

EXPLORING CORRELATIONS OF ENERGY COMPANIES ON BURSA MALAYSIA DURING THE COVID-19 PANDEMIC USING NETWORK ANALYSIS

(Meneroka Korelasi Syarikat Tenaga dalam Bursa Malaysia Semasa Pandemik COVID-19 Menggunakan Analisis Rangkaian)

HAFIZAH BAHALUDIN, ALYSSA APRIL DELLOW, MIMI HAFIZAH ABDULLAH,
MUNIRA ISMAIL & FATIMAH ABDUL RAZAK*

ABSTRACT

The COVID-19 pandemic has profoundly disrupted the global economy, and the energy sector has been particularly hard hit. With a sharp decline in the global economic outlook, the energy industry faced significant challenges, including a substantial drop in oil prices that reverberated throughout energy markets worldwide. In light of this unprecedented situation, our study aims to delve into the impact of COVID-19 on Shariah-compliant energy stocks listed on Bursa Malaysia between 2019 and 2020. To accomplish this, we employed the triangulated maximally filtered graph (TMFG) approach for analysing intricate datasets. By constructing networks using the TMFG technique and employing the degree centrality measure on 26 energy stocks in the pre-COVID period (2019) and during the COVID period (2020), we examined the structural changes and correlations within the networks. Notably, our findings reveal that the correlation among energy stocks became even stronger during the COVID period, highlighting the sector's heightened interdependence. Additionally, our analysis identifies Hibiscus Petroleum Bhd (HIBI) as the most influential stock throughout both timeframes, underscoring its significance amidst the pandemic-induced market fluctuations. These research outcomes carry significant practical implications, such as offering valuable insights to market participants in navigating the energy market's evolving landscape, which then enables informed decision-making for portfolio management and effective policy implementation.

Keywords: COVID-19; energy sector; Shariah-compliant stocks; Bursa Malaysia; triangulated maximally filtered graph; degree centrality; correlations; network analysis

ABSTRAK

Pandemik COVID-19 telah memberikan kesan mendalam terhadap ekonomi global, dan sektor tenaga terjejas teruk. Dengan kemerosotan mendadak dalam prospek ekonomi global, industri tenaga menghadapi cabaran besar, termasuk penurunan ketara dalam harga minyak yang memberi kesan kepada pasaran tenaga di seluruh dunia. Berdasarkan situasi yang belum pernah terjadi ini, kajian kami bertujuan untuk menyelidik kesan COVID-19 terhadap saham tenaga patuh syariah yang disenaraikan di Bursa Malaysia antara tahun 2019 dan 2020. Untuk mencapai matlamat ini, kami menggunakan pendekatan *triangulated maximally filtered graph* (TMFG) untuk menganalisis set data yang rumit. Dengan membina rangkaian menggunakan teknik TMFG dan ukuran pemusatan darjah ke atas 26 saham tenaga dalam tempoh sebelum COVID (2019) dan semasa COVID (2020), kami meneliti perubahan struktur dan korelasi dalam rangkaian-rangkaian tersebut. Penemuan kami mendedahkan bahawa korelasi antara saham tenaga menjadi lebih kuat semasa tempoh COVID, menonjolkan kesalingbergantungan sektor yang semakin meningkat. Selain itu, analisis kami mengenal pasti Hibiscus Petroleum Bhd (HIBI) sebagai saham paling berpengaruh sepanjang kedua-dua tempoh masa ini, menekankan kepentingannya di tengah-tengah turun naik pasaran yang disebabkan oleh pandemik. Hasil penyelidikan ini membawa implikasi praktikal seperti memberikan maklumat

berkaitan pasaran tenaga, yang kemudiannya membolehkan pembuatan keputusan yang efektif serta pengurusan portfolio dan pelaksanaan dasar berkesan.

Kata kunci: COVID-19; sektor tenaga; saham patuh Syariah; Bursa Malaysia; *triangulated maximally filtered graph*; pemusatan darjah; korelasi; analisis rangkaian

References

- Abbasian-Naghneh S., Tehrani R. & Tamimi M. 2020. The network analysis of Tehran stock exchange using minimum spanning tree and hierarchical clustering. *Iranian Journal of Finance* **4**(2): 1–18.
- Abdul Razak F. & Expert P. 2021. Modelling the spread of COVID-19 on Malaysian contact networks for practical reopening strategies in an institutional setting. *Sains Malaysiana* **50**(5): 1497–1509.
- Aslam F., Mohmand Y.T., Ferreira P., Memon B.A., Khan M. & Khan M. 2020. Network analysis of global stock markets at the beginning of the coronavirus disease (COVID-19) outbreak. *Borsa Istanbul Review* **20**: S49–S61.
- Bahaludin H. & Muhammad Syafiq S.N.A. 2021. The impact of COVID-19 on industrial products and services sector of Bursa Malaysia by using minimum spanning tree. *Menemui Matematik (Discovering Mathematics)* **43**(2): 111–120.
- Barabási A.-L. & Albert R. 1999. Emergence of scaling in random networks. *Science* **286**(5439): 509–512.
- Bardoscia M., Barucca P., Battiston S., Caccioli F., Cimini G., Garlaschelli D., Saracco F., Squartini T. & Caldarelli G. 2021. The physics of financial networks. *Nature Reviews Physics* **3**(7): 490–507.
- Basel Committee on Banking Supervision. 2013. *Global Systemically Important Banks: Updated Assessment Methodology and the Higher Loss Absorbency Requirement*. Bank for International Settlements.
- Berouaga Y., El Msiyah C. & Madkour J. 2023. Portfolio optimization using minimum spanning tree model in the Moroccan stock exchange market. *International Journal of Financial Studies* **11**(2): 53.
- Briola A. & Aste T. 2022. Dependency structures in cryptocurrency market from high to low frequency. *Entropy* **24**(11): 1548.
- Briola A. & Aste T. 2023. Topological feature selection. *Proceedings of 2nd Annual Workshop on Topology, Algebra, and Geometry in Machine Learning (TAG-ML)*, pp. 534–556.
- Bursa Malaysia. 2024. *Bursa Malaysia Sectorial Index Series*. Kuala Lumpur: Bursa Malaysia.
- Bursa Malaysia. n.d.a. Shariah-compliant stocks (i-Stocks). https://www.bursamalaysia.com/trade/our_products_services/islamic_market/bursa_malaysia_i/shariah_compliant_stocks (9 May 2024).
- Bursa Malaysia. n.d.b. Shariah screening methodology. https://www.bursamalaysia.com/trade/our_products_services/islamic_market/shariah_governance/shariah_screening_methodology (19 May 2024).
- Chan-Lau J.A. 2018. Systemic centrality and systemic communities in financial networks. *Quantitative Finance and Economics* **2**(2): 468–496.
- Chen D., Hu H. & Zheng M. 2021. How does energy production respond to the COVID-19 pandemic? Evidence from China. *Asian Economics Letters* **2**(2).
- Chen J. 2023. What is systemic risk? Definition in banking, causes and examples. <https://www.investopedia.com/terms/s/systemic-risk.asp> (4 April 2024).
- Chundakkadan R. & Nedumparambil E. 2022. In search of COVID-19 and stock market behavior. *Global Finance Journal* **54**: 100639.
- Clemente G.P., Grassi R. & Hitaj A. 2021. Asset allocation: New evidence through network approaches. *Annals of Operations Research* **299**(1): 61–80.
- Colander D., Goldberg M., Haas A., Juselius K., Kirman A., Lux T. & Sloth B. 2009. The financial crisis and the systemic failure of the economics profession. *Critical Review: A Journal of Politics and Society* **21**(2–3): 249–267.
- Dellow A.A., Ismail M., Bahaludin H. & Razak F.A. 2024. Comparing the impacts of past major events on the network topology structure of the Malaysian consumer products and services sector. *Journal of the Knowledge Economy*.
- Dimitrios K. & Vasileios O. 2015. A network analysis of the Greek stock market. *Procedia Economics and Finance* **33**: 340–349.
- Epstein G. 2019. Financialization, rentier interests and central bank policy. In *The Political Economy of Central Banking*, pp. 380–406. Edward Elgar Publishing.
- Ertuğrul H.M., Güngör B.O. & Soytas U. 2020. The effect of the COVID-19 outbreak on the Turkish diesel consumption volatility dynamics. *Energy RESEARCH LETTERS* **1**(3).

- Financial Stability Board. 2011. *Policy Measures to Address Systemically Important Financial Institutions*. France: Financial Stability Board.
- Freeman L.C. 1977. A set of measures of centrality based on betweenness. *Sociometry* **40**(1): 35–41.
- Freeman L.C. 1978. Centrality in social networks conceptual clarification. *Social Networks* **1**(3): 215–239.
- Ghabri Y., Ayadi A. & Guesmi K. 2021. Fossil energy and clean energy stock markets under COVID-19 pandemic. *Applied Economics* **53**(43): 4962–4974.
- Gil-Alana L.A. & Monge M. 2020. Crude oil prices and COVID-19: Persistence of the shock. *Energy RESEARCH LETTERS* **1**(1): 1–4.
- Güngör B.O., Ertuğrul H.M. & Soytaş U. 2021. Impact of COVID-19 outbreak on Turkish gasoline consumption. *Technological Forecasting and Social Change* **166**(3): 120637.
- Hoang A.T., Nižetić S., Olcer A.I., Ong H.C., Chen W.-H., Chong C.T., Thomas S., Bandh S.A. & Nguyen X.P. 2021. Impacts of COVID-19 pandemic on the global energy system and the shift progress to renewable energy: Opportunities, challenges, and policy implications. *Energy Policy* **154**: 112322.
- Hua J., Wang G. & Xu Y. 2019. Adopting centrality measure models in visualized financial datasets. *2019 International Conference on Image and Video Processing, and Artificial Intelligence*, pp. 1132103.
- Huang S. & Liu H. 2021. Impact of COVID-19 on stock price crash risk: Evidence from Chinese energy firms. *Energy Economics* **101**: 105431.
- Kang H., An J., Kim H., Ji C., Hong T. & Lee S. 2021. Changes in energy consumption according to building use type under COVID-19 pandemic in South Korea. *Renewable and Sustainable Energy Reviews* **148**: 111294.
- Kazemilari M., Mardani A., Streimikiene D. & Zavadskas E.K. 2017. An overview of renewable energy companies in stock exchange: Evidence from minimal spanning tree approach. *Renewable Energy* **102**: 107–117.
- Khan Tareen H. & Siddiqui D.A. 2019. Analysis on impact of macro-economic and returns on shariah compliant and non-compliant portfolio: Evidence from the capital structure and volatility of Pakistan stock market. Available at SSRN: <https://ssrn.com/abstract=3384215> or <http://dx.doi.org/10.2139/ssrn.3384215>.
- Le T.-H., Le A.T. & Le H.-C. 2021. The historic oil price fluctuation during the COVID-19 pandemic: What are the causes? *Research in International Business and Finance* **58**(4): 101489.
- Liu C. 2021a. COVID-19 and the energy stock market: Evidence from China. *Energy RESEARCH LETTERS* **2**(3).
- Liu K. 2021b. The effects of COVID-19 on Chinese stock markets: An EGARCH approach. *Economic and Political Studies* **9**(2): 148–165.
- Liu T., Nakajima T. & Hamori S. 2022. The impact of economic uncertainty caused by COVID-19 on renewable energy stocks. *Empirical Economics* **62**(4): 1495–1515.
- Lu H., Ma X. & Ma M. 2021. Impacts of the COVID-19 pandemic on the energy sector. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)* **22**(12): 941–956.
- Mahdi B.S., Al-Bayati J.H.H. & Al-Mahdawi A.J. 2022. Minimum spanning tree application in COVID-19 network structure analysis in the countries of the Middle East. *Journal of Discrete Mathematical Sciences and Cryptography* **25**(8): 2723–2728.
- Mantegna R.N. 1999. Hierarchical structure in financial markets. *The European Physical Journal B* **11**(1): 193–197.
- Massara G.P., Di Matteo T. & Aste T. 2017. Network filtering for big data: Triangulated maximally filtered graph. *Journal of Complex Networks* **5**(2): 161–178.
- Ministry of Economy. 2023. *National Energy Transition Roadmap: Energising the Nation, Powering Our Future*. Putrajaya: Ministry of Economy.
- Mo D. & Chen Y. 2021. Projecting financial technical indicators into networks as a tool to build a portfolio. *IEEE Access* **9**: 39973–39984
- Nobi A., Maeng S.E., Ha G.G. & Lee J.W. 2014. Effects of global financial crisis on network structure in a local stock market. *Physica A: Statistical Mechanics and its Applications* **407**: 135–143.
- Peralta G. & Zareei A. 2016. A network approach to portfolio selection. *Journal of Empirical Finance* **38**: 157–180.
- Pozzi F., Di Matteo T. & Aste T. 2013. Spread of risk across financial markets: Better to invest in the peripheries. *Scientific Reports* **3**: 1665.
- Raza M.W., Said B. & Elshahat A. 2023. COVID-19 and informational efficiency in Asian emerging markets: A comparative study of conventional and Shariah-compliant stocks. *International Journal of Islamic and Middle Eastern Finance and Management* **16**(3): 576–592.
- Salvi A., Zito M. & Caragnano A. 2019. Does it pay to be Shariah-compliant? Evidence from the European stock market. *European Journal of Islamic Finance*.
- Samitas A., Kampouris E. & Polyzos S. 2022. COVID-19 pandemic and spillover effects in stock markets: A financial network approach. *International Review of Financial Analysis* **80**(2): 102005.
- Suranathan S., Abdullah M.H., Fauzi M.A., Omar M. & Bahaludin H. 2024. The FTSE Bursa Malaysia emas index financial networks: A case of US-China trade war. *Proceedings Of The 29th National Symposium On Mathematical Sciences*, pp. 050001.
- Tumminello M., Aste T., Di Matteo T. & Mantegna R.N. 2005. A tool for filtering information in complex systems. *Proceedings of the National Academy of Sciences* **102**(30): 10421–10426.

- Turiel J., Barucca P. & Aste T. 2022. Simplicial persistence of financial markets: Filtering, generative processes and structural risk. *Entropy* **24**(10): 1482.
- Wielechowski M. & Czech K. 2022. Companies' stock market performance in the time of COVID-19: Alternative energy vs. main stock market sectors. *Energies* **15**(1): 106.
- Xiong H., Shi W., Xu S. & Shen H. 2021. Impact of COVID-19 on corporate liabilities in the energy & power industry. *Energy RESEARCH LETTERS* **2**(1).
- Xu Q., Wang L., Jiang C., Jia F. & Chen L. 2022. Tail dependence network of new energy vehicle industry in mainland China. *Annals of Operations Research* **315**(1): 565–590.
- Yu S. & Shun J. 2023. Parallel filtered graphs for hierarchical clustering. *2023 IEEE 39th International Conference on Data Engineering (ICDE)*, pp. 1967–1980.

Department of Computational and Theoretical Sciences
Kulliyah of Science
International Islamic University Malaysia
Bandar Indera Mahkota Campus, Jalan Sultan Ahmad Shah,
25200 Kuantan
Pahang, MALAYSIA
E-mail: hafizahbahaludin@iium.edu.my, mimihafizah@iium.edu.my

Department of Mathematical Sciences
Faculty of Science and Technology
Universiti Kebangsaan Malaysia
43600, Bangi
Selangor, MALAYSIA
*E-mail: alyssaaprialdellow@gmail.com, munira@ukm.edu.my, fatima84@ukm.edu.my**

Received: 2 June 2024

Accepted: 1 July 2024

*Corresponding author