three areas: the consumer goods sector (CGI), basic industrial and chemical sector (BIC), and miscellaneous industry (MSI), both before and during the COVID-19 pandemic in Indonesia. The analysis employs forecast error variance decomposition, vector autoregression, impulse response function analysis, and causality investigation. The monthly time-series data used in the study covers the period from January 2008 to December 2020. The investment in the sectoral stock market in Indonesia shows an upward trend over the research period, promoting Indonesia's aspirations for sustainable economic growth.

The study's findings suggest that only inflation has a short-term impact on MSI. When there are shocks to inflation and exchange rates, sectoral stock markets respond negatively in the second period, leading to a decrease in the revenue from industrial sectoral shares. Conversely, if there is a shock in the industrial stock market, other sectors respond positively. This implies a positive opportunity for returns for one sector at the beginning of the period, in the event of shocks in other sectors. However, the research period reflects the impact of the COVID-19 pandemic in Indonesia (2008–2020), which caused uncertainty regarding the shocks experienced in each sectoral stock market to the returns achieved.

It is known that the economy in Indonesia is a small open economy, which means that economic globalisation has an impact on its domestic industry. Moreover, global pricing policies for basic industrial goods in international markets can affect domestic industrial market prices and involve the consumption of industrial goods. Therefore, it is natural that the domestic industrial sectors can be interrelated or have a causality relationship. This suggests that foreign needs are also met domestically (import).

Investment in the stock market in the consumer goods industry and other industry sectors can be affected by the shock of the Indonesian exchange rate against the currency on the international market. Research findings indicate a causal link between inflation and the exchange rate, with inflation being influenced by the more dominant exchange rate. This result implies that Indonesian macroeconomic policy-making must take into account the stability of inflation and the exchange rate.

The results of the IRF and FEVD tests provide further support to the regression results of the VAR Model. The results of the comprehensive causality test also support this, which reveals that changes in the industrial stock market can influence changes in the Rupiah exchange rate. This test demonstrates how alterations in the industrial stock market can impact one of the stock markets in the industrial sector, highlighting the heavy dependence of industrial products on imported items. Consequently, it is crucial to maintain stability between industrial stock markets from shocks by monitoring inflation fluctuations that can affect exchange rates. This is because imported inputs play a significant role in the industrial sector's production inputs.

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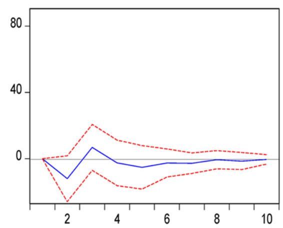
Appendix A

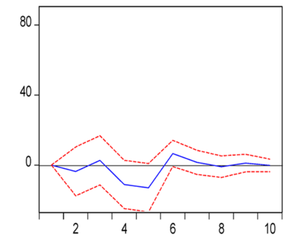
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(CGI) to D(INF)



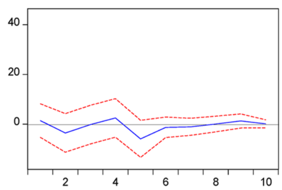
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(CGI) to D(KURS)



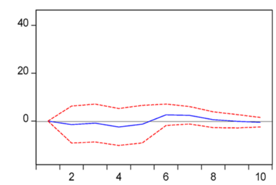
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(BIC) to D(INF)



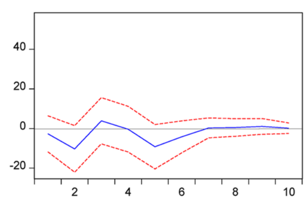
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(BIC) to D(KURS)



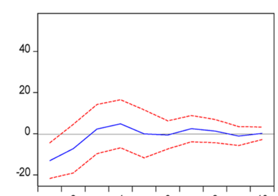
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(MSI) to D(INF)



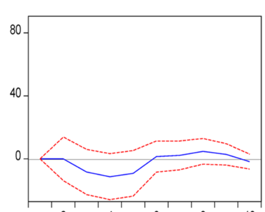
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(MSI) to D(KURS)



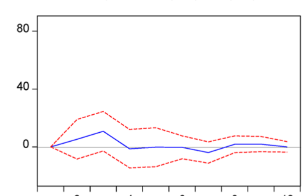
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(CGI) to D(BIC)



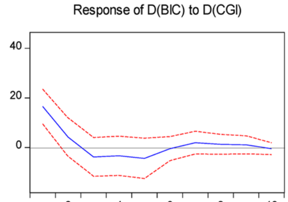
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(CGI) to D(MSI)



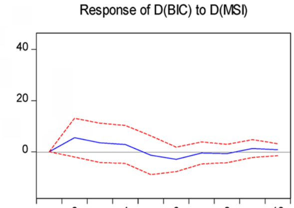
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(BIC) to D(CGI)



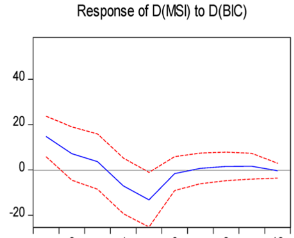
Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(BIC) to D(MSI)



Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(MSI) to D(BIC)



Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(MSI) to D(CGI)