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RESEARCH ARTICLE

Network Topology of KLCI During the 2023 Malaysian State Elections: A Minimum Spanning Tree Approach

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ABSTRACT

A financial network represents stocks as nodes linked by correlations, reflecting the complex and dynamic nature of stock markets. While financial network analysis has been widely used to study market behaviour during major global events, limited attention has been given to structural changes in the Malaysian equity market during domestic political episodes. This study addresses this gap by examining network topology shifts surrounding the 2023 Malaysian State Elections, a period marked by heightened political fragmentation and uncertainty. The analysis focuses on the top 30 companies of the FTSE Bursa Malaysia KLCI. Daily closing prices are examined over a window spanning one month before and one month after the elections, from 11 July 2023 to 13 September 2023. The elections covered six states: Selangor, Kelantan, Terengganu, Negeri Sembilan, Kedah, and Penang. A minimum spanning tree approach is employed to visualise market structure, while degree centrality is used to measure the relative influence of individual stocks. The results reveal a clear regime shift driven by political sentiment. Prior to the elections, the network is highly centralised around Genting Malaysia Berhad, indicating market sensitivity to the "Green Wave" narrative and perceived regulatory risks affecting the gaming sector. Following the elections, the network rapidly reverts to a fundamentals-driven structure centered on major banking stocks, particularly CIMB and RHB Bank, reflecting a return to conventional macroeconomic considerations.

Contribution/Originality: This study is one of very few studies which have investigated how domestic state elections reshape the topological structure of the Malaysian equity market. Using minimum spanning tree and degree centrality analysis, it documents a politically driven regime shift in the KLCI, providing actionable insights for investors and policymakers during periods of political uncertainty.

1. Introduction

In most advanced democratic countries, the conduct of by-elections is an integral part in Elections serve as major exogenous shocks that introduce significant uncertainty into financial markets (Pástor and Veronesi, 2011). While existing literature extensively covers the impact of general elections on return volatility, less is known about how political events alter the topological structure of market correlations. Understanding these structural shifts is crucial for portfolio diversification, as assets that are uncorrelated during normal periods may suddenly synchronise during political crises. To predict a company's and the economy's future, it is important to understand the relationship between stocks. The relationship between the stocks will help investors identify the problems or difficulties that a certain stock market may face at a given time. A financial network consisting of nodes representing companies and edges representing relationships between stocks makes it easier for investors and researchers to analyse financial markets.

The minimum spanning tree (MST) technique is one of the widely applied to visualise complex systems such as financial markets, for instance Jang et al. (2011), Xie et al. (2017) and Kuranchie-Pong & Forson (2025). This technique, which was introduced by Mantegna (1999) in financial networks, is known to simplify the financial network by representing it as a graph with nodes and edges. The visualisation will help investors analyse changes in the relationship between the stocks. The relationship between the stocks can be identified by examining their correlation. This significance will help investors understand the relationships in the financial network. With this understanding, we can identify which stock plays the most important role during state elections. Several studies use the MST technique to construct and investigate a financial network. Numerous studies have investigated financial markets in Bursa Malaysia using the MST, including Yee and Salleh (2018), Bahaludin et al. (2019), Mahamood et al. (2019a), Bahaludin and Syafiq (2021), Zulrushdi et al. (2024), and Bahaludin et al. (2024).

The financial network can also help investors identify the most influential stock markets in a given period. The degree centrality technique is used to determine the most influential stock (Roy and Sarkar, 2011). This technique refers to the number of links between two stocks. The greater the number of links, the greater the influence of stock. This technique will result in a degree value for the stock market. The highest degree value of the stock market results in the most influential stock (Tomeczek, 2022). This method is also used in studies investigating changes in a financial network. Some studies investigated changes in the financial market using degree centrality, such as Mahamood (2019b) and Bahaludin et al. (2023).

From another perspective, several studies investigate the effect of elections on the stock market, see Liew and Rowland (2016), Memon et al. (2020), and Misman et al. (2020). Those studies concluded that elections have a significant impact on the stock market, as they cause the financial market to fluctuate during election periods. Recently, the Malaysian government held state elections in Selangor, Kelantan, Terengganu, Negeri Sembilan, Kedah, and Penang on 12 August 2023. This election causes fluctuations in the stock market due to political factors. It will also change the relationship between stock markets. The political event is expected to affect the Malaysian market during state elections.

Elections in Malaysia create some unease in the market. Even when the outcome is expected, investors usually adjust their positions while waiting for clearer policy signals. During this period, stocks do not move in isolation. Some sectors react faster, some absorb the shock, and others amplify it. Most studies of Bursa Malaysia still examine individual stock behavior in isolation. We do not have a clear picture of how stocks are linked or how uncertainty spreads across markets during an election. Without that network view, it is hard to tell which stocks are central, which ones are vulnerable, and how the overall market structure shifts in response to political events.

The objective in this study is two-fold. First is set out to fill that gap by constructing a financial network for the FTSE Bursa Malaysia KLCI before and after the Malaysian state election. Second, to identify the central nodes, or crucial stocks, in the financial network before and after the state elections. Therefore, the significance of the study is that it enables us to understand how the financial market behaves under political pressure by mapping the connections between stocks and providing useful information for both investors and policymakers.

2. Method

2.1. Data

In this study, we analysed data from the FTSE Bursa Malaysia KLCI over 60 days, comprising 30 days before, from 11 July 2023 until 11 August 2023, and 30 days after the state election, from 13 August 2023 until 13 September 2023. The data covers the top 30 companies listed on Bursa Malaysia. Data was obtained from secondary sources via the Investing.com website. The list of companies involved in the study is shown in Table 1.

Table 1: Bursa Malaysia sectorial index series.

No.	Name	RIC	Industry	Sector
1.	AMMB Holdings Bhd	AMMB	Banking Service	Financial
2.	Axiata	AXIA	Telecommunication Service	Technology
3.	CelcomDigi Bhd	CELC	Telecommunication Service	Technology
4.	CIMB Group	CIMB	Banking Service	Financial
5.	Dialog	DIAL	Oil & Gas Related Equipment and Services	Energy
6.	Genting	GENT	Hotels & Entertainment Services	Consumer Cyclicals
7.	Genting Malaysia	GENM	Hotels & Entertainment Services	Consumer Cyclicals
8.	Hong Leong Bank	HLBB	Banking Service	Financial
9.	Hong Leong Financial	HLCB	Banking Service	Financial
10.	IHH Healthcare	IHHH	Healthcare Providers & Services	Healthcare
11.	IOI Corp	IOIB	Food & Tobacco	Consumer Non-

				Cyclicals
12.	Kuala Lumpur Kepong	KLKK	Chemicals	Basic Material
13.	Malayan Banking	MBBM	Banking Service	Financial
14.	Maxis	MXSC	Telecommunication Service	Technology
15.	MISC Bhd	MISC	Transport Infrastructure	Industrial
16.	Mr D I Y	MRDI	Specialty Retailers	Consumer Cyclicals
17.	Nestle	NESM	Food & Tobacco	Consumer Non-Cyclicals
18.	Petronas Chemicals	PCGB	Chemicals	Basic Material
19.	Petronas Dagangan	PETR	Oil & Gas	Energy
20.	Petronas Gas	PGAS	Natural Gas Utilities	Utilities
21.	PPB	PEPT	Food & Tobacco	Consumer Non-Cyclicals
22.	Press Metal Bhd	PMET	Metals & Mining	Basic Materials
23.	Public Bank	PUBM	Banking Service	Financial
24.	QL Resources Bhd	QRES	Food & Tobacco	Consumer Non-Cyclicals
25.	RHB Bank	RHBC	Banking Service	Financial

2.2. The Minimum Spanning Tree

The MST method visualises the financial network and helps provide an understanding of its state. Visualisation has two main elements: nodes and edges. Nodes represent the stocks (companies), and edges represent the relationships between the analysed stocks. The distance between the stocks indicates their correlation. The longer the distance, the weaker the correlation is between the stocks. The MST is constructed through a chronological process. First, the rate of return is calculated, followed by the correlation and distance matrices. The Kruskal algorithm (1956) is then used to construct a minimum spanning tree.

First, cross-correlation matrices are calculated from the log returns of closing prices. The log returns, *r* can be computed as follows:

$$r_i(t) = \ln\frac{P_i(t+1)}{P_i(t)}$$

where the price of stock *i* on date *t* is represented by $P_i(t)$.
The correlation of coefficients between the stocks *i* and *j* is given by:

$$C_{ij} = \frac{\langle r_i r_j\rangle - \langle r_i\rangle\langle r_j\rangle}{\sqrt{(\langle r_i^2\rangle - \langle r_i\rangle^2)\left(\langle r_j^2\rangle - \langle r_j\rangle^2\right)}}$$

where $\langle \cdots \rangle$ represents the average over time. Correlation coefficients obtained within the range $-1 \leq C_{ij} \leq 1$. The values of −1 means are inversely correlated, and the values of 1 means are perfectly correlated between stocks. Meanwhile, the value of 0 shows that the stocks are uncorrelated. The symmetric $N \times N$ matrix will be formed by the correlation coefficient between stocks *i* and *j*.

Second, transform the correlation coefficients, C_{ij} into a distance matrix, *d* to construct the network. However, correlation coefficients cannot be treated as a distance between two stocks since they do not satisfy the properties of a Euclidean metric, which are:

$$\begin{cases} d_{ij} \geq 0 \\ d_{ij} = d_{ji} \\ d_{ij} \leq d_{ik} + d_{kj} \end{cases}$$

Thus, the distance between stock *i* and stock *j* can be calculated as follows:

$$d_{ij} = \sqrt{2(1 - C_{ij})}$$

Thirdly, the Kruskal algorithm is implemented to construct financial networks using the minimum spanning tree based on the distance matrix.

2.3. Degree Centrality

Centrality measures are used to analyse the financial network further. There are four types of centrality measures, namely degree centrality, betweenness, closeness, and eigenvector centrality. In this study, we utilised degree centrality to analyse the data in more depth.

Degree centrality represents the total number of stocks that are connected to a stock *i*. Freeman (1978) gives the calculation of degree centrality as follows:

$$C_{Degree}(i) = \frac{\sum_{J}^{N} A_{ij}}{N - 1}$$

where A_{ij} = 1 if the stocks *i* and *j* is connected, and 0 otherwise.

3. Results and Discussion

This section discusses the findings of the study. The results are shown by constructing financial networks that represent the situation of the financial markets before and after the state elections. The financial network is constructed using an MST, and a deeper analysis is conducted using degree centrality to identify the most influential stocks during the two periods. The analysis of correlation is also presented, showing the relationship between the stocks. This study also explains the correlation between stocks based on the financial networks constructed.

Figure 1 shows the correlation between the stocks before the state elections. Most stocks have positive correlations, while several have negative correlations. 367 pairs of stocks have a positive correlation. It can be observed in the blue-colored shape in the figure. Among these stocks, 11 pairs have strong correlation: AMMB–CIMB, AMMB–PUBM, AMMB–RHBC, CIMB–RHBC, DIAL–GENM, GENM–GENT, IOIB–TLMM, KLKK–TENA, MBBM–TENA, PCGB–PMET, and RHBC–PUBM. These pairs have a correlation value between 0.6 and 1.0. The pair with the highest positive correlation is GENM – GENT, with a value of 0.84582. This shows that the pair has a strong relationship where they will act together. The emergence of Genting Malaysia (GENM) as the central node prior to the election is a critical finding. This centralisation likely reflects investor anxiety regarding the 'Green Wave' political narrative. As the opposition coalition (Perikatan Nasional) advocated for stricter Islamic principles, non-shariah stocks (gaming and alcohol) became the focal point of market sensitivity. Consequently, GENM acted as the market bellwether, with systemic risk propagating from the gaming sector to the broader market.

Meanwhile, there are 68 pairs of stocks with a negative correlation. Among these stocks, only one pair has the highest negative correlation: SIME – MRDI. This pair has the highest negative correlation among the stocks, at -0.54469. This shows that the stocks have an inverse relationship: if one stock increases, the other will decrease. SIME and MRDI come from different industries and sectors. SIME is in the Consumer Non-Cyclicals sector, while MRDI is in the Consumer Cyclicals sector. This shows that stocks from different sectors will behave differently. Other than that, AMMB has the highest number of positive connections with other stocks: AMMB – CIMB, AMMB – PUBM, and AMMB – RHBC. These pairs came from the same sector and industry: the financial sector and the banking services industry. This relationship is consistent with the statement above, in which stocks from the same sectors and industries exhibit the same behaviour and act together. Whereas the stock with the highest number of negative connections is MRDI. It involves 10 pairs from different sectors and industries. This shows that MRDI is a stock that will act differently from the other stocks.

Figure 1: Correlation of stocks listed on FTSE Bursa Malaysia KLCI before the state elections.

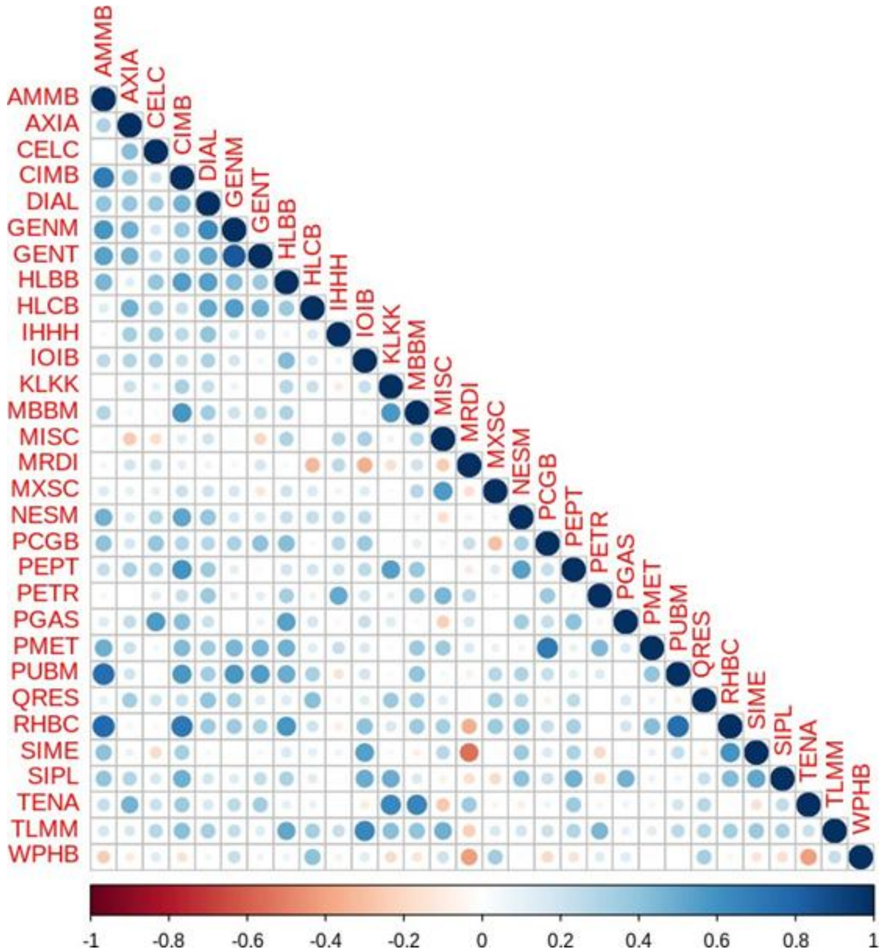
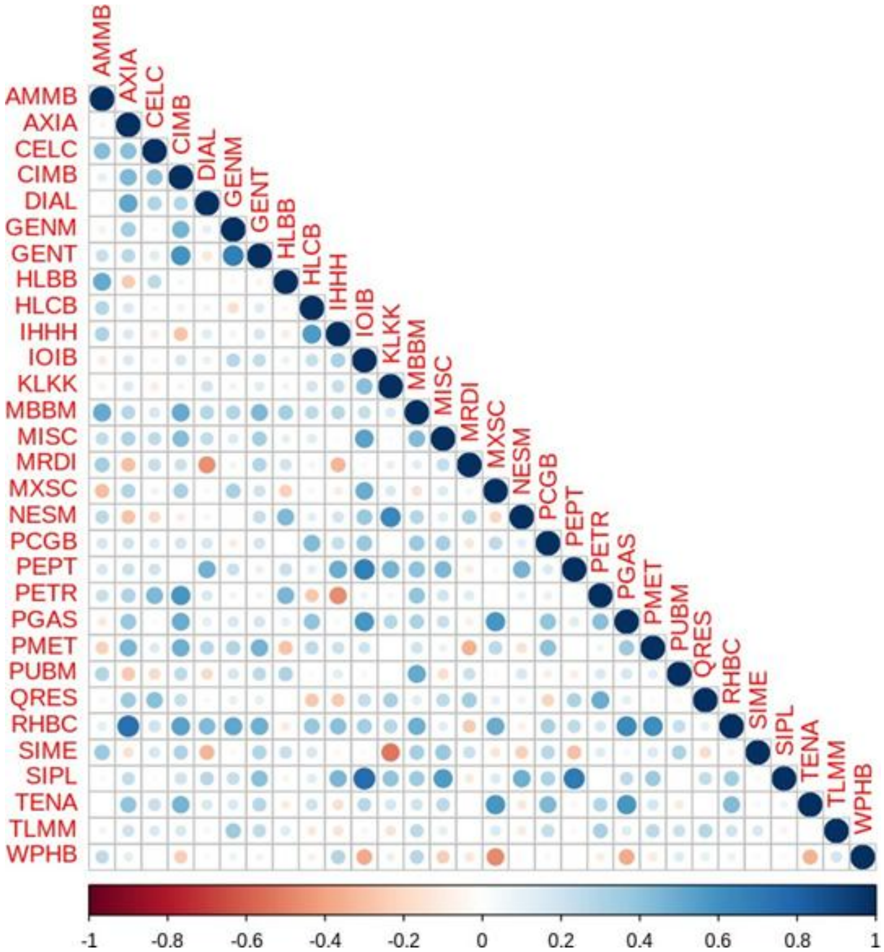


Figure 2 shows the correlation in stock prices after state elections. Generally, most stocks have positive correlations, and several have negative correlations. However, the number of positive correlations between the stocks has decreased compared to that before the state elections. Three hundred twenty-four pairs of stocks have positive correlations. It can be observed from the blue-coloured shape depicted in the figure. Among these stocks, eight pairs have strong correlations: AXIA–RHBC, GENM–GENT, IOIB–SIPL, IOIB–PEPT, KLKK–NESM, PEPT–SIPL, PGAS–RHBC, and PMET–RHBC. These pairs have a correlation value between 0.6 and 1.0. The pair with the highest positive correlation is IOIB - SIPL, with a value of 0.764074, indicating a strong relationship in which the pair will act together. It means that if one stock price increases, the other will also increase. IOIB and SIPL are in the same sector, which is consumer non-cyclicals.

These two stocks are also in the same industry: food and tobacco. Stocks in the same industry and sector will exhibit similar behaviour, as they have a strong positive correlation.

Figure 2: Correlation of stock listed on FTSE Bursa Malaysia KLCI after the state elections.



Meanwhile, there are 111 pairs of stocks with a negative correlation. Among these stocks, only one pair has the most negative correlation: MXSC - WPHB. This pair has the most negative correlation (-0.47952), indicating an inverse relationship: if one stock increases, the other decreases. MXSC and WPHB come from different industries. MXSC is in the technology sector, and WPHB is in the industrials sector, which shows that stocks from different sectors will behave differently. Other than that, IOIB has the highest number of positive connections with other stocks, which are IOIB – PEPT and IOIB - SIPL. These pairs came from the same sector and industry: the Consumer Non-Cyclicals sector and the Food and Tobacco industry. This relationship is consistent with the statement above, in which stocks from the same sectors and industries exhibit the same behaviour and act together.

On the other hand, the stock with the most negative connections is HLBB. It involves nine pairs across different sectors and industries, suggesting that HLBB will behave differently from other stocks.

3.2. Network Analysis

Figure 3 shows the minimum spanning tree of the stocks before the state elections. It shows that five clusters are formed, with RHBC at the centre. It is connected with HLBB, SIME, AMMB, and CIMB. The first cluster group consists of GENM, GENT, DIAL, AXIA, HLCB, WPHB, and QRES. The shortest distance between the nodes in the first group is the link between GENM and GENT, with a value of 0.555302. The second group consists of AMMB, PUBM, PMET, and PCGB. The shortest distance in this group is the link between AMMB and PUBM, with a value of 0.694551. The third cluster group consists of RHBC, HLBB, PGAS, and CELC, with node distances quite similar. Next, the fourth cluster group consists of CIMB, MBBM, TENA, KLKK, and MRDI. Lastly, the fifth cluster group consists of SIME, SIPL, IOIB, TLMM, MISC, MXSC, PETR, and IHHH. This is also the largest group, with eight stocks. The distance between the nodes is also quite similar. In addition, we identify the peripheral stocks, namely IHHH, MXSC, KLKK, MRDI, NESM, PCGB, QRES, WPHB, and CELC. These are stocks with the least risk among the others in the financial network.

Figure 3: Minimum spanning tree before state elections.

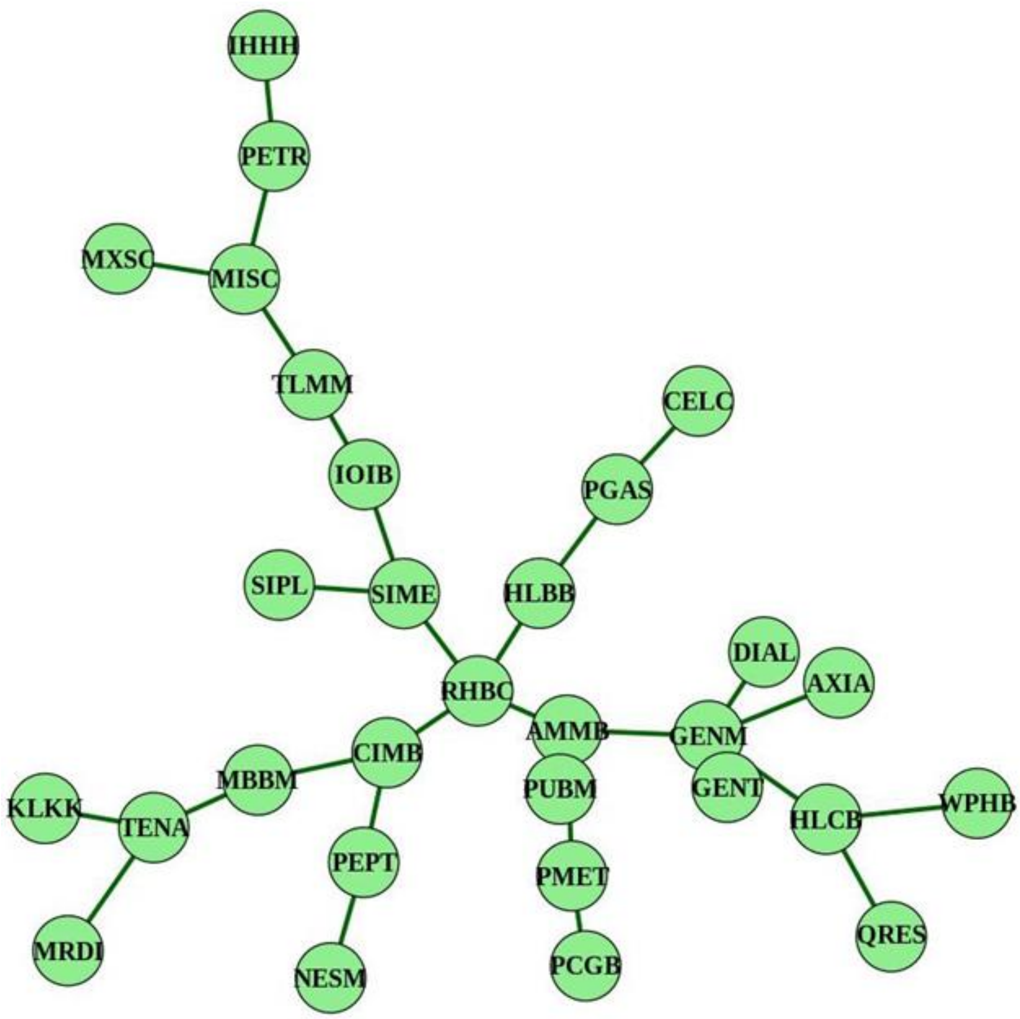


Figure 4 shows the minimum spanning tree of the stocks after the state elections. It shows that four clusters are formed, with RHBC at the centre. It is connected to AXIA, CIMB, PMET, and PGAS. The first cluster group consists of CIMB, GENT, GENM, TLMM, MBBM, AMMB, HLBB, PUBM, PETR, CELC, MRDI, and QRES. This is the largest group, with 12 stocks. The shortest distance between the nodes in the first group is the link between GENM and GENT, which has a value of 0.796107. The second cluster group consists of RHBC, PMET, AXIA, and DIAL. The shortest distance in this group is the link between RHBC and AXIA, with a value of 0.70844. The third cluster group consists of PGAS, TENA, MXSC, and PCGB, with the shortest inter-node distance being the link between TENA and MXSC. Lastly, the fourth cluster group consists of IOIB, SIPL, PEPT, IHHH, HLBC, WPHB, NESM, KLKK, MISC, and SIME. The smallest distance in the group is between NESM and KLKK. In addition, we identify the peripheral stocks, namely HLCB, HLBB, PUBM, TLMM, CELC, MRDI, PCGB, MXSC, SIME, KLKK, and WPHB. These stocks are the stocks that have the least risk among the other stocks in the financial network.

Figure 4: Minimum spanning tree after state elections.

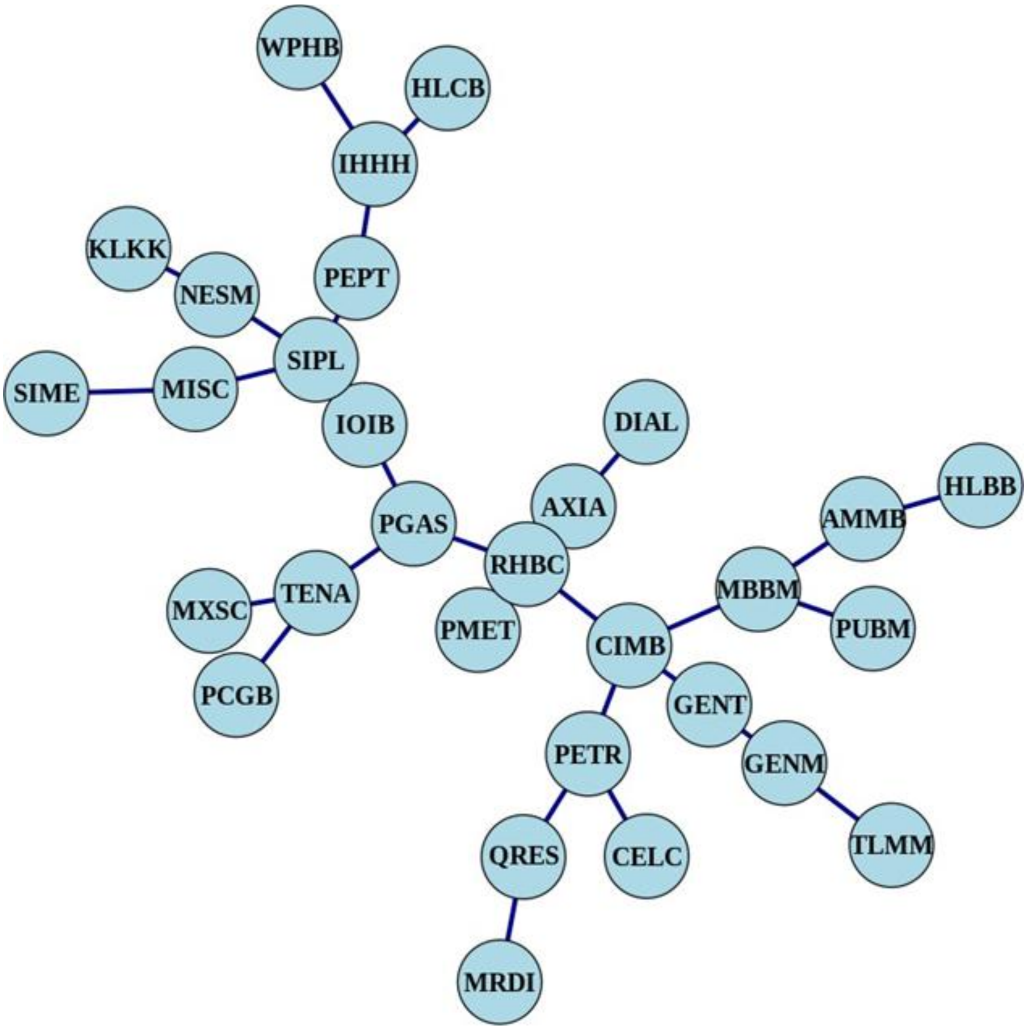


Figure 5 shows the network for degree centrality between the stocks before the state election. The size of nodes varies, reflecting the degree of centrality or influence level of a stock. The larger the stock, the greater its influence. Meanwhile, the width or thickness of the edges represents the strength of the relationship or the correlation between the stocks. The thicker the edge, the higher the relationship between the stocks. As can be seen, the most influential stock is GENM, as it is the largest size. The smallest stocks are KLKK, MRDI, NESM, CELC, PUBM, PCGB, GENT, QRES, WPHB, IHHH, and SIPL. These stocks are located at the end of the network, indicating that they have the least influence before the state election. Other than that, the positions of the stocks vary in this figure. The positions indicate each stock's level of risk. If the stock acts as a central node, it is

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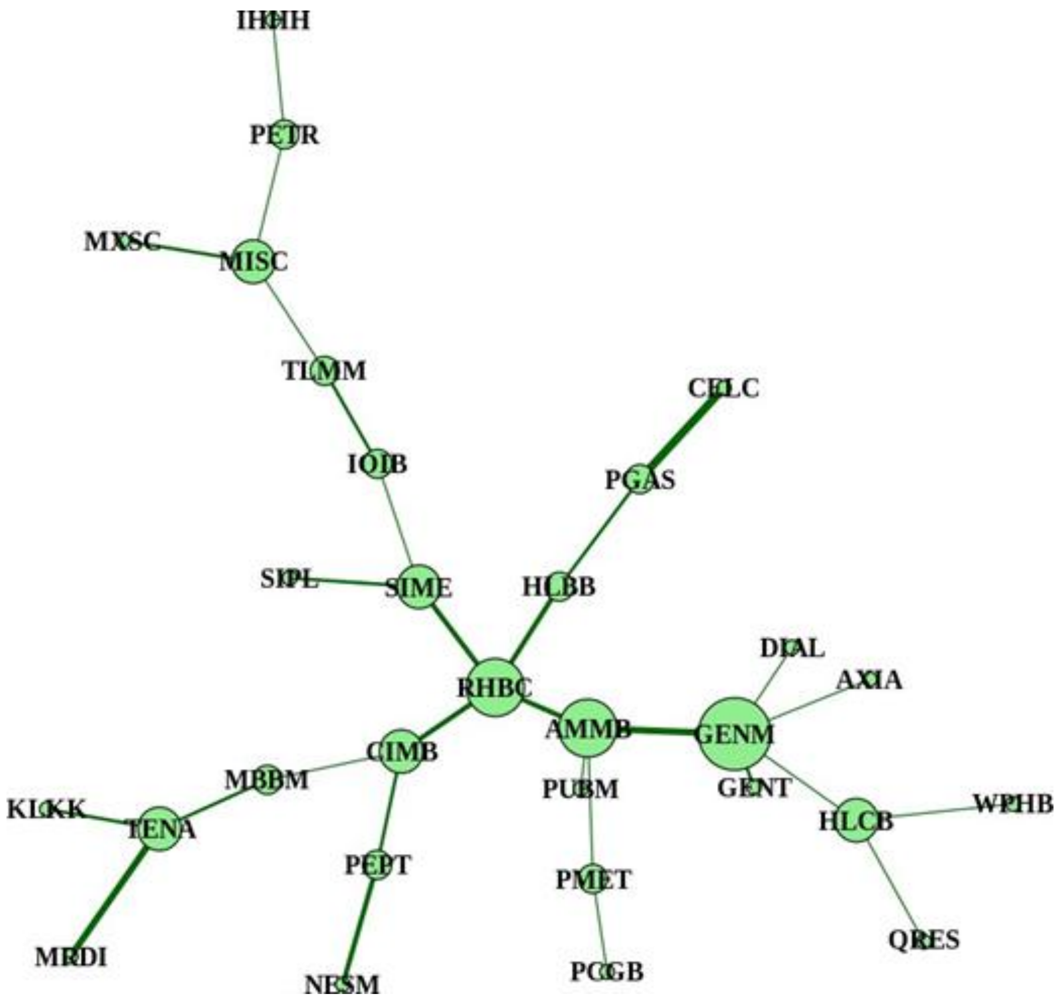
high-risk. Meanwhile, if the peripheral stocks are used, they have less risk. During the pre-election, RHBC acts as the central node, and the stocks at the end of the network serve as peripheral stocks.

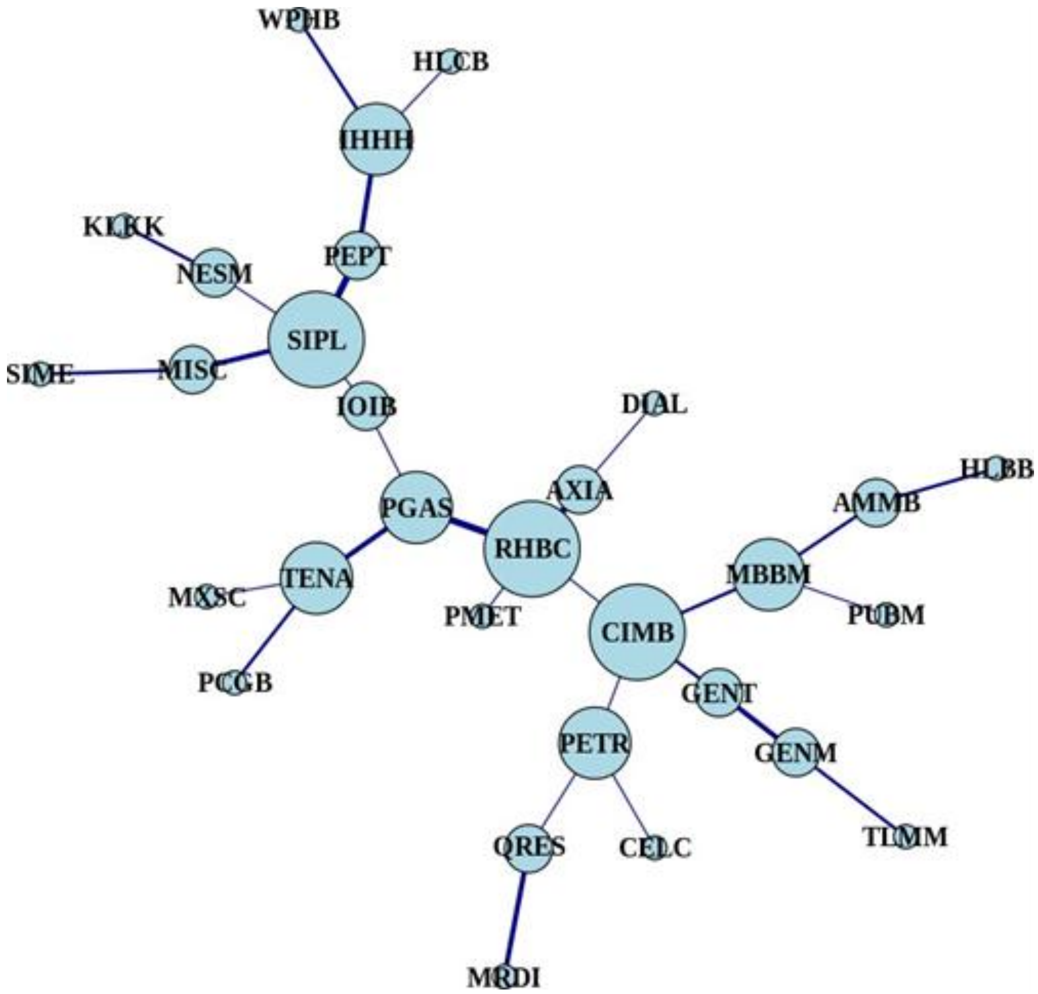
Figure 5: Minimum spanning tree before state elections based on the degree centrality.



Post-election, the network topology reorganised around financial institutions like CIMB and RHB as depicted in Figure 6. This shift indicates a return to fundamentals. Once the political status quo was preserved (the Unity Government retained key states), the regulatory risk premium on gaming stocks dissipated. The market's focus reverted to macroeconomic drivers such as interest rates and economic growth in which the banking sector serves as the traditional proxy.

The smallest stocks are MRDI, CELC, TLMM, KLKK, SIME, WPHB, HLCB, MXSC, and DIAL. These stocks have the least influence on the other stocks, as they are located at the end of the network. The financial markets are affected by state elections. The majority of stocks showed positive correlations before the state elections, whereas a small number showed negative correlations. The financial network saw a rise in negative correlations following the state elections, but overall positive correlations still dominated. It is highlighted that the number of the most influential stocks increases from one before the state elections to three after the state elections. Following the state elections, the number of peripheral stocks increased from 11 to 13. Apart from that, before the state elections, five groups developed. After the state elections, it was reduced to four groups of clusters. These results indicate that the state elections have a significant impact on the financial market.

Figure 6: Minimum spanning tree after state elections based on the degree of centrality.



3.4. Pre- and Post-Election Analysis

The network shows the identification of Genting Malaysia (GENM) as the primary central node during the pre-election phase. This is an unexpected outcome given that Malaysian banking institutions usually dominate in the stock market. This deviation appears closely linked to heightened political anxiety surrounding the "Green Wave" and the rising influence of the conservative opposition coalition, namely Perikatan Nasional. Investors probably thought the gambling industry was the asset class most vulnerable to changes in state administration, particularly regarding potential policy shifts on licensing and Shariah compliance.

Consequently, GENM effectively ceased trading on its own corporate fundamentals and instead traded as a proxy for political stability. The high degree of connectivity suggests that volatility in GENM driven by polling data or campaign rhetoric propagated rapidly to unrelated sectors, confirming that political regulatory risk was the dominant systematic factor during this window. Following the polling results on August 12, 2023, the network structure underwent rapid reorganisation. The centrality of GENM diminished significantly, while the banking sector, represented by CIMB and RHB Bank, reclaimed its position at the core of the minimum spanning tree.

This change in topology indicates the dissipation of the special regulatory risk premium associated with the election. As the Unity Government kept control of important economic states such as Selangor and Penang, which made the threat of radical policy changes for non-Shariah industries subsided. Therefore, the market's focus reverted to conventional macroeconomic variables such as interest rate outlooks and GDP growth. Since banks are the principal source of credit across the economy, their return to centrality means that the market is back to normal, in which systemic connection is once more motivated by economic health rather than political anxiety.

4. Conclusion

This study provides quantitative evidence that political events not only heighten volatility but also fundamentally transform the transmission channels of risk within the equities market. Our minimal spanning tree analysis shows a clear shift from a political-risk network focused on equities that are vulnerable to policy (gaming/GENM) to a fundamental-value network based on the financial sector (banks). This shows policymakers and portfolio managers that when there is ideological conflict, non-Shariah stocks may temporarily take the position of traditional blue chips as the main drivers of systemic correlation.

Ethics Approval and Consent to Participate

This study did not require ethics approval as no human participants were involved in the research process. All data were sourced exclusively from publicly available secondary financial databases via Investing.com. The study involved only quantitative analysis of historical stock price records, which are freely accessible and contain no personal, sensitive, or individually identifiable information.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declared that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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