THE INTEGRATION OF THE INDONESIAN STOCK MARKET WITH DEVELOPED STOCK MARKETS: PRE- AND POST-COVID-19 PANDEMIC

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Abstract:

Background: Stock portfolio management is essential for risk reduction and forecasting future stock market movements. When Covid-19 was declared a pandemic, stock markets worldwide, particularly the Indonesian stock market, faced significant declines. The Indonesian market dropped by 33%, mirroring a global trend of simultaneous declines, indicating a joint movement among stock markets.
Purpose: This study aims to investigate the integration of the Indonesian stock market with the ten largest stock markets by market capitalization globally, comparing the periods before and after the Covid-19 pandemic.
Design/Methodology/Approach: The study utilizes daily closing returns of stock market indices, divided into two periods: before the crisis (January 1, 2016 - December 31, 2019) and after the crisis (January 1, 2020 - December 31, 2023). Data is sourced from Yahoo Finance. The analysis combines Orthogonal Generalized Autoregressive Conditional Heteroscedasticity (OGARCH) and Principal Component Analysis (PCA).
Findings/Results: The results show that integration between stock markets was higher in the post-crisis period, indicating an increase in market integration after the Covid-19 pandemic. The Indonesian stock market remained segmented in both periods, exhibiting low correlation with other markets. European and American stock markets showed higher integration, while Asian markets were generally segmented.
Conclusion: Post-pandemic integration was higher than before, though the Indonesian stock market continued to have low correlation with other global markets, despite a slight increase in correlation over time.
Originality/Value: This research offers a novel comparative analysis of stock market integration, highlighting Indonesia's persistent market segmentation despite global shifts before and after the Covid-19 pandemic.

Keywords: Covid-19, market capitalization, OGARCH, stock markets, PCA

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INTRODUCTION

Stock portfolio diversification is necessary to reduce investment risk, as the future movement of stock market indices is uncertain. When Covid-19 was declared a pandemic, many stock markets around the world experienced a decline in performance, with the Indonesian stock market falling by up to 33%. Many stock markets saw a similar decline at roughly the same time, indicating a joint movement between them. The high level of co-movement among several stock markets suggests correlation or integration, and increasing stock market integration reduces opportunities for portfolio diversification. Therefore, it is important to conduct research on stock market integration to identify portfolio diversification opportunities, particularly in developed countries, which are considered more resilient to shocks (Celebi & Hönig, 2019; Majid & Kassim, 2009; Wang et al. 2003).

Several previous studies have explored stock market integration around the time of the Asian financial crisis in 1997. Girard & Rahman (2002) examined the integration of the United States stock market with several markets in East and Southeast Asia, while Chatterjee et al. (2003) focused specifically on the integration of stock markets in East and Southeast Asia. Wang et al. (2003) studied the integration of five stock markets in Africa and the United States. Click & Plummer (2005) analyzed the integration of five ASEAN stock markets. Vo & Daly (2005) explored stock market integration across several global markets. Brailsford et al. (2006) investigated stock market integration in three East Asian and three Southeast Asian countries. Finally, Huyghebaert & Wang (2010) examined the integration of seven East Asian stock markets.

Research on stock market integration during the period of the global financial crisis in 2008 has also been conducted. Majid & Kassim (2009) examined the integration of five stock markets to identify portfolio diversification opportunities. Gangadharan & Yoonus (2012) explored the integration of the Indian stock market with the United States stock market. Goucha & Hamdi (2016) studied the integration of stock markets in the GCC (Gulf Cooperation Council) and MENA (Middle East and North Africa) countries. Jiang et al. (2017) examined the integration of six stock markets in developed countries. Robiyanto (2017) investigated stock market integration in ASEAN. Almohamad et al. (2018) focused on stock market integration in the MENA region. Liao et al. (2019) analyzed the integration of fourteen stock markets in Europe, while Muharam et al. (2019) studied stock market integration in Asia and Eastern Europe. Habiba et al. (2020) examined the integration of the United States stock market with those in South Asia, and Muharam et al. (2020) looked at stock market integration in East Asia and Southeast Asia. Finally, Bruce-Tagoe & Chiou (2021) investigated the integration of five stock markets in developed countries.

Several studies have also explored stock market integration during the Covid-19 pandemic crisis period. Santoso & Muharam (2021) examined the integration of the ASEAN 5+3 stock markets alongside world gold and oil prices. Carausu & Lupu (2022) studied the integration of stock markets in Eastern Europe with those of the United States and China. Nguyen et al. (2022) analyzed the integration of the United States stock market with several Asian stock markets. Song et al. (2022) focused on the integration of the United States and China stock markets. Finally, Verma (2023) examined the joint movements of stock markets in several Asian countries.

This study differs from previous research in several key ways. First, it focuses on the integration of the Indonesian stock market with the ten largest stock markets by market capitalization globally, providing a broader comparison that includes developed markets around the world. Furthermore, it compares the pre- and post-COVID-19 periods, offering insights into how the pandemic has affected global stock market integration. Finally, this study uniquely includes a comparative analysis of the Indonesian stock market within the broader context of the largest global markets, offering new insights into Indonesia's market integration in the post-pandemic era, rather than focusing solely on specific regions as previous studies have done (such as Eastern Europe, East and Southeast Asia, Africa, and the MENA region).

To effectively approach problem-solving for stock portfolio diversification, it's important to first assess the risks involved in investing, especially given uncertainties like those caused by the Covid-19 pandemic. Analyzing past market trends shows that stock markets often move together during crises, which can limit diversification opportunities. Therefore, focusing on more stable developed markets can offer potential advantages. By continuously monitoring and adjusting the portfolio based on new information, investors can manage risks more effectively and improve their investment results.

This research aims to examine the integration of the Indonesian stock market with the 10 stock markets with the largest market capitalization in the world in the period before and after the Covid-19 pandemic crisis. The benefit of this research is that it is used to look for portfolio diversification opportunities. The analysis method used is Orthogonal Generalized Autoregressive Conditional Heteroscedasticity (OGARCH) combined with Principal Component Analysis. This method is used to reduce several stock markets into several components.

METHODS

The data used in this research are quantitative and secondary in nature, specifically focusing on daily closing stock market index returns, which include numerical values representing the performance of various stock market indices on a daily basis. Additionally, time series data is used, which refers to data organized chronologically, tracking stock market index returns over specific time periods (pre- and post-Covid-19). These data types allow for statistical analysis and modeling to identify patterns and relationships in stock market behavior. The data for this research consist of daily closing stock market index returns from the ten largest stock market indices by market capitalization globally, as well as the Indonesian stock market. The data source is the www.investing.com website. The indices used in each country are as follows: the United States (NYSE), China (SSEC), Japan (NIKKEI), India (SENSEX), the United Kingdom (LSE), France (CAC), Saudi Arabia (Tadawul), Canada (TSX), Germany (DAX), Switzerland (SMI), and Indonesia (JCI).

The research data used in this study is sourced from Yahoo Finance. The time period covered ranges from 1 January 2016 to 8 December 2023, comprising a total of 2,085 data points. This period is divided into two segments: the pre-Covid-19 period (1 January 2016 – 31 December 2019) with 1,042 observations, and the post-Covid-19 period (1 January 2020 – 31 December 2023) with 1,043 observations.

The analytical technique used in this study involves methods such as Orthogonal Generalized Autoregressive Conditional Heteroscedasticity (OGARCH) combined with Principal Component Analysis, which helps analyze multiple markets and identify key components for better diversification. The OGARCH model, introduced by Van der Weide (2002), is widely used in finance to forecast volatility and correlations, particularly in analyzing dynamic relationships between assets. Principal component analysis (PCA) is a technique used for linear dimensionality reduction, which is applied in exploratory data analysis, visualization, and data preprocessing by transforming the data onto a new coordinate system to highlight the directions (principal components) that capture the largest variation in the data. GO-GARCH offers greater flexibility than other multivariate GARCH models by reducing the effects of changing dynamics and parameter heterogeneity, making it useful for studying correlations between cryptocurrencies and other assets. This method has also been employed by Alexander (2002), Robiyanto (2017), and Muharam et al. (2020) to reduce stock markets into several components.

Engle & Granger (1987) explain that integration occurs when there is a relationship or correlation over a certain period of time. Click & Plummer (2005) state that stock market integration refers to a condition where two or more stock markets exhibit similar movements or have a high correlation in their movements. Majid & Kassim (2009) argue that integrated stock markets display similar movements and stability over the long term. According to Sharma & Seth (2012), stock market integration occurs when multiple stock markets across different countries follow the same movement trend, with returns aligning with the associated risk. Mohti et al. (2019) state that an integrated stock market has a long-term relationship in its movement.

High stock market integration is indicated by a strong correlation. A stock market can be considered integrated if there is a statistically significant correlation in its movements, even if the correlation is relatively low. A high correlation between two or more stock markets indicates a stronger reciprocal relationship. When stock markets are highly correlated, the opportunity for portfolio diversification is reduced. Conversely, if stock markets are not correlated, there is a greater opportunity to diversify the portfolio (Bracker et al. 1999).

Stock market integration can occur due to several factors. Stock markets in countries located in the same geographic area tend to have higher movement correlations compared to those in countries that are geographically distant or not in the same region. The similarity in stock market size and industrial composition also increases stock market integration. Additionally, similarities in

stock market movements can be attributed to common international factors. If one stock market experiences a shock, it can affect the movements of other stock markets (Santoso & Muharam, 2021).

In 2020, the outbreak of the Covid-19 pandemic spread to nearly all countries worldwide. This event caused a drastic decline in national economies and a drop in stock market indices. The impact of the Covid-19 pandemic was massive globally, affecting every country without exception. According to Sharif et al. (2020), the impact of the Covid-19 pandemic was similar to the global financial crisis of 2008. All countries affected by Covid-19 experienced a decline in stock market performance. Verma (2023) states that crisis situations, such as the Covid-19 pandemic, influence the similarity of movements across multiple stock markets, as all are impacted by the same factors.

The Covid-19 pandemic is considered a macroeconomic factor because it resulted in a global crisis. According to Wang et al. (2003), macroeconomic events, such as the global financial crisis, influence stock market integration. Celebi & Hönig (2019) also state that macroeconomic factors affect stock price movements. Majid & Kassim (2009) argue that a global-scale crisis will impact the economy and stock market movements of every country in the world without exception. Research has shown that, in general, the level of integration increases during and after a crisis, meaning that stock market integration is higher during this period than in the pre-crisis period. Previous studies have proven that the crisis resulting from the Covid-19 pandemic has affected the level of stock market integration. Santoso & Muharam (2021) found that the extent of stock market integration differed before and during the Covid-19 pandemic, with integration levels being higher during the pandemic. Research by Carausu & Lupu (2022) indicates that the Covid-19 pandemic crisis increased the integration of the United States stock market with nine Eastern European stock markets. Similarly, research by Song et al. (2022) shows that stock market integration during the Covid-19 crisis was higher than in the previous period. Thus, the following hypotheses are proposed:

H1. Stock market integration increases during global crises, such as the Covid-19 pandemic, resulting in higher correlation between stock markets compared to the pre-crisis period.

H2. Geographic proximity, similar market size, industrial composition, and common international factors contribute to higher stock market integration.

RESULTS

The stationary test is conducted using the Augmented Dickey-Fuller Test at the Level stage with the Schwarz Information Criterion. The results of the stationary test for the periods before and after the Covid-19 crisis are shown in Table 1. The results of the correlation analysis for all stock markets studied during the period before the COVID-19 crisis are shown in Table 2.

Table 1. Stationary Test Results

Indices	Exchanges	Country	Pre-Crisis		Post Crisis	
			t-statistic	Prob.	t-statistic	Prob.
NYSE	New York Stock Exchange	USA	-31.19229	0.0000**	-9.532546	0.0000**
SSEC	Shanghai Stock Exchange Composite Index	China	-34.33142	0.0000**	-28.82699	0.0000**
NIKKEI	Nikkei 225	Japan	-31.90116	0.0000**	-30.58777	0.0000**
SENSEX	Bombay Stock Exchange Sensitive Index	India	-28.86797	0.0000**	-13.69051	0.0000**
LSE	London Stock Exchange	UK	-30.77456	0.0000**	-32.91149	0.0000**
CAC	CAC 40	France	-30.50875	0.0000**	-32.69224	0.0000**
Tadawul	Saudi Stock Exchange	Saudi Arabia	-26.52987	0.0000**	-11.66466	0.0000**
TSX	Toronto Stock Exchange	Canada	-29.37639	0.0000**	-11.02672	0.0000**
DAX	Deutscher Aktienindex	Germany	-31.29943	0.0000**	-32.69908	0.0000**
SMI	Swiss Market Index	Switzerland	-30.40429	0.0000**	-32.30840	0.0000**
JCI	Jakarta Composite Index	Indonesia	-28.17590	0.0000**	-30.99096	0.0000**

Note: ** significant at 0.01 and, * significant at 0.05

Table 2 presents the correlation results for all stock markets during the period before the Covid-19 crisis. This correlation analysis is essential for understanding the relationship between the Indonesian stock market and other stock markets in general. The results indicate that the Indonesian stock market and other stock markets tend to have a low correlation. The subsequent results, shown in Table 3 and Table 4, provide a more detailed analysis.

Table 3 presents the results of the principal component analysis for the period before the Covid-19 crisis. The results show that all the stock markets studied are divided into two principal components. Principal Component (PC) 1 has an eigenvalue of 4.8679 and a proportion of 0.4425, meaning that the components forming PC 1 account for 44.25% of the return variance. Meanwhile, Principal Component (PC) 2 has an eigenvalue of 1.3495 and a proportion of 0.1227, meaning that the components forming PC 2 account for 12.27% of the return variance. Together, the two principal components in the period before the Covid-19 crisis explain a cumulative proportion of 56.52% of the return variance, while the remaining 43.48% is attributed to other factors.

Table 2. Stock Market Correlation in the Pre-Crisis Period

	NYSE	SSEC	NIKKEI	SENSEX	LSE	CAC	Tadawul	TSX	DAX	SMI	JCI
NYSE	1										
SSEC	0.1607	1									
NIKKEI	0.2325	0.2824	1								
SENSEX	0.2686	0.2259	0.3451	1							
LSE	0.5347	0.2131	0.2789	0.3245	1						
CAC	0.6147	0.1866	0.3521	0.3562	0.8076	1					
Tadawul	0.1848	0.1466	0.2294	0.1677	0.2250	0.2614	1				
TSX	0.7223	0.1701	0.2466	0.2151	0.5054	0.5451	0.1861	1			
DAX	0.5789	0.2156	0.3205	0.3568	0.7536	0.9054	0.2329	0.4859	1		
SMI	0.5287	0.1880	0.3016	0.3381	0.7408	0.8033	0.2203	0.4639	0.7799	1	
JCI	0.1089	0.1776	0.2046	0.2887	0.1790	0.1763	0.1278	0.1151	0.1591	0.1707	1

Note: NYSE (New York Stock Exchange); SSEC (Shanghai Stock Exchange Composite Index); NIKKEI (Nikkei 225); SENSEX (Bombay Stock Exchange Sensitive Index); LSE (London Stock Exchange); CAC(CAC 40); Tadawul (Saudi Stock Exchange); TSX (Toronto Stock Exchange); DAX (Deutscher Aktienindex); SMI (Swiss Market Index); JCI (Jakarta Composite Index)

Table 3. Principal component analysis results for the pre-crisis period

Principal Components	Eigenv alue	Proportion	Cumulative Value	Cumulative Proportion
1	4.8679	0.4425	4.8679	0.4425
2	1.3495	0.1227	6.2175	0.5652

Table 4. Eigenvectors (loadings) for the Pre-Crisis Period

	Variables	PC 1	PC 2
NYSE	New York Stock Exchange	0.335920	-0.215794
SSEC	Shanghai Stock Exchange Composite Index	0.150838	0.443719
NIKKEI	Nikkei 225	0.216172	0.424877
SENSEX	Bombay Stock Exchange Sensitive Index	0.226248	0.399831
LSE	London Stock Exchange	0.383535	-0.136840
CAC	CAC 40	0.415300	-0.149273
Tadawul	Saudi Stock Exchange	0.160049	0.246396
TSX	Toronto Stock Exchange	0.312200	-0.189654
DAX	Deutscher Aktienindex	0.400784	-0.138385
SMI	Swiss Market Index	0.382706	-0.132353
JCI	Jakarta Composite Index	0.129373	0.491737

The analysis reveals the eigenvector results, which provide more detailed information about the components forming PC 1 and PC 2 in the period before the Covid-19 crisis. The results show that PC 1 is formed by the stock markets of the United States, England, France, Canada, Germany, and Switzerland, indicating that these stock markets are highly integrated. In contrast, PC 2 is formed by the stock markets of China, Japan, India, Saudi Arabia, and Indonesia, suggesting that these stock markets have fewer similar movements or tend to be more segmented (Figure 1).

The results of the correlation analysis for all stock markets studied in the period after the Covid-19 crisis are shown in Table 5. The results show the correlation analysis of all stock markets in the period after the Covid-19 crisis. This analysis helps to observe the correlation between the Indonesian stock market and other global stock markets. The findings indicate that the Indonesian stock market and other stock markets exhibit varying degrees of correlation, ranging from low to medium, and in some cases, high correlation. The next results are shown in Table 6 for a more detailed analysis.

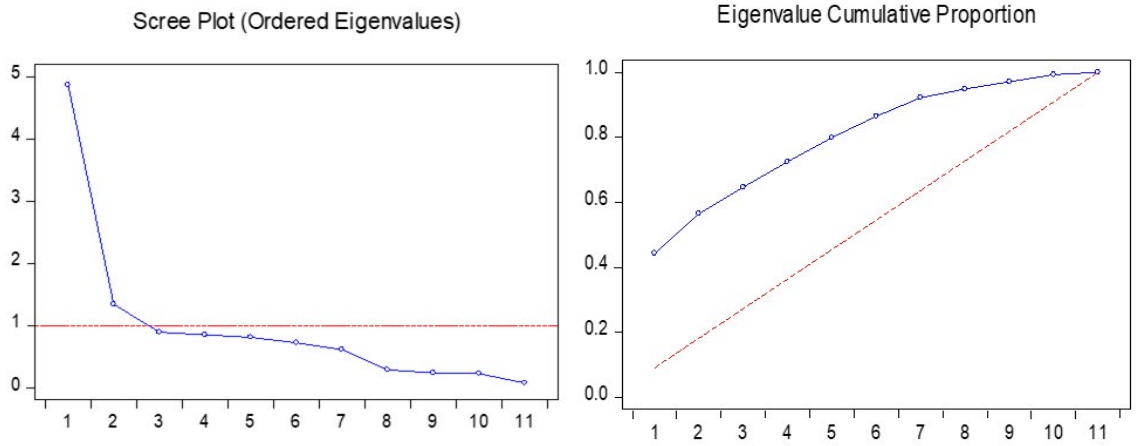

Figure 1. Pre-crisis eigenvalues and cumulative proportion analysis

Table 5. Stock market correlation in the post-crisis period

	NYSE	SSEC	NIKKEI	SENSEX	LSE	CAC	Tadawul	TSX	DAX	SMI	JCI
NYSE	1										
SSEC	0.2763	1									
NIKKEI	0.1872	0.2893	1								
SENSEX	0.3445	0.3378	0.2479	1							
LSE	0.6635	0.3470	0.2128	0.4663	1						
CAC	0.6781	0.3475	0.1880	0.4816	0.8725	1					
Tadawul	0.3552	0.2829	0.1923	0.2394	0.3522	0.3403	1				
TSX	0.8877	0.2856	0.2045	0.3898	0.6797	0.6590	0.3778	1			
DAX	0.6664	0.3445	0.1762	0.4494	0.8396	0.9395	0.3150	0.6506	1		
SMI	0.5980	0.3117	0.1540	0.3977	0.7802	0.8035	0.3471	0.6267	0.8005	1	
JCI	0.2705	0.2568	0.2370	0.4193	0.2483	0.2615	0.2680	0.2699	0.2354	0.2006	1

Note: NYSE (New York Stock Exchange); SSEC (Shanghai Stock Exchange Composite Index); NIKKEI (Nikkei 225); SENSEX (Bombay Stock Exchange Sensitive Index); LSE (London Stock Exchange); CAC(CAC 40); Tadawul (Saudi Stock Exchange); TSX (Toronto Stock Exchange); DAX (Deutscher Aktienindex); SMI (Swiss Market Index); JCI (Jakarta Composite Index)

Table 6. Principal component analysis results for the post-crisis period

Principal Components	Eigen value	Proportion	Cumulative Value	Cumulative Proportion
1	5.5750	0.5068	5.5750	0.5068
2	1.3405	0.1219	6.9156	0.6287

Table 6 presents the results of the principal component analysis in the period after the Covid-19 crisis. Two components were identified during this period. Principal component (PC) 1 has an eigenvalue of 5.5750 and a proportion of 0.5068, indicating that the components forming PC 1 are influenced by the same risk factors, accounting for 50.68%. Meanwhile, principal component (PC) 2 has an eigenvalue of 1.3405 and a proportion of 0.1219, meaning that the components forming PC 2 are influenced by the same risk factors, contributing 12.19%. Thus, the cumulative proportion of the two principal components in the post-Covid-19 period is 0.6287, meaning that 62.87% of the stock market movements were influenced by the same risk factors, with the remaining 37.13% explained by other factors.

Table 7 presents the eigenvector results, offering a more detailed view of the components forming PC 1 and PC 2 in the period after the Covid-19 crisis. The results indicate that PC 1 is formed by the stock markets of the United States, England, France, Canada, Germany, and Switzerland, suggesting high integration among these markets. In contrast, PC 2 is formed by the stock markets of China, Japan, India, Saudi Arabia, and Indonesia, indicating that these markets have fewer similar movements or tend to be more segmented.

Based on the analysis results from the periods before and after the Covid-19 crisis, as shown in Figure 2, two principal components were formed in each period. Additionally, there are differences in the level of integration between the two research periods. The period after the Covid-19 crisis showed a higher overall level of integration compared to the pre-crisis period. However, PC 2 indicated that the post-crisis period had a lower level of integration. These findings align with research by Muharam et al. (2020), which found that the integration level was lower in the pre-crisis period, and PC 2 in the pre-crisis period had higher integration than the post-crisis period. Overall, the results are also supported by studies by Majid & Kassim (2009) and Bruce-Tagoe & Chiou (2021), which showed that integration was lower in the pre-crisis period compared to the post-crisis period.

Other results indicate that the composition of the principal components before and after the Covid-19 crisis remained unchanged. Principal component 1 consists of the stock markets of the United States, England, France, Canada, Germany, and Switzerland, while principal component 2 consists of the stock markets of China, Japan, India, Saudi Arabia, and Indonesia. Interestingly, PC 1 includes stock markets from Europe and the Americas, while PC 2 includes stock markets from Asia. These results suggest that geographic or regional factors influence market integration. This regional distinction underscores the role of geographic factors in market integration, as highlighted in studies by Dewi et al. (2023) and Dilla et al. (2020), which examine stock return volatility and sectoral performance during the pandemic. Additionally, Setiadi et al. (2023) and Putra et al. (2024) emphasize the influence of macroeconomic conditions and investor behavior on market dynamics in Indonesia, reinforcing the notion that regional characteristics significantly affect integration levels in global stock markets.

Table 7. Eigenvectors (loadings) for the Post-Crisis Period

	Variables	PC 1	PC 2
NYSE	New York Stock Exchange	0.344840	-0.139141
SSEC	Shanghai Stock Exchange Composite Index	0.203183	0.389500
NIKKEI	Nikkei 225	0.134030	0.512051
SENSEX	Bombay Stock Exchange Sensitive Index	0.252189	0.315123
LSE	London Stock Exchange	0.378656	-0.154778
CAC	CAC 40	0.386804	-0.177931
Tadawul	Saudi Stock Exchange	0.208145	0.233466
TSX	Toronto Stock Exchange	0.349086	-0.114804
DAX	Deutscher Aktienindex	0.379446	-0.200112
SMI	Swiss Market Index	0.355453	-0.204560
JCI	Jakarta Composite Index	0.172425	0.512093

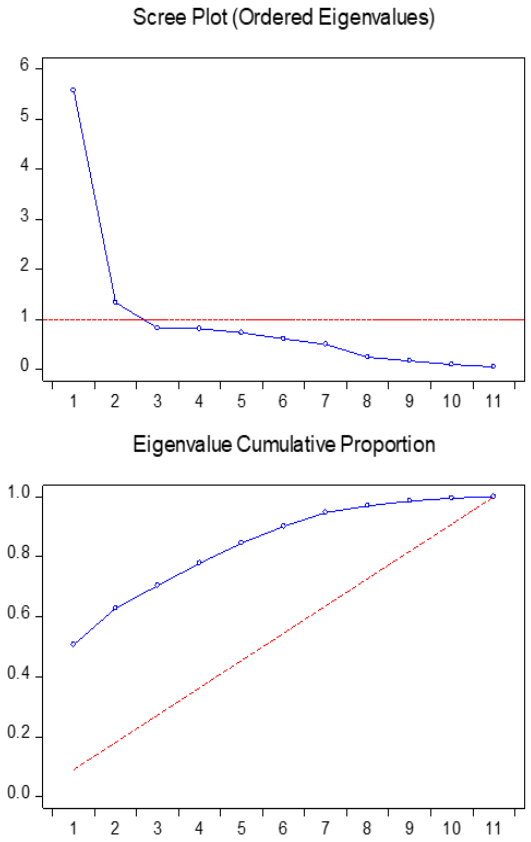

Figure 2. Eigenvalues and cumulative proportion after covid-19 crisis

Managerial Implication

The results from the tests and analyses provide important insights for investors and financial managers working with stock markets after COVID-19. The increased correlations among different stock markets suggest that they are becoming more connected. This means that when one market moves, others may follow, which can impact investment strategies. Managers should rethink traditional ways of diversifying investments. Instead of just spreading money across similar markets, they should consider including assets from markets that behave differently to reduce risk and enhance overall stability.

The analysis also shows that different risk factors are now affecting stock market behavior. In the post-crisis period, while overall market connections have increased, the specific reasons for market changes differ by region. For example, stock markets in the United States and Europe show higher integration, while Asian markets, including Indonesia, seem to move more independently. Managers need to pay attention to these regional differences when making investment choices. Understanding how each market operates will help them make smarter decisions. Additionally, the findings highlight the need for ongoing monitoring and analysis. As market conditions change, staying updated on correlations and risk factors will help managers adjust their strategies. This flexibility is crucial for managing risks and improving returns.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of the previous analysis and discussion, in general it shows that integration in the period after the Covid-19 pandemic was higher than in the period before the Covid-19 pandemic, meaning that there was an increase in integration of stock market due to the pandemic. The results of the principal component analysis show that the Indonesian stock market tends to be segmented with other stock markets in both periods. The Indonesian stock market tends to have a low correlation with other stock markets in both periods, although there is an increase in correlation from the previous period. Other results show that the components forming PC 1 are the stock markets of countries from the European and American continents, while the components forming PC 2 are the stock markets of countries from the Asian continent, meaning that geographical factors also influence the level of stock market integration.

Recommendations

The implications of this research show increased integration thereby reducing opportunities for portfolio diversification, but the opportunity for domestic investors to diversify their stock portfolios in other stock markets is still open. Domestic investors can diversify their stock portfolios in developed country stock markets because developed country stock markets are considered more resistant to shocks caused by the crisis. This research still has limitations, namely tte limited number of stock markets studied, so for future research it is recommended to add stock markets from other countries with large market capitalization or add stock markets from countries that have bilateral relations with Indonesia.

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