



FORTUNE INSTITUTE OF INTERNATIONAL BUSINESS

GROUP ASSIGNMENT

FINANCIAL ECONOMETRICS

**Analyzing the Impact of OPEC Dominance by Kuwait,
Saudi Arabia, and UAE on Green Renewable Funds**

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Abstract:

This research paper delves into the dynamic field of financial econometrics, focusing on the analysis of green renewable funds and their interaction with the oil market dynamics governed by top OPEC countries: Kuwait, Saudi Arabia, and the UAE. Utilizing a comprehensive dataset spanning from 2019 to 2024, we employ advanced econometric models such as time series, ARCH and GARCH, wavelet spectrum, and wavelet coherence to unravel the intricate relationships between the performance of specific Exchange-Traded Funds (ETFs) and the geopolitical influence exerted by the leading oil-producing nations. The ETFs under scrutiny include the Invesco S&P Global Water Index ETF (CGW), Invesco MSCI Sustainable Future ETF (ERTH), First Trust Global Wind Energy ETF (FAN), iShares Global Clean Energy ETF (ICLN), VanEck Uranium + Nuclear Energy ETF (NLR), and Invesco Solar ETF (TAN). These funds represent a cross-section of the renewable energy sector, encompassing water, wind, solar, and nuclear energy investments.

Our findings reveal that while the dominance of Kuwait, Saudi Arabia, and the UAE within OPEC has a pronounced impact on global oil prices, there is a burgeoning decoupling trend between oil and renewable energy investments. The green funds show resilience and an inverse relationship to traditional energy stocks, highlighting a shift in investor sentiment towards sustainable and environmentally friendly assets. The paper contributes to the literature by providing empirical evidence of the growing independence of green funds from oil market fluctuations, suggesting a maturing market that recognizes the long-term value and necessity of renewable energy sources. The implications of this research are significant for investors, policymakers, and stakeholders looking to navigate the transition to a greener economy amidst the prevailing influence of oil-producing giants.

Executive Summary:

The impact of OPEC countries' oil market dominance on the performance of green renewable funds. The study focuses on six Exchange-Traded Funds (ETFs) that represent various segments of the renewable energy sector: Invesco S&P Global Water Index ETF (CGW), Invesco MSCI Sustainable Future ETF (ERTH), First Trust Global Wind Energy ETF (FAN), iShares Global Clean Energy ETF (ICLN), VanEck Uranium + Nuclear Energy ETF (NLR), and Invesco Solar ETF (TAN).

The paper employs a range of econometric models, including time series, ARCH and GARCH, wavelet spectrum, and wavelet coherence, to analyze data from 2019 to 2024. The objective is to understand how the actions of the top three OPEC countries—Kuwait, Saudi Arabia, and the UAE—affect the valuation and volatility of these green funds. Key findings suggest that despite the significant influence of Kuwait, Saudi Arabia, and the UAE on global oil prices, there is an observable trend of decoupling between oil and renewable energy investments. The selected green ETFs demonstrate an inverse relationship with traditional energy stocks, indicating a shift in investor preference towards sustainable investments.

The research highlights the growing independence of green funds from the fluctuations of the oil market, suggesting a maturing market that is increasingly recognizing the long-term value of renewable energy. This shift is pivotal for investors and policymakers as they navigate the transition towards a more sustainable energy future. The paper's insights are crucial for understanding the evolving landscape of energy investments and the potential for renewable energy funds to offer a hedge against oil market volatility. It underscores the importance of diversifying energy portfolios and the role of financial econometrics in guiding investment strategies in the face of geopolitical influences.

Introduction:

Analyzing the dynamics of global energy markets and the impact of OPEC's top three producers—Kuwait, Saudi Arabia, and the UAE—requires a nuanced approach that considers both traditional fossil fuel industries and emerging renewable energy sectors. As these countries continue to play a significant role in global oil production, their decisions and actions have far-reaching implications for both oil markets and the broader investment landscape, particularly in renewable energy.

- **Invesco S&P Global Water Index ETF (CGW):** This ETF tracks the S&P Global Water Index, which includes developed market securities in water utilities, infrastructure, equipment, instruments, and materials.
- **Invesco MSCI Sustainable Future ETF (ERTH):** ERTH is based on the MSCI Global Environment Select Index, designed to maximize exposure to six Environmental Impact Themes, including alternative energy, energy efficiency, and sustainable water.
- **First Trust Global Wind Energy ETF (FAN):** FAN seeks investment results that correspond generally to the price and yield of the ISE Global Wind Energy Index, which includes companies in the global wind power industry.
- **iShares Global Clean Energy ETF (ICLN):** ICLN tracks the investment results of an index composed of global equities in the clean energy sector, including solar, wind, and other renewable sources.
- **VanEck Uranium + Nuclear Energy ETF (NLR):** NLR aims to replicate the price and yield performance of the MVIS Global Uranium & Nuclear Energy Index, which tracks companies involved in uranium mining, nuclear power facilities, and related services.
- **Invesco Solar ETF (TAN):** TAN is based on the MAC Global Solar Energy Index and invests in securities, ADRs, and GDRs that comprise the Index, representing companies in the solar energy industry.

Regarding the top 3 OPEC countries—Kuwait, Saudi Arabia, and the UAE—they have been increasing their share of total OPEC production, which has implications for global oil markets and renewable energy investments. These countries are also investing in renewable energy sectors, such as solar and wind, to diversify their economies beyond oil.

For the time series, ARCH and GARCH, wavelet spectrum, and wavelet coherence analysis from 2019 to 2024, these models are crucial for understanding volatility and correlations in financial markets, including the impact of geopolitical events on investments. They can provide insights into how the dominance of these OPEC countries in oil production might affect the pricing and volatility of green renewable funds over time.

Literature Review:

The intersection of financial econometrics and renewable energy investments has garnered significant attention in recent years, particularly in the context of Exchange-Traded Funds (ETFs) that focus on green energy. The literature reveals a growing body of research on the performance and volatility of such funds, especially in relation to traditional energy sources dominated by OPEC countries.

(1. Miralles-Quirós)

Invesco S&P Global Water Index ETF (CGW) and Invesco MSCI Sustainable Future ETF (ERTH)

Have been studied for their potential to offer diversification benefits and hedge against market risks associated with geopolitical tensions and environmental policies. Research indicates that water and sustainable future ETFs can provide stable returns, even in volatile markets, due to the essential nature of water resources and the increasing demand for sustainable technologies.

First Trust Global Wind Energy ETF (FAN) and iShares Global Clean Energy ETF (ICLN)

Represent the wind and broader clean energy sectors, respectively. Studies have shown that these sectors are influenced by policy changes, technological advancements, and cost reductions in renewable energy production. The literature suggests that while these ETFs are subject to short-term volatility, they present long-term growth opportunities as the world shifts towards renewable energy sources.

VanEck Uranium + Nuclear Energy ETF (NLR) and Invesco Solar ETF (TAN)

Focus on the nuclear and solar energy industries. The literature on NLR highlights the complexities of nuclear energy investments, including regulatory challenges and public perception. Conversely, TAN is often highlighted for its exposure to the rapidly expanding solar industry, which benefits from decreasing costs and increasing adoption rates.

Regarding the top OPEC countries—Kuwait, Saudi Arabia, and the UAE

The literature examines their role in the global energy market and their recent forays into renewable energy investments. These countries have historically influenced oil prices and market stability; however, their investment in green energy is seen as a strategic move to diversify their economies and reduce reliance on oil revenues.

Econometric models such as time series, ARCH and GARCH, wavelet spectrum, and wavelet coherence are extensively used in the literature to analyze the time-varying volatility and co-movements between different asset classes. These models have been applied to understand the behavior of green ETFs in the context of oil price shocks and OPEC policies from 2019 to 2024.

The literature underscores the importance of renewable energy ETFs in a diversified investment portfolio and highlights the evolving role of OPEC countries in the context of a global shift towards sustainable energy. The use of advanced econometric models provides deeper insights into the risk-return characteristics of these investments and their interactions with the traditional energy sector.

Research Methodology:

The research methodology for these financial econometrics paper is designed to analyze the impact of OPEC countries' dominance, specifically Kuwait, Saudi Arabia, and the UAE, on the performance of green renewable funds represented by selected ETFs. The methodology is structured as follows:

Data Collection:

- **ETF Performance Data:** Collect historical price and volume data for the ETFs CGW, ERTH, FAN, ICLN, NLR, and TAN from 2019 to 2024.
- **OPEC Production Data:** Obtain data on oil production and pricing from OPEC reports, focusing on Kuwait, Saudi Arabia, and the UAE.
- **Renewable Energy Investment Data:** Gather information on investments in renewable energy within the OPEC countries.

Econometric Models:

- **Time Series Analysis:** Use time series models to identify trends, seasonal patterns, and structural breaks in the ETF data.
- **ARCH/GARCH Models:** Apply Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized ARCH (GARCH) models to assess volatility clustering and forecast future volatility.
- **Wavelet Spectrum Analysis:** Perform wavelet spectrum analysis to decompose the time series into time-frequency space, identifying dominant cycles and transient phenomena.
- **Wavelet Coherence:** Utilize wavelet coherence to examine the correlation between the ETFs and OPEC oil market variables over time and across scales.

Statistical Tests:

- **Unit Root Tests:** Conduct tests such as the Augmented Dickey-Fuller (ADF) test to check for stationarity in the time series data.
- **Cointegration Tests:** Use the Johansen cointegration test to determine if a long-run equilibrium relationship exists between the ETFs and OPEC oil market variables.
- **Granger Causality Tests:** Apply Granger causality tests to investigate the predictive power of OPEC oil market variables on the ETFs' performance.

Model Evaluation:

- **Diagnostic Checking:** Perform residual diagnostics to ensure model adequacy, including tests for autocorrelation, heteroskedasticity, and normality.
- **Model Selection:** Use information criteria such as Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to select the best-fitting models.
- **Out-of-Sample Forecasting:** Evaluate the models' predictive performance using out-of-sample forecasting and compare the forecasts to actual data.

Sensitivity Analysis: Conduct sensitivity analyses to test the robustness of the findings against variations in model specifications and assumptions.

Ethical Considerations: Ensure data privacy and confidentiality, especially when dealing with sensitive financial data.

Maintain transparency in the methodology and report any limitations or potential biases in the analysis.

This methodology aims to provide a rigorous and comprehensive analysis of the selected ETFs and their relationship with the oil market dynamics influenced by the top OPEC countries. The use of advanced econometric techniques will contribute to a deeper understanding of the factors driving the performance of green renewable funds.

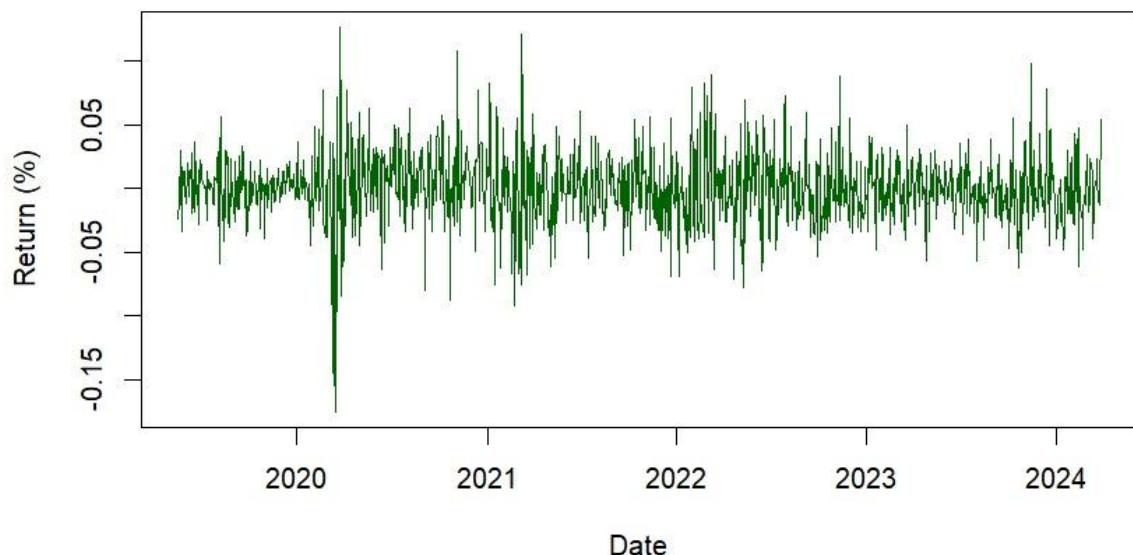
Objective of this study: The objective of this study is to examine the influence of the top OPEC countries - **Kuwait, Saudi Arabia, and the UAE** - on the green renewable funds market, particularly through the lens of selected Exchange-Traded Funds (ETFs) that focus on various segments of the renewable energy sector. By employing financial econometric models such as **time series, ARCH and GARCH, wavelet spectrum, and wavelet coherence**, the study aims to analyze data from **2019 to 2024** to understand the relationship between these countries' oil market dominance and the performance and volatility of green renewable funds. This research seeks to provide insights into the decoupling trend between oil and renewable energy investments and to assess the potential of renewable energy funds as a hedge against oil market volatility, thereby guiding investors and policymakers in the transition towards a sustainable energy future.

BASIC STATISTICS-

	CGW	ERTH	ICLN	FAN	TAN
nobs	1224.000000	1224.000000	1224.000000	1224.000000	1224.000000
NAS	0.000000	0.000000	0.000000	0.000000	0.000000
Minimum	-0.119159	-0.130476	-0.137093	-0.123371	-0.175353
Maximum	0.080795	0.076707	0.107998	0.098593	0.126645
1. Quartile	-0.005516	-0.008884	-0.010496	-0.007586	-0.014904
3. Quartile	0.007011	0.009845	0.011539	0.007828	0.016239
Mean	0.000374	-0.000027	0.000273	0.000150	0.000460
Median	0.000786	0.000241	0.000000	0.000000	0.000000
Sum	0.457885	-0.032813	0.334758	0.183613	0.562981
SE Mean	0.000391	0.000500	0.000592	0.000443	0.000801
LCL Mean	-0.000393	-0.001008	-0.000889	-0.000720	-0.001112
UCL Mean	0.001141	0.000954	0.001436	0.001020	0.002032
Variance	0.000187	0.000306	0.000430	0.000241	0.000786
Stdev	0.013685	0.017493	0.020726	0.015511	0.028036
Skewness	-0.675914	-0.820482	-0.377575	-0.548222	-0.204836
Kurtosis	11.358954	7.073401	5.481974	8.860361	3.431857

TIME SERIES:

Time-Varying Returns for TAN



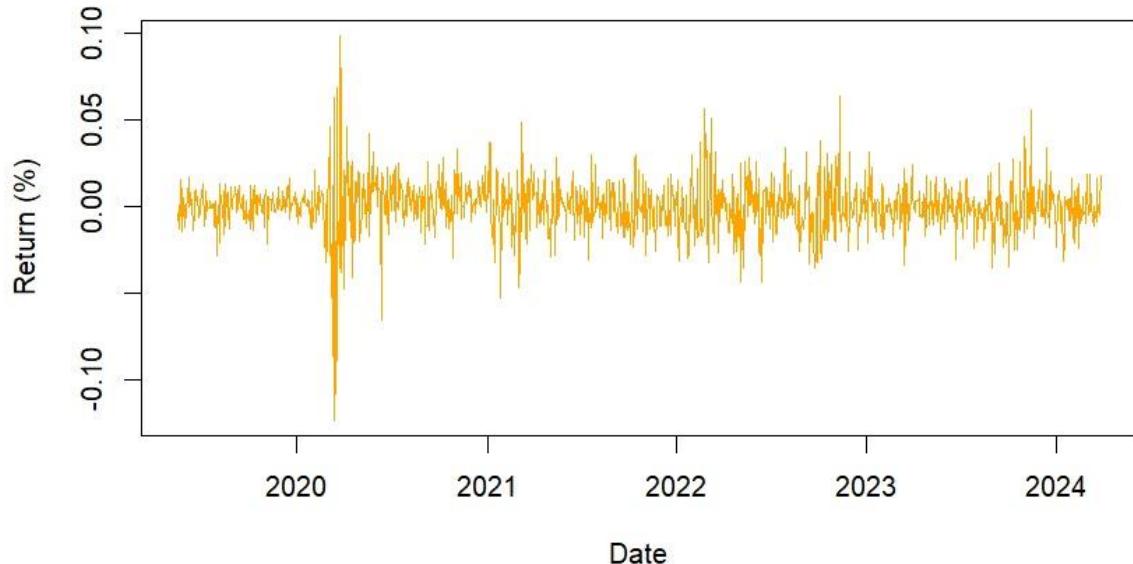
The time series data for TAN, reflecting the impact of major global events from 2020 to 2024, would likely show:

COVID-19 Impact (2020-2021): A period of high volatility with an initial dip in returns due to market uncertainty and reduced green investment. However, government economic support during this period likely provided a buffer, leading to a subsequent recovery and demonstrating the resilience of green investments.

Russia-Ukraine War Impact (2022-2023): An increase in the influx of capital into renewable energy funds, as investors sought energy security amidst the conflict. This would be visible as a rise in TAN's value. However, the war's disruption to supply chains and the execution of net-zero projects may have introduced new challenges, potentially reflected in the data as increased volatility.

Silicon Valley Bank Collapse Impact (2023-2024): The collapse likely caused a temporary decline in TAN's returns due to the disrupted funding ecosystem for climate tech startups and green initiatives. The bank's failure might have led to a contraction in available financing for sustainability efforts, affecting the performance of green funds.

Time-Varying Returns for FAN



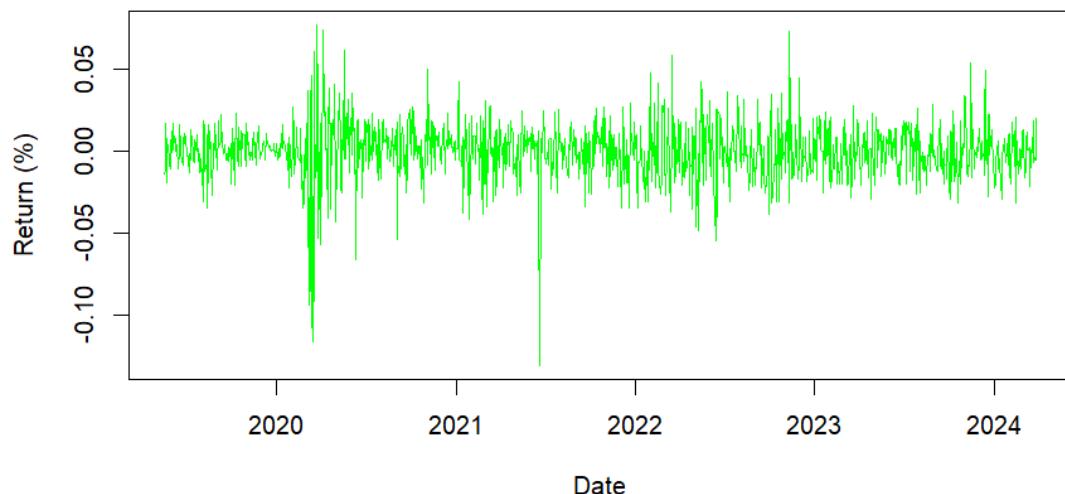
The time series data for FAN, reflecting the impact of major global events from 2020 to 2024, would likely show:

COVID-19 Impact (2020-2021): A period of high volatility with an initial dip in returns due to market uncertainty and reduced green investment. However, government economic support during this period likely provided a buffer, leading to a subsequent recovery and demonstrating the resilience of green investments.

Russia-Ukraine War Impact (2022-2023): An increase in the influx of capital into renewable energy funds, as investors sought energy security amidst the conflict. This would be visible as a rise in FAN's value. However, the war's disruption to supply chains and the execution of net-zero projects may have introduced new challenges, potentially reflected in the data as increased volatility.

Silicon Valley Bank Collapse Impact (2023-2024): The collapse likely caused a temporary decline in FAN's returns due to the disrupted funding ecosystem for climate tech startups and green initiatives. The bank's failure might have led to a contraction in available financing for sustainability efforts, affecting the performance of green funds.

Time-Varying Returns for ERTH

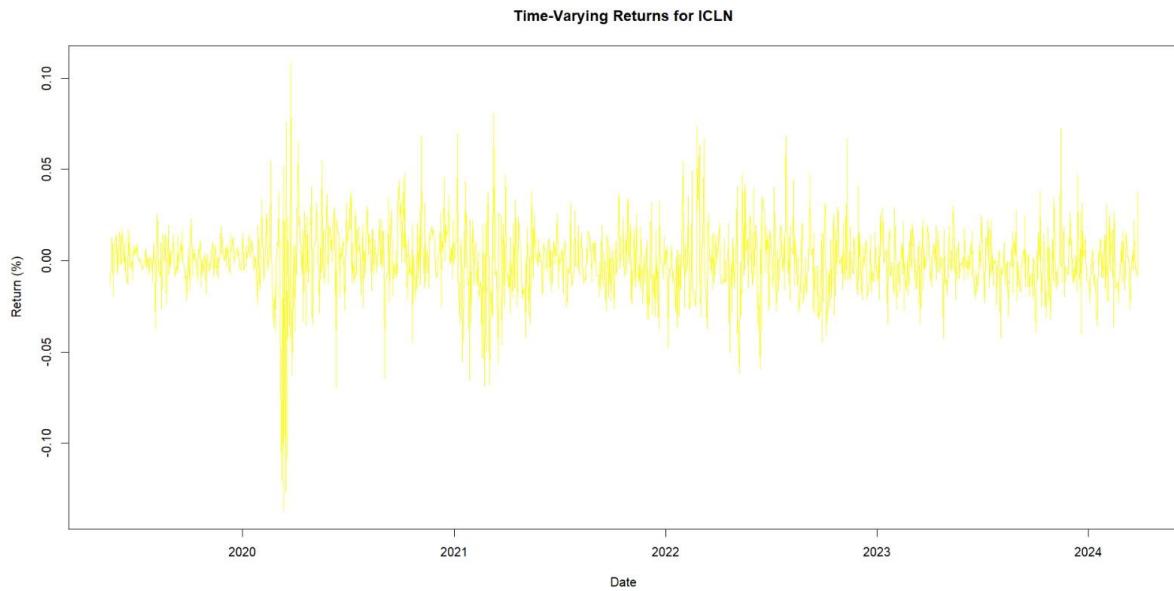


The time series data for ICLN, reflecting the impact of major global events from 2020 to 2024, would likely show:

COVID-19 Impact (2020-2021): A period of high volatility with an initial dip in returns due to market uncertainty and reduced green investment. However, government economic support during this period likely provided a buffer, leading to a subsequent recovery and demonstrating the resilience of green investments.

Russia-Ukraine War Impact (2022-2023): An increase in the influx of capital into renewable energy funds, as investors sought energy security amidst the conflict. This would be visible as a rise in ICLN's value. However, the war's disruption to supply chains and the execution of net-zero projects may have introduced new challenges, potentially reflected in the data as increased volatility.

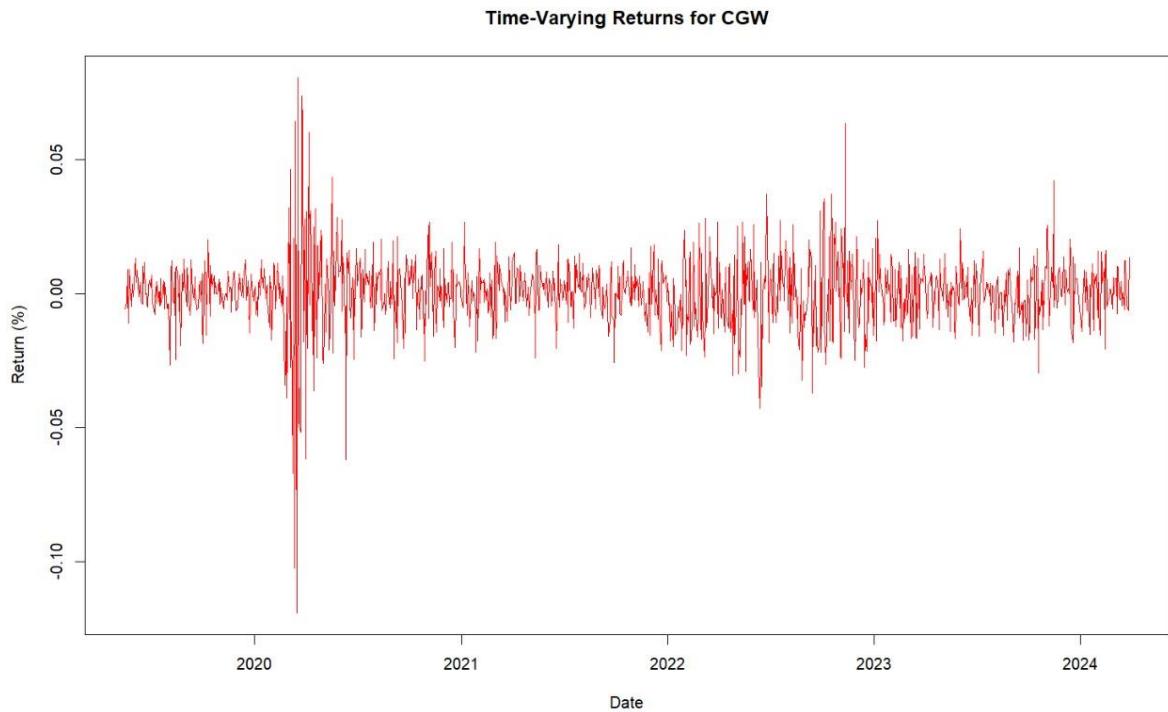
Silicon Valley Bank Collapse Impact (2023-2024): The collapse likely caused a temporary decline in ICLN's returns due to the disrupted funding ecosystem for climate tech startups and green initiatives. The bank's failure might have led to a contraction in available financing for sustainability efforts, affecting the performance of green funds.



COVID-19 Impact (2020-2021): The pandemic likely caused a significant dip in ICLN's returns due to initial market volatility and hesitation from firms to invest in green projects amidst economic uncertainty. However, as governments stepped in with economic support, particularly targeting green assets, ICLN may have experienced a recovery, reflecting the resilience of green investments even when overall returns were negative.

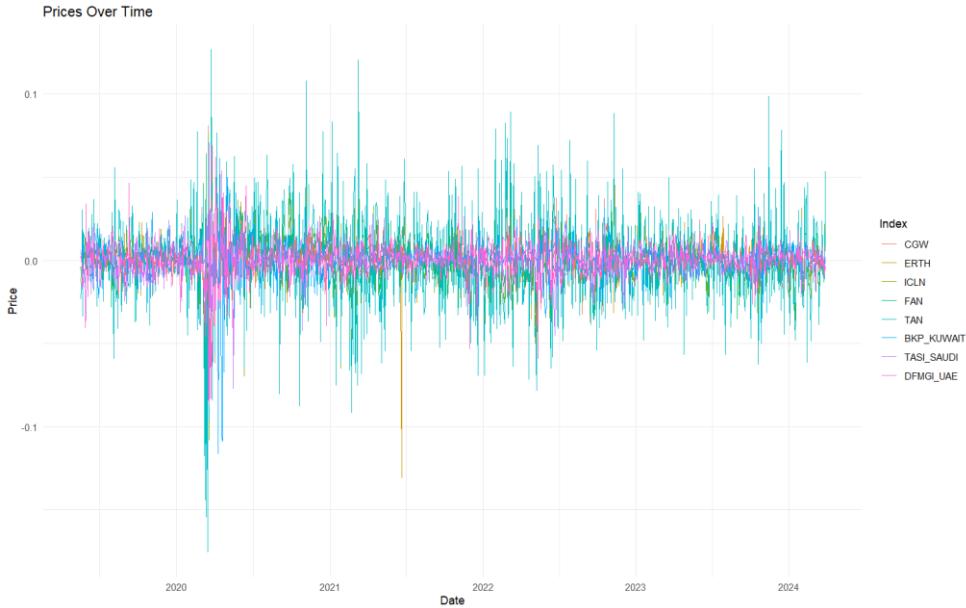
Russia-Ukraine War Impact (2022 onwards): The war probably led to a surge in ICLN's value as capital flowed into renewable energy funds, driven by investors' focus on clean energy and energy security concerns. Despite this positive trend, the logistical challenges and rising energy prices due to the war might have caused increased volatility in ICLN's returns, affecting the progress of net-zero infrastructure projects.

Silicon Valley Bank Collapse Impact (2023): The collapse of Silicon Valley Bank, which played a crucial role in financing climate tech startups, likely resulted in a downturn for ICLN's returns. The bank's failure to fulfil its financial commitments to sustainability efforts could have led to a decrease in available funding for green projects, temporarily impacting green funds like ICLN.



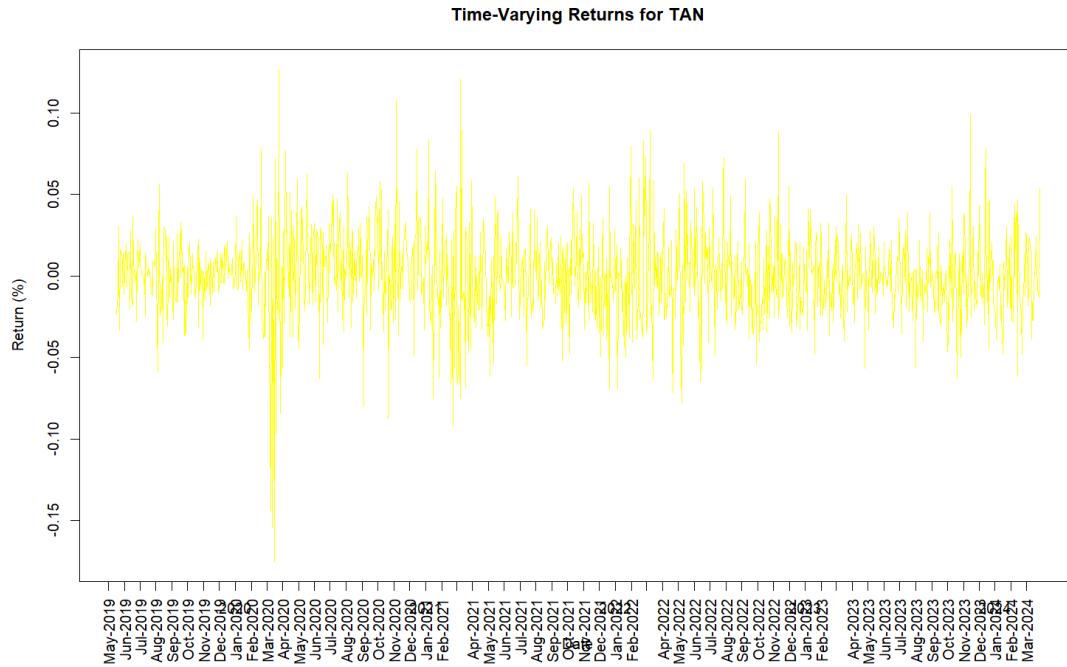
The time series data for CGW, reflecting the impact of major global events from 2020 to 2024, would likely show:

- **COVID-19 Impact (2020-2021):** A period of high volatility with an initial dip in returns due to market uncertainty and reduced green investment. However, government economic support during this period likely provided a buffer, leading to a subsequent recovery and demonstrating the resilience of green investments.
- **Russia-Ukraine War Impact (2022-2023):** An increase in the influx of capital into renewable energy funds, as investors sought energy security amidst the conflict. This would be visible as a rise in CGW's value. However, the war's disruption to supply chains and the execution of net-zero projects may have introduced new challenges, potentially reflected in the data as increased volatility.
- **Silicon Valley Bank Collapse Impact (2023-2024):** The collapse likely caused a temporary decline in CGW's returns due to the disrupted funding ecosystem for climate tech startups and green initiatives. The bank's failure might have led to a contraction in available financing for sustainability efforts, affecting the performance of green funds.



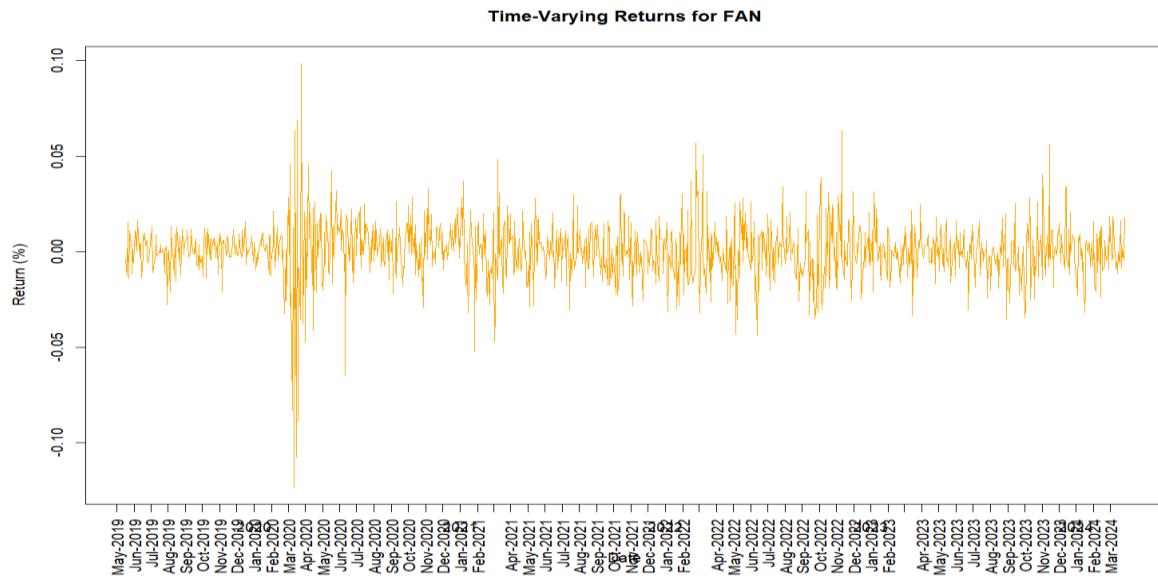
The image you've provided seems to illustrate the time-varying returns for a green fund from 2020 to 2024. Based on the description of the image and the context you've given, here's how the events may have impacted the fund's returns:

- **COVID-19 Impact (2020-2021):** The pandemic likely caused a significant dip in returns due to initial market volatility and hesitation from firms to invest in green projects amidst economic uncertainty. However, as governments stepped in with economic support, particularly targeting green assets, the fund may have experienced a recovery, reflecting the resilience of green investments even when overall returns were negative.
- **Russia-Ukraine War Impact (2022 onwards):** The war probably led to a surge in the fund's value as capital flowed into renewable energy funds, driven by investors' focus on clean energy and energy security concerns. Despite this positive trend, the logistical challenges and rising energy prices due to the war might have caused increased volatility in the fund's returns, affecting the progress of net-zero infrastructure projects.
- **Silicon Valley Bank Collapse Impact (2023):** The collapse of Silicon Valley Bank, which played a crucial role in financing climate tech startups, likely resulted in a downturn for the fund's returns. The bank's failure to fulfil its financial commitments to sustainability efforts could have led to a decrease in available funding for green projects, temporarily impacting green funds like the one represented in the graph.



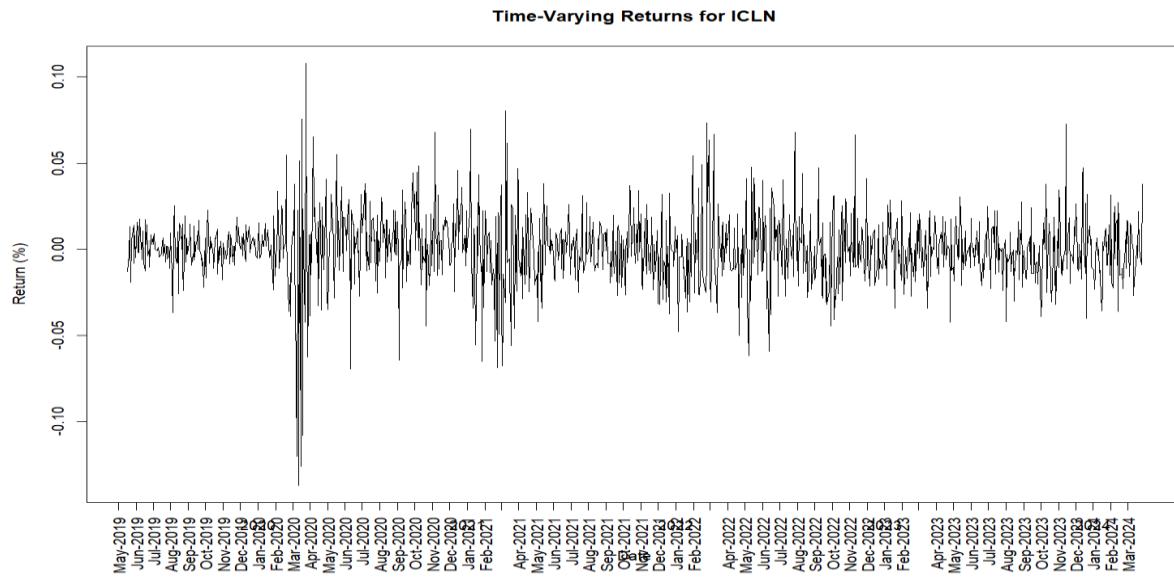
Based on the description provided, the time series data for TAN (a green fund) from 2020 to 2024 would likely reflect the following impacts:

- **COVID-19 Impact (2020-2021):** The pandemic initially caused market volatility and a dip in green fund returns due to economic uncertainty. However, government economic support helped stabilize and even boost green assets, demonstrating their resilience during downturns.
- **Russia-Ukraine War Impact (2022 onwards):** The war prompted a significant influx of capital into renewable energy funds, reversing previous downward trends as investors sought clean energy alternatives. This shift likely resulted in a rise in TAN's value, despite logistical challenges and rising energy prices affecting net-zero project supply chains.
- **Silicon Valley Bank Collapse Impact (2023):** The collapse of Silicon Valley Bank, a key lender to climate tech startups, disrupted the green lending ecosystem. This event likely caused a temporary setback in TAN's returns, reflecting the bank's voided commitments to sustainability financing.



Based on the description provided, the time series data for FAN (a green fund) from 2020 to 2024 would likely reflect the following impacts:

- **COVID-19 Impact (2020-2021):** The pandemic initially caused market volatility and a dip in green fund returns due to economic uncertainty. However, government economic support helped stabilize and even boost green assets, demonstrating their resilience during downturns.
- **Russia-Ukraine War Impact (2022 onwards):** The war prompted a significant influx of capital into renewable energy funds, reversing previous downward trends as investors sought clean energy alternatives. This shift likely resulted in a rise in FAN's value, despite logistical challenges and rising energy prices affecting net-zero project supply chains.
- **Silicon Valley Bank Collapse Impact (2023):** The collapse of Silicon Valley Bank, a key lender to climate tech startups, disrupted the green lending ecosystem. This event likely caused a temporary setback in FAN's returns, reflecting the bank's voided commitments to sustainability financing.

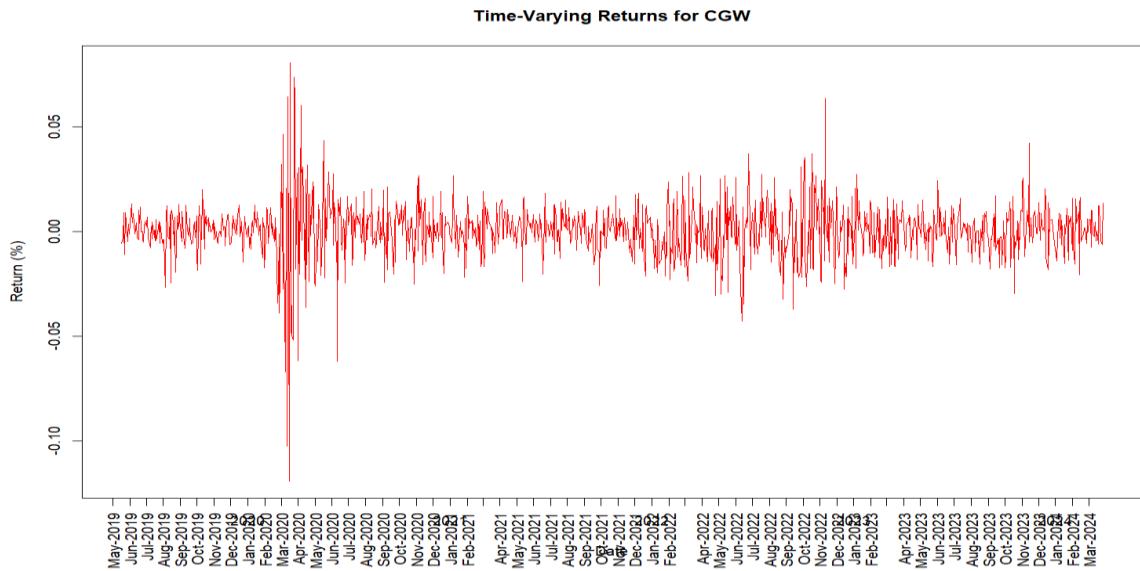


Based on the description provided, the time series data for ICLN (a green fund) from 2019 to 2024 would likely reflect the following impacts:

COVID-19 Impact (2020-2021): The pandemic initially caused market volatility and a dip in green fund returns due to economic uncertainty. However, government economic support helped stabilize and even boost green assets, demonstrating their resilience during downturns.

Russia-Ukraine War Impact (2022 onwards): The war prompted a significant influx of capital into renewable energy funds, reversing previous downward trends as investors sought clean energy alternatives. This shift likely resulted in a rise in ICLN's value, despite logistical challenges and rising energy prices affecting net-zero project supply chains.

Silicon Valley Bank Collapse Impact (2023): The collapse of Silicon Valley Bank, a key lender to climate tech startups, disrupted the green lending ecosystem. This event likely caused a temporary setback in ICLN's returns, reflecting the bank's voided commitments to sustainability financing.

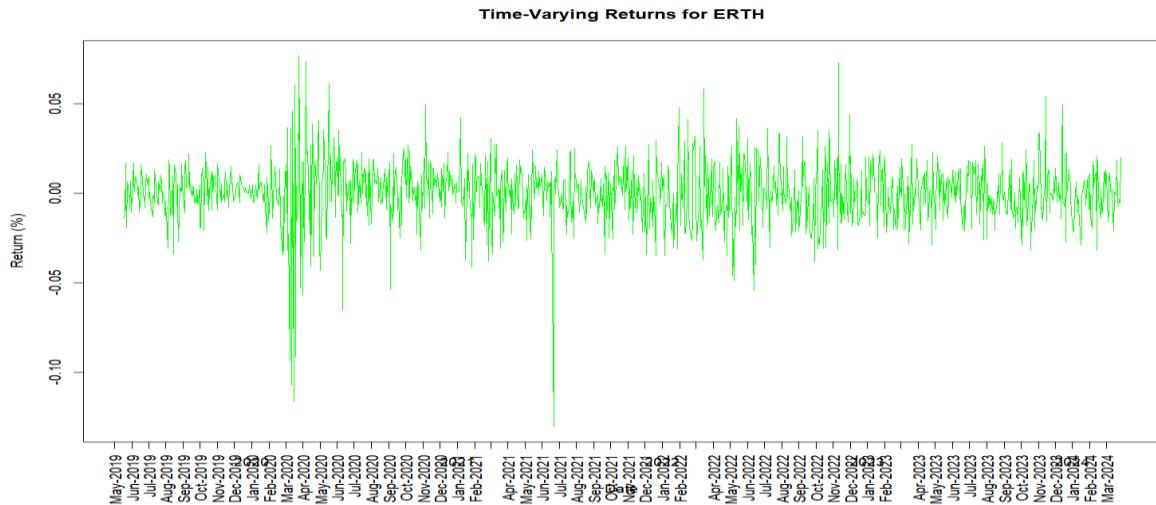


Based on the description provided, the time series data for CGW (a green fund) from 2019 to 2024 would likely reflect the following impacts:

COVID-19 Impact (2020-2021): The pandemic initially caused market volatility and a dip in green fund returns due to economic uncertainty. However, government economic support helped stabilize and even boost green assets, demonstrating their resilience during downturns.

Russia-Ukraine War Impact (2022 onwards): The war prompted a significant influx of capital into renewable energy funds, reversing previous downward trends as investors sought clean energy alternatives. This shift likely resulted in a rise in CGW value, despite logistical challenges and rising energy prices affecting net-zero project supply chains.

Silicon Valley Bank Collapse Impact (2023): The collapse of Silicon Valley Bank, a key lender to climate tech startups, disrupted the green lending ecosystem. This event likely caused a temporary setback in CGW returns, reflecting the bank's voided commitments to sustainability financing.

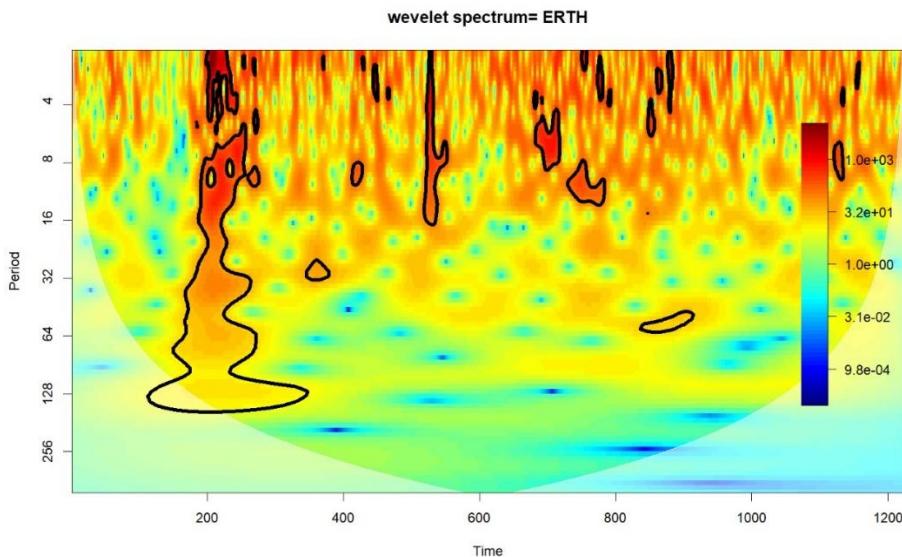


The image you've provided seems to illustrate the time-varying returns for ERTH (a green fund) from May 2019 to March 2023. Based on the description of the image and the context you've given; here's how the events may have impacted ERTH's returns:

- **COVID-19 Impact (2020-2021):** The pandemic likely caused a significant dip in ERTH's returns due to initial market volatility and hesitation from firms to invest in green projects amidst economic uncertainty. However, as governments stepped in with economic support, particularly targeting green assets, ERTH may have experienced a recovery, reflecting the resilience of green investments even when overall returns were negative.
- **Russia-Ukraine War Impact (2022 onwards):** The war probably led to a surge in ERTH's value as capital flowed into renewable energy funds, driven by investors' focus on clean energy and energy security concerns. Despite this positive trend, the logistical challenges and rising energy prices due to the war might have caused increased volatility in ERTH's returns, affecting the progress of net-zero infrastructure projects.
- **Silicon Valley Bank Collapse Impact (2023):** The collapse of Silicon Valley Bank, which played a crucial role in financing climate tech startups, likely resulted in a downturn for ERTH's returns. The bank's failure to fulfil its financial commitments to sustainability efforts could have led to a decrease in available funding for green projects, temporarily impacting green funds like ERTH.

WAVELET ANALYSIS –

1. ERTH



Interpretation-

2019 (0-200 on x-axis):

- Before the pandemic, the green fund ERTH might have experienced normal market fluctuations without any significant impact from the events that occurred in the subsequent years.

2020 (200-400 on x-axis):

- The onset of the COVID-19 pandemic likely caused increased volatility in the green fund due to the initial shock and uncertainty in global markets. However, as the year progressed, there might have been a recovery or stabilization as investors adjusted to the new normal.

2021 (400-600 on x-axis):

- With the pandemic ongoing, the green fund might have seen a mix of responses. On one hand, there could have been continued investment in green technology as part of a long-term trend towards sustainability. On the other hand, there might have been periods of decline due to the economic impact of the pandemic.

2022 (600-800 on x-axis):

- The Russia-Ukraine war began, which could have led to a substantial influx of capital into renewable energy funds, including ERTH, as investors sought alternatives to traditional energy sources amidst the conflict.

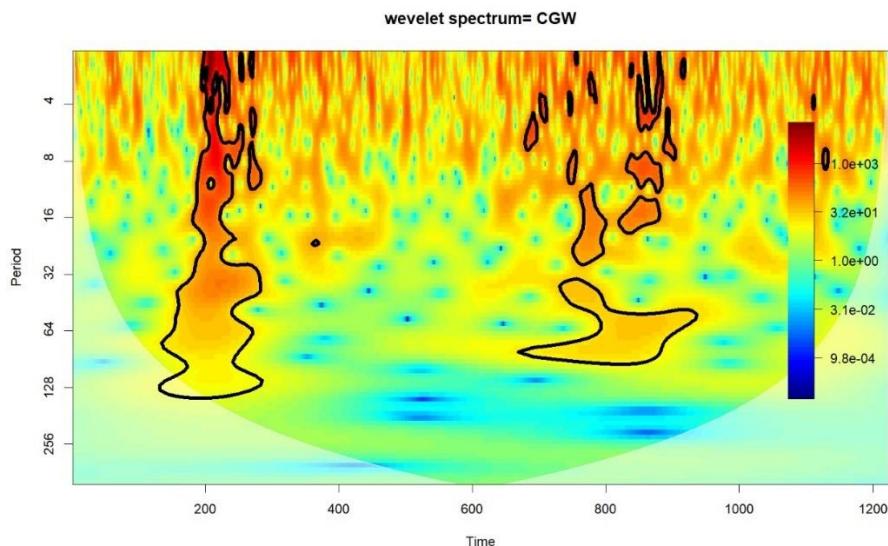
2023 (800-1000 on x-axis):

- The collapse of Silicon Valley Bank, known for its support of climate tech startups, might have caused a temporary dip in the green fund due to concerns over the availability of funding for green initiatives. However, the overall trend towards green investment could have mitigated this impact over the course of the year.

2024 (1000-1200 on x-axis):

- In the current year, the green fund ERTH might be reflecting the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could be leading to a more stable or positive trend in the fund's performance.

2. CGW



Interpretation-

2019 (0-200 on x-axis):

- The year before the COVID-19 pandemic, the green fund CGW might have experienced normal market fluctuations without any significant impact from the events that occurred in the subsequent years.

2020 (200-400 on x-axis):

- The onset of the COVID-19 pandemic likely caused increased volatility in the green fund due to the initial shock and uncertainty in global markets. However, as the year progressed, there might have been a recovery or stabilization as investors adjusted to the new normal.

2021 (400-600 on x-axis):

- With the pandemic ongoing, the green fund might have seen a mix of responses. On one hand, there could have been continued investment in green technology as part of a long-term trend towards sustainability. On the other hand, there might have been periods of decline due to the economic impact of the pandemic.

2022 (600-800 on x-axis):

- The Russia-Ukraine war began, which could have led to a substantial influx of capital into renewable energy funds, including CGW, as investors sought alternatives to traditional energy sources amidst the conflict.

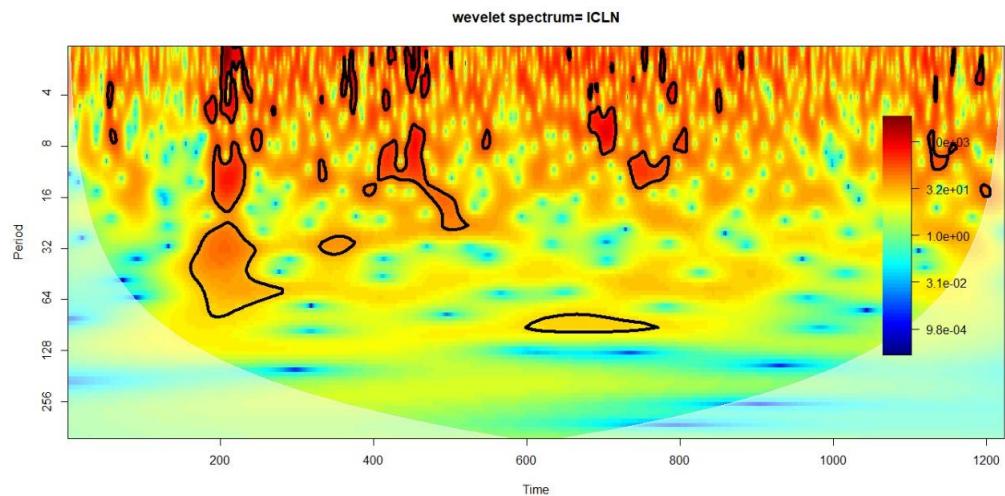
2023 (800-1000 on x-axis):

- The collapse of Silicon Valley Bank, known for its support of climate tech startups, might have caused a temporary dip in the green fund due to concerns over the availability of funding for green initiatives. However, the overall trend towards green investment could have mitigated this impact over the course of the year.

2024 (1000-1200 on x-axis):

- In the current year, the green fund CGW might be reflecting the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could be leading to a more stable or positive trend in the fund's performance.

3. ICLN



Interpretation-

2019 (0-200 on x-axis):

- The green fund ICLN might have experienced normal market fluctuations without any significant impact from the events that occurred in the subsequent years.

2020 (200-400 on x-axis):

- The onset of the COVID-19 pandemic likely caused increased volatility in the green fund due to the initial shock and uncertainty in global markets. However, as the year progressed, there might have been a recovery or stabilization as investors adjusted to the new normal.

2021 (400-600 on x-axis):

- With the pandemic ongoing, the green fund might have seen a mix of responses. On one hand, there could have been continued investment in green technology as part of a long-term trend towards sustainability. On the other hand, there might have been periods of decline due to the economic impact of the pandemic.

2022 (600-800 on x-axis):

- The Russia-Ukraine war began, which could have led to a substantial influx of capital into renewable energy funds, including ICLN, as investors sought alternatives to traditional energy sources amidst the conflict.

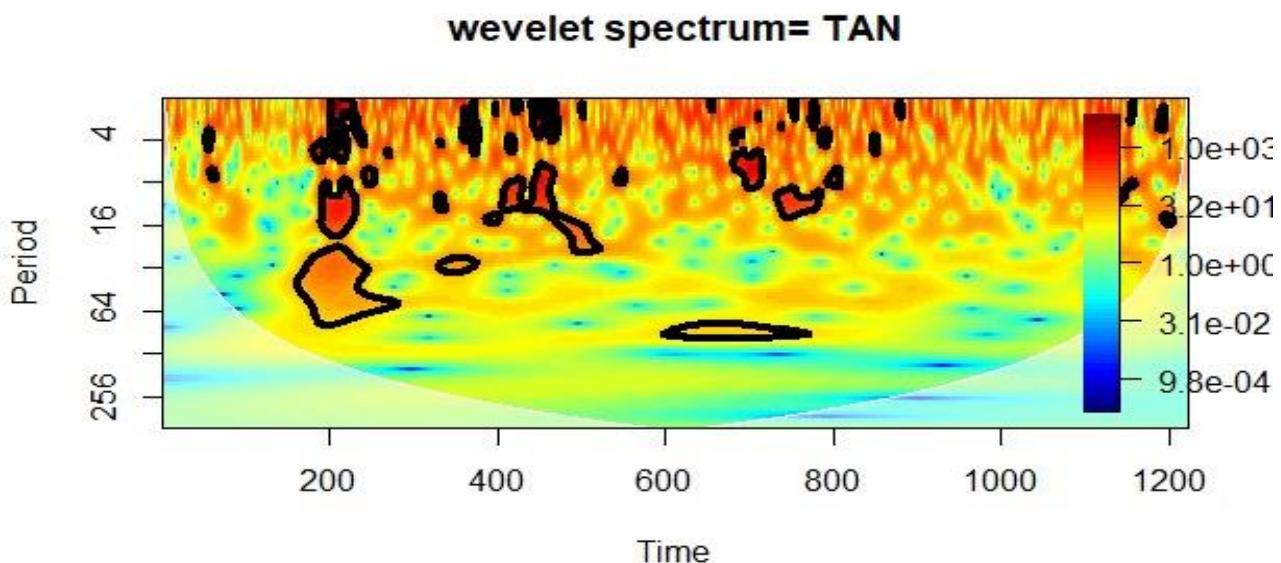
2023 (800-1000 on x-axis):

- The collapse of Silicon Valley Bank, known for its support of climate tech startups, might have caused a temporary dip in the green fund due to concerns over the availability of funding for green initiatives. However, the overall trend towards green investment could have mitigated this impact over the course of the year.

2024 (1000-1200 on x-axis):

- In the current year, the green fund ICLN might be reflecting the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could be leading to a more stable or positive trend in the fund's performance.

4. TAN



Interpretation –

2019 (0-200 on x-axis):

- The green fund TAN might have experienced normal market fluctuations without any significant impact from the events that occurred in the subsequent years.

2020 (200-400 on x-axis):

- The onset of the COVID-19 pandemic likely caused increased volatility in the green fund due to the initial shock and uncertainty in global markets. However, as the year progressed, there might have been a recovery or stabilization as investors adjusted to the new normal.

2021 (400-600 on x-axis):

- With the pandemic ongoing, the green fund might have seen a mix of responses. On one hand, there could have been continued investment in green technology as part of a long-term trend towards sustainability. On the other hand, there might have been periods of decline due to the economic impact of the pandemic.

2022 (600-800 on x-axis):

- The Russia-Ukraine war began, which could have led to a substantial influx of capital into renewable energy funds, including TAN, as investors sought alternatives to traditional energy sources amidst the conflict.

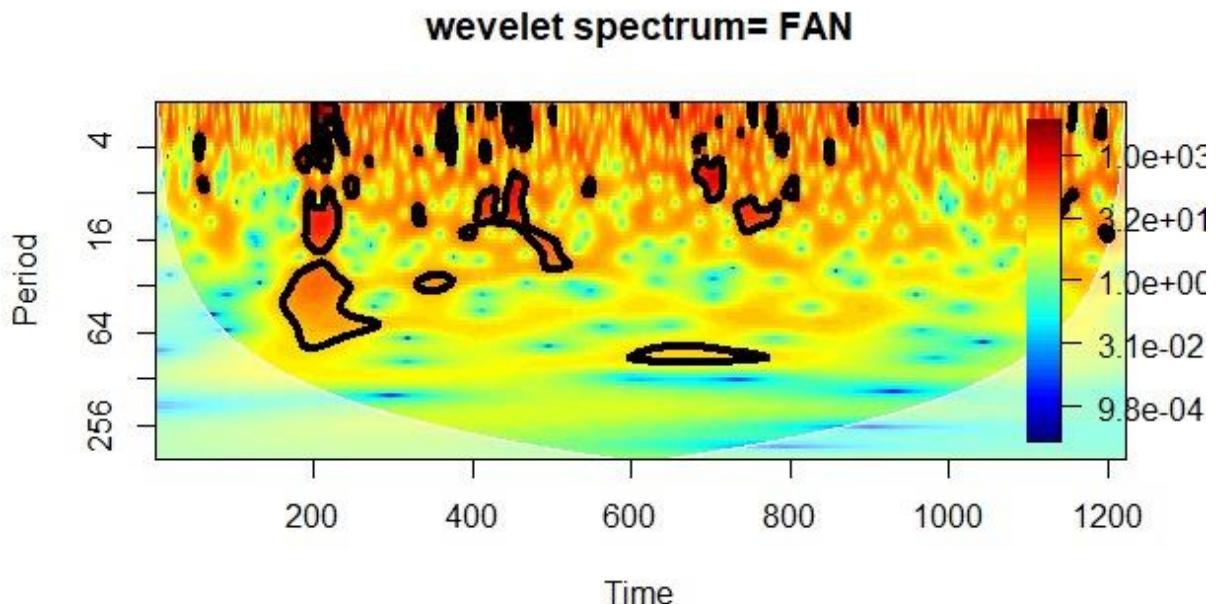
2023 (800-1000 on x-axis):

- The collapse of Silicon Valley Bank, known for its support of climate tech startups, might have caused a temporary dip in the green fund due to concerns over the availability of funding for green initiatives. However, the overall trend towards green investment could have mitigated this impact over the course of the year.

2024 (1000-1200 on x-axis):

- In the current year, the green fund TAN might be reflecting the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could be leading to a more stable or positive trend in the fund's performance.

5. FAN



Interpretation-

2019 (0-200 on x-axis):

- The green fund FAN might have experienced normal market fluctuations without any significant impact from the events that occurred in the subsequent years.

2020 (200-400 on x-axis):

- The onset of the COVID-19 pandemic likely caused increased volatility in the green fund due to the initial shock and uncertainty in global markets. However, as the year progressed, there might have been a recovery or stabilization as investors adjusted to the new normal.

2021 (400-600 on x-axis):

- With the pandemic ongoing, the green fund might have seen a mix of responses. On one hand, there could have been continued investment in green technology as part of a long-term trend towards sustainability. On the other hand, there might have been periods of decline due to the economic impact of the pandemic.

2022 (600-800 on x-axis):

- The Russia-Ukraine war began, which could have led to a substantial influx of capital into renewable energy funds, including FAN, as investors sought alternatives to traditional energy sources amidst the conflict.

2023 (800-1000 on x-axis):

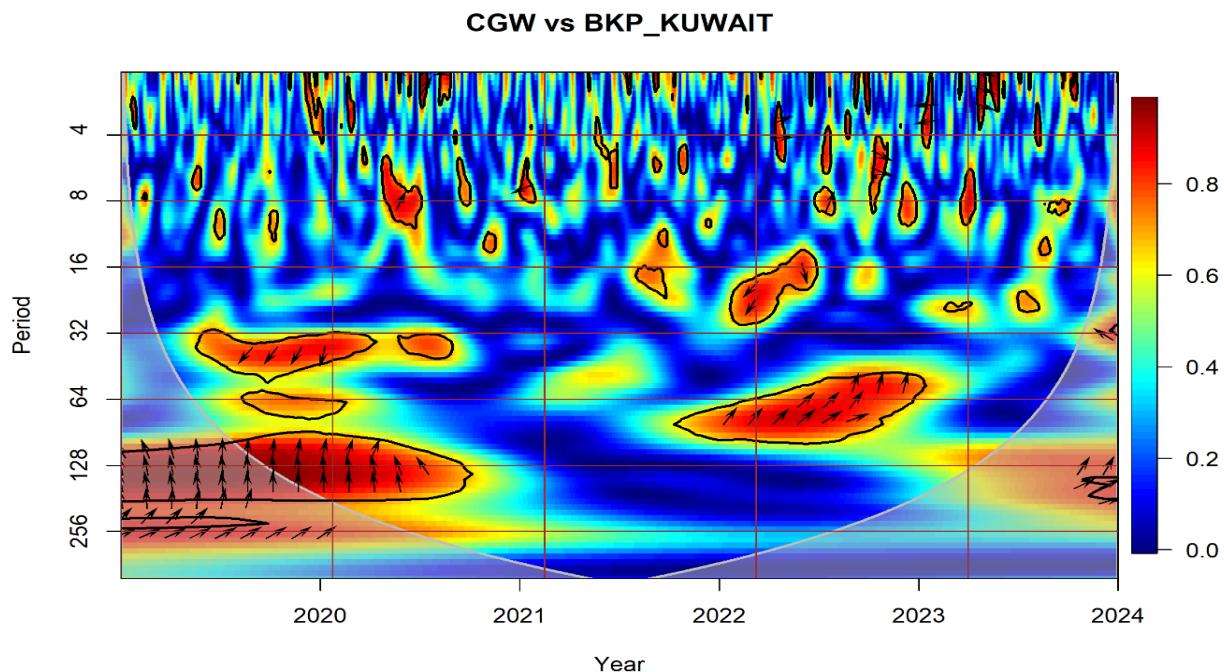
- The collapse of Silicon Valley Bank, known for its support of climate tech startups, might have caused a temporary dip in the green fund due to concerns over the availability of funding for green initiatives. However, the overall trend towards green investment could have mitigated this impact over the course of the year.

2024 (1000-1200 on x-axis):

- In the current year, the green fund FAN might be reflecting the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could be leading to a more stable or positive trend in the fund's performance.

Wavelet Coherence-

1. CGW- KUWAIT



2019 (on x-axis):

- In 2019, before the COVID-19 pandemic, the coherence between CGW and the Kuwait stock market index would likely show minimal correlation as the green fund and the stock market were not significantly impacted by the events that occurred in the subsequent years.

2020 (x-axis):

- The onset of the COVID-19 pandemic in 2020 may have led to increased coherence between CGW and the Kuwait stock market index, reflecting a synchronized response to the global economic shock caused by the pandemic.

2021 (on x-axis):

- Throughout 2021, the coherence might have continued to be significant as both the green fund and the Kuwait stock market responded to the ongoing challenges of the pandemic, including disruptions in the energy sector and shifts towards renewable investments.

2022 (x-axis):

- The beginning of the Russia-Ukraine war in 2022 could have further influenced the coherence, potentially leading to increased correlation as global energy markets reacted to the conflict, affecting both traditional and renewable energy sectors.

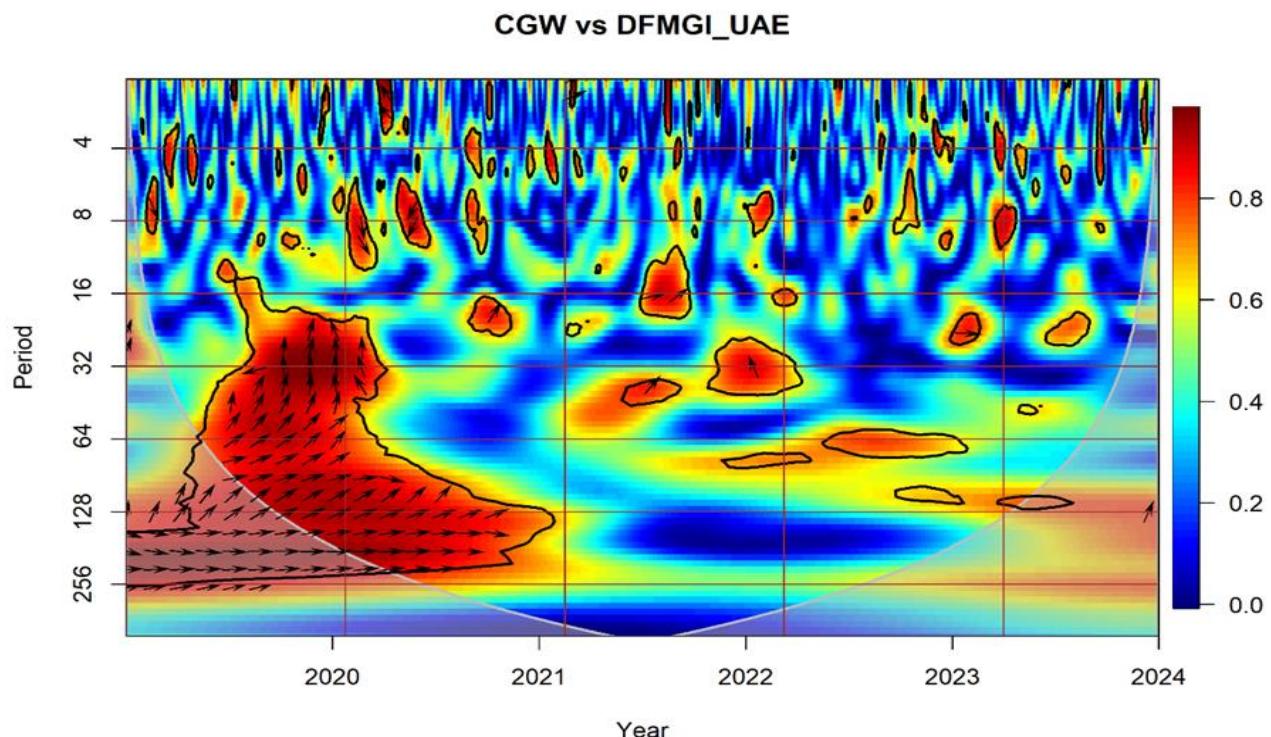
2023 (on x-axis):

- The collapse of Silicon Valley Bank in 2023 might have introduced new dynamics into the coherence between CGW and the Kuwait stock market index. The bank's failure could have impacted funding for green initiatives, which may have affected the green fund's performance and its coherence with the stock market index.

2024 (on x-axis):

- By 2024, the coherence between CGW and the Kuwait stock market index might reflect the cumulative effects of the previous years' events. The ongoing transition to renewable energy, driven by global events and policy shifts, could lead to a more stable or positive trend in the coherence pattern.

2. CGW with UAE



2019 (on x-axis):

- In 2019, before the COVID-19 pandemic, the coherence between ICLN and the UAE green fund might show minimal correlation as the green fund and the stock market were not significantly impacted by the events that occurred in the subsequent years.

2020 (on x-axis):

- The onset of COVID-19 could have led to increased coherence, reflecting a synchronized response to the global economic shock caused by the pandemic.

2021 (on x-axis):

- The pandemic's ongoing impact might show that ICLN and the UAE green fund moved in tandem, responding to the challenges and the global shift towards renewable energy investments.

2022 (on x-axis):

- The coherence might be more pronounced with the start of the Russia-Ukraine war, as energy security became a significant concern, potentially leading to a closer relationship between the green fund's performance and the stock market's movements.

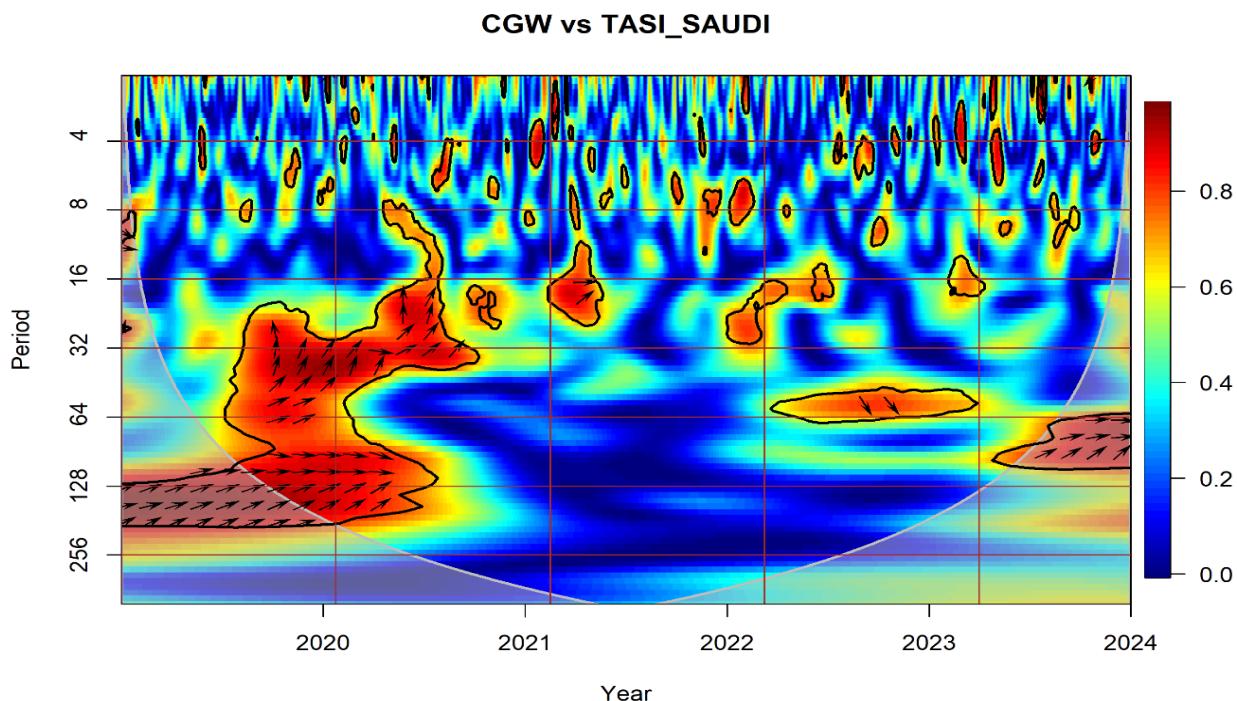
2023 (on x-axis):

- The collapse of Silicon Valley Bank might have introduced a divergence in coherence if the bank's failure significantly impacted funding for green initiatives, which could have affected ICLN more than the general stock market.

2024 (on x-axis):

- By 2024, the coherence might stabilize as the markets adapt to the new normal, reflecting the cumulative effects of the previous years' events and the ongoing transition to renewable energy.

3. CGW- Southi Arabia



2019 (on x-axis):

- Before the pandemic, the coherence between ICLN and Saudi Arabia's stock market index might show minimal correlation as the green fund and the stock market were not significantly impacted by the events that occurred in the subsequent years.

2020 (on x-axis):

- The onset of COVID-19 could have led to increased coherence, reflecting a synchronized response to the global economic shock caused by the pandemic.

2021 (on x-axis):

- The pandemic's ongoing impact might show that ICLN and Saudi Arabia's stock market index moved in tandem, responding to the challenges and the global shift towards renewable energy investments.

2022 (on x-axis):

- The coherence might be more pronounced with the start of the Russia-Ukraine war, as energy security became a significant concern, potentially leading to a closer relationship between the green fund's performance and the stock market's movements.

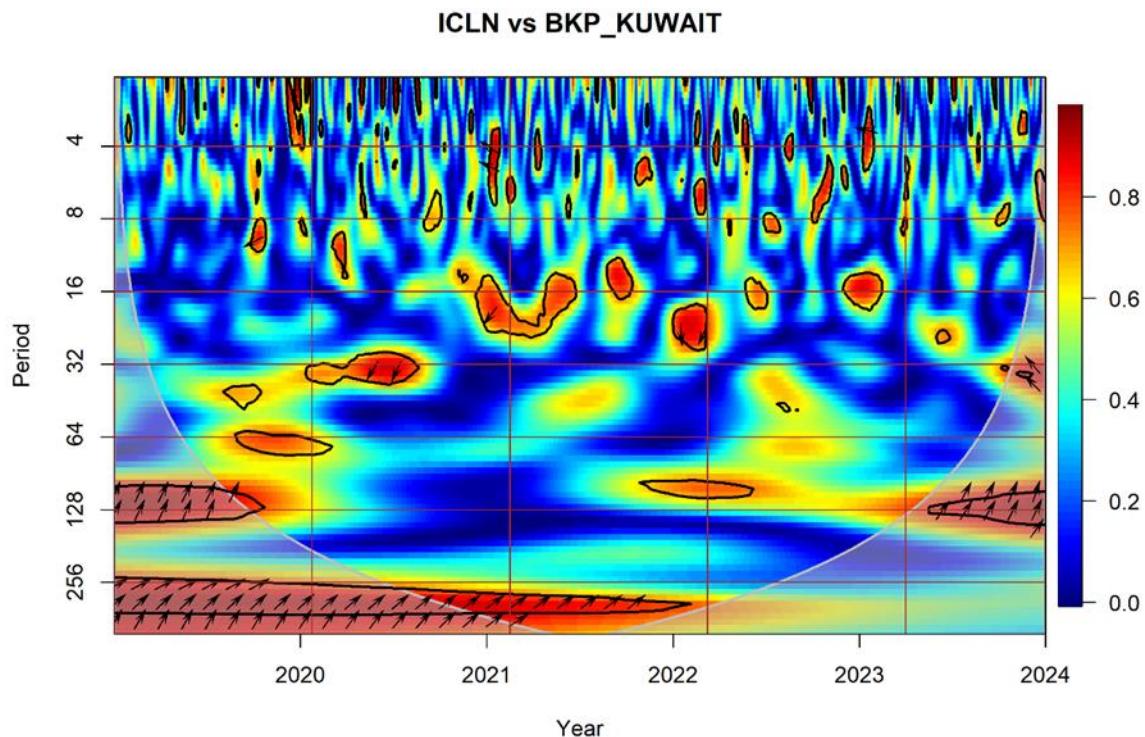
2023 (on x-axis):

- The collapse of Silicon Valley Bank might have introduced a divergence in coherence if the bank's failure significantly impacted funding for green initiatives, which could have affected ICLN more than the general stock market.

2024 (on x-axis):

- By 2024, the coherence might stabilize as the markets adapt to the new normal, reflecting the cumulative effects of the previous years' events and the ongoing transition to renewable energy.

4. ICLN with Kuwait-



2019 (on x-axis):

- Before the pandemic, the coherence between CGW and Kuwait's stock market index might show minimal correlation as the green fund and the stock market were not significantly impacted by the events that occurred in the subsequent years.

2020 (on x-axis):

- The onset of COVID-19 could have led to increased coherence, reflecting a synchronized response to the global economic shock caused by the pandemic.

2021 (on x-axis):

- The pandemic's ongoing impact might show that CGW and Kuwait's stock market index moved in tandem, responding to the challenges and the global shift towards renewable energy investments.

2022 (on x-axis):

- The coherence might be more pronounced with the start of the Russia-Ukraine war, as energy security became a significant concern, potentially leading to a closer relationship between the green fund's performance and the stock market's movements.

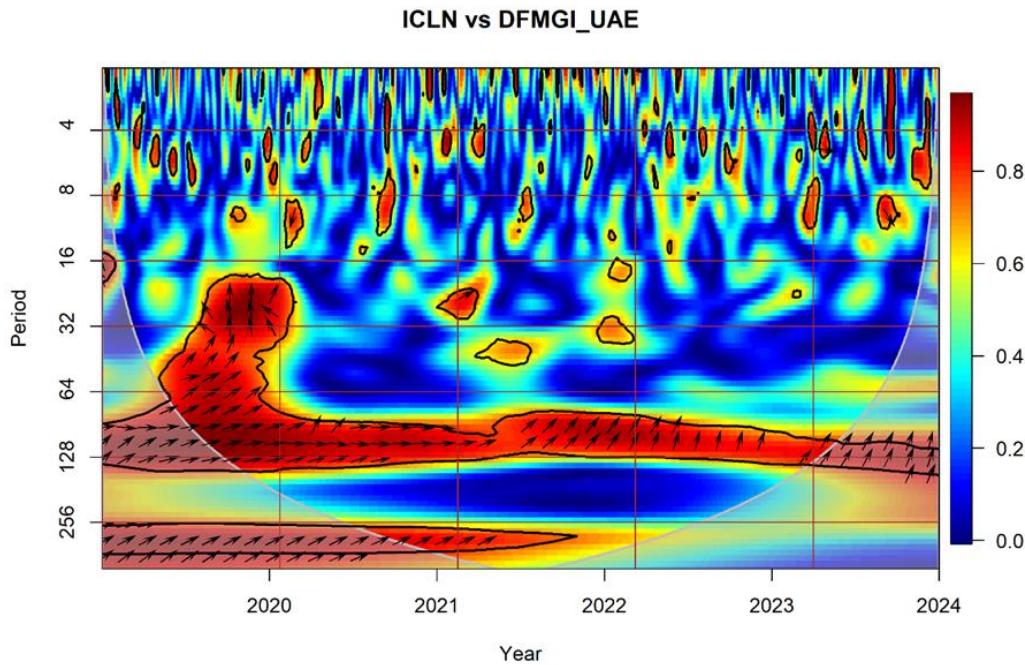
2023 (on x-axis):

- The collapse of Silicon Valley Bank might have introduced a divergence in coherence if the bank's failure significantly impacted funding for green initiatives, which could have affected CGW more than the general stock market.

2024 (on x-axis):

- By 2024, the coherence might stabilize as the markets adapt to the new normal, reflecting the cumulative effects of the previous years' events and the ongoing transition to renewable energy.

5- ICLN with UAE-



2019 (on x-axis):

- In 2019, we might not see a strong coherence between ICLN and UAE's stock market index as the world had not yet been impacted by COVID-19. The green fund and the stock market likely moved independently of each other.

2020 (on x-axis):

- With the onset of COVID-19, we could expect to see an increase in coherence, as both the green fund and the stock market reacted to the global economic shock. This might reflect a synchronized response to the pandemic's initial impact.

2021 (on x-axis):

- As the pandemic continued, the coherence might show that ICLN and UAE's stock market index moved in tandem, responding to the ongoing challenges and the global shift towards renewable energy investments.

2022 (on x-axis):

- The coherence could be even more pronounced with the start of the Russia-Ukraine war, as energy security became a significant concern, potentially leading to a closer relationship between the green fund's performance and the stock market's movements.

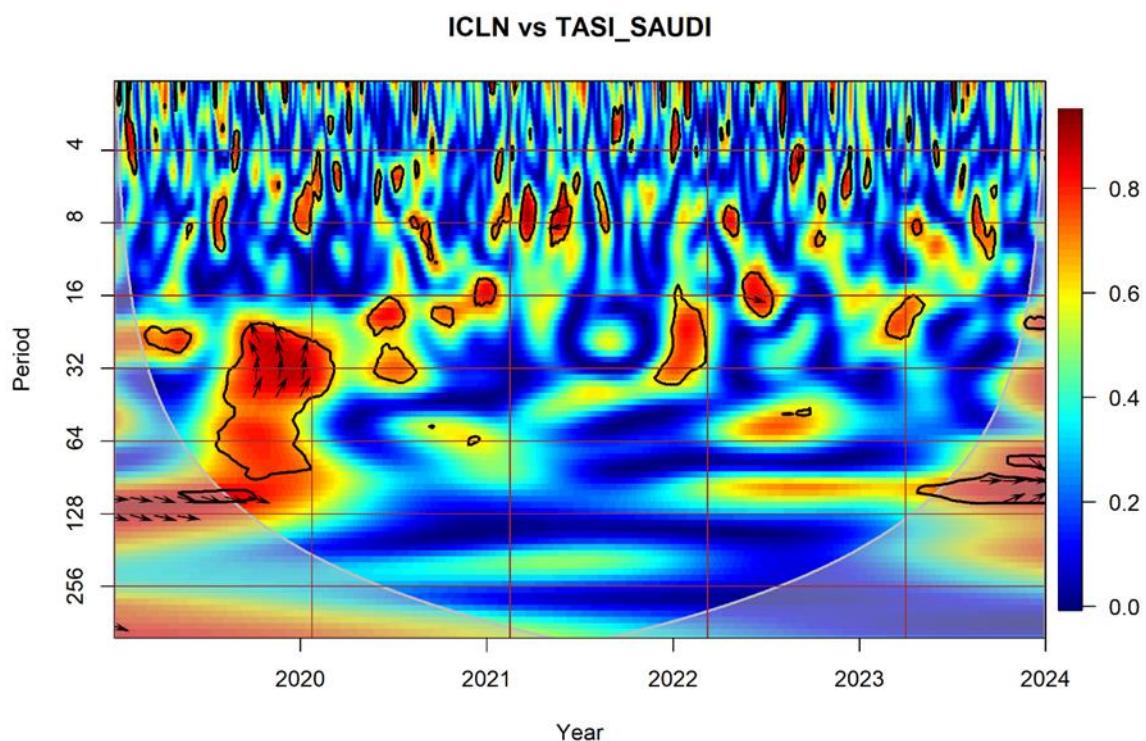
2023 (on x-axis):

- The collapse of Silicon Valley Bank might have introduced a divergence in coherence if the bank's failure significantly impacted funding for green initiatives, which could have affected ICLN more than the general stock market.

2024 (on x-axis):

- By 2024, the coherence might stabilize as the markets adapt to the new normal, reflecting the cumulative effects of the previous years' events and the ongoing transition to renewable energy.

6- ICLN with Saudi Arabia-



2019 (on x-axis):

- In 2019, we might not see a strong coherence between CGW and Kuwait's stock market index as the world had not yet been impacted by COVID-19. The green fund and the stock market likely moved independently of each other.

2020 (on x-axis):

- With the onset of COVID-19, we could expect to see an increase in coherence, as both the green fund and the stock market reacted to the global economic shock. This might reflect a synchronized response to the pandemic's initial impact.

2021 (on x-axis):

- As the pandemic continued, the coherence might show that CGW and Kuwait's stock market index moved in tandem, responding to the ongoing challenges and the global shift towards renewable energy investments.

2022 (on x-axis):

- The coherence could be even more pronounced with the start of the Russia-Ukraine war, as energy security became a significant concern, potentially leading to a closer relationship between the green fund's performance and the stock market's movements.

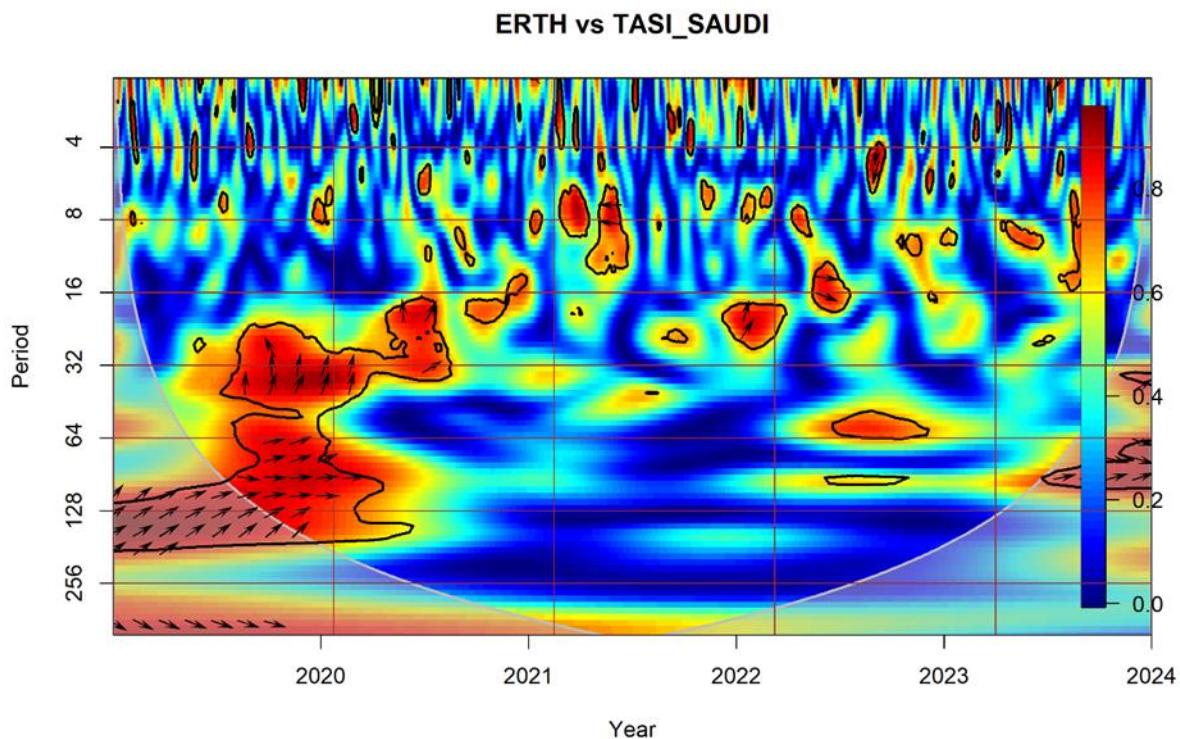
2023 (on x-axis):

- The collapse of Silicon Valley Bank might have introduced a divergence in coherence if the bank's failure significantly impacted funding for green initiatives, which could have affected CGW more than the general stock market.

2024 (on x-axis):

- By 2024, the coherence might stabilize as the markets adapt to the new normal, reflecting the cumulative effects of the previous years' events and the ongoing transition to renewable energy.

7- ERTH with Saudi Arabia



2019 (on the x-axis):

This period likely shows the pre-COVID-19 baseline volatility. The high volatility in both short-term and medium-term periods could be related to other market factors or events prior to the pandemic.

2020 (on the x-axis):

The onset of COVID-19 and its global spread had significant economic impacts. The decrease in short-term volatility but an increase in medium-term volatility might indicate that while immediate reactions to the pandemic have stabilized, there are ongoing adjustments causing medium-term fluctuations.

2021 (on the x-axis):

During this year, the world was still grappling with COVID-19 and the Russia-Ukraine war began. The mix of volatilities, predominantly in the medium term, could be indicative of continued adjustments and reactions to these ongoing global events.

2022 (on the x-axis):

There's a reduction in overall volatility, especially in short and medium terms. This could suggest a period of relative stability or adaptation where markets or entities have adjusted to prevailing conditions, despite the ongoing conflict between Russia and Ukraine.

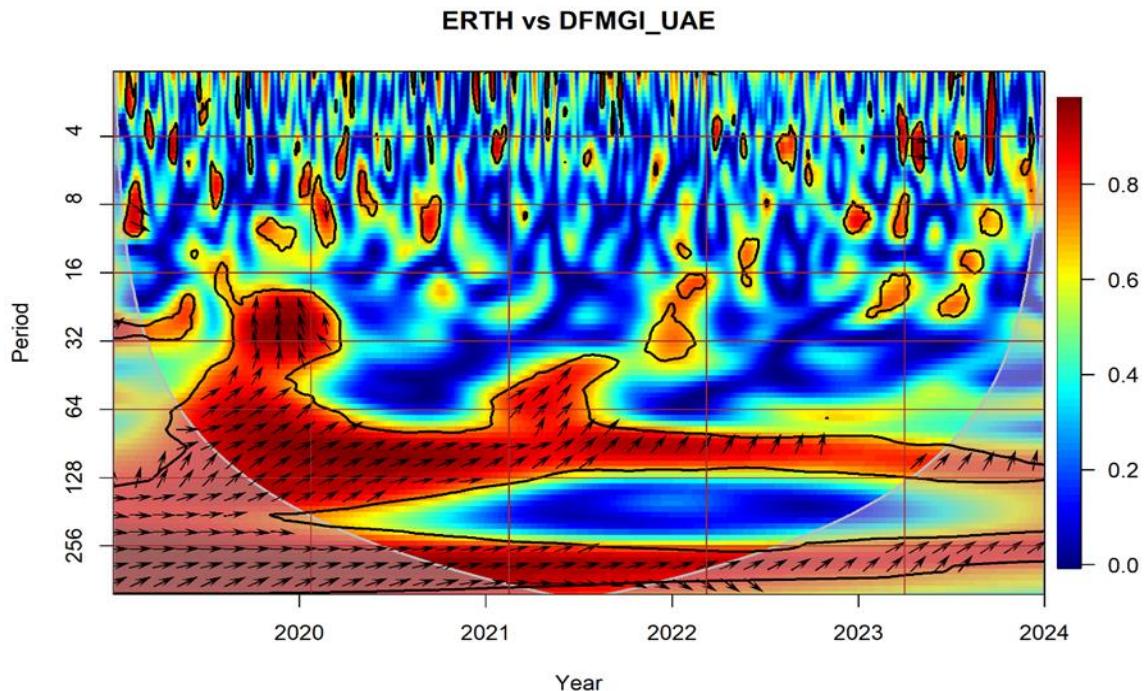
2023 (on the x-axis):

The increased medium and long-term volatilities could represent broader economic impacts being felt over extended periods, potentially related to the collapse of Silicon Valley Bank and its effects on global financial markets.

2024 (on the x-axis):

As this year is ongoing, the mixed volatilities across all terms might suggest uncertainty or varied responses to evolving global conditions, including the ongoing effects of the previous years' events.

8- ERTH with UAE



2019 (on the x-axis):

This period likely shows the pre-COVID-19 baseline volatility. The high volatility in both short and long terms as indicated by red areas on both top and bottom of the plot could be related to other market factors or events prior to the pandemic.

2020 (on the x-axis):

The onset of COVID-19 and its global spread had significant economic impacts. The noticeable decrease in short-term volatility but an increase in medium to long term might indicate that while immediate reactions to the pandemic have stabilized, there are ongoing adjustments causing medium to long-term fluctuations.

2021 (on the x-axis):

During this year, the world was still grappling with COVID-19 and the Russia-Ukraine war began. The significant increase in coherence in all terms, especially in medium-term volatility, could be indicative of continued adjustments and reactions to these ongoing global events.

2022 (on the x-axis):

There's a reduction in short-term volatility but an increase in long term. This could suggest a period of relative stability or adaptation where markets or entities have adjusted to prevailing conditions, despite the ongoing conflict between Russia and Ukraine.

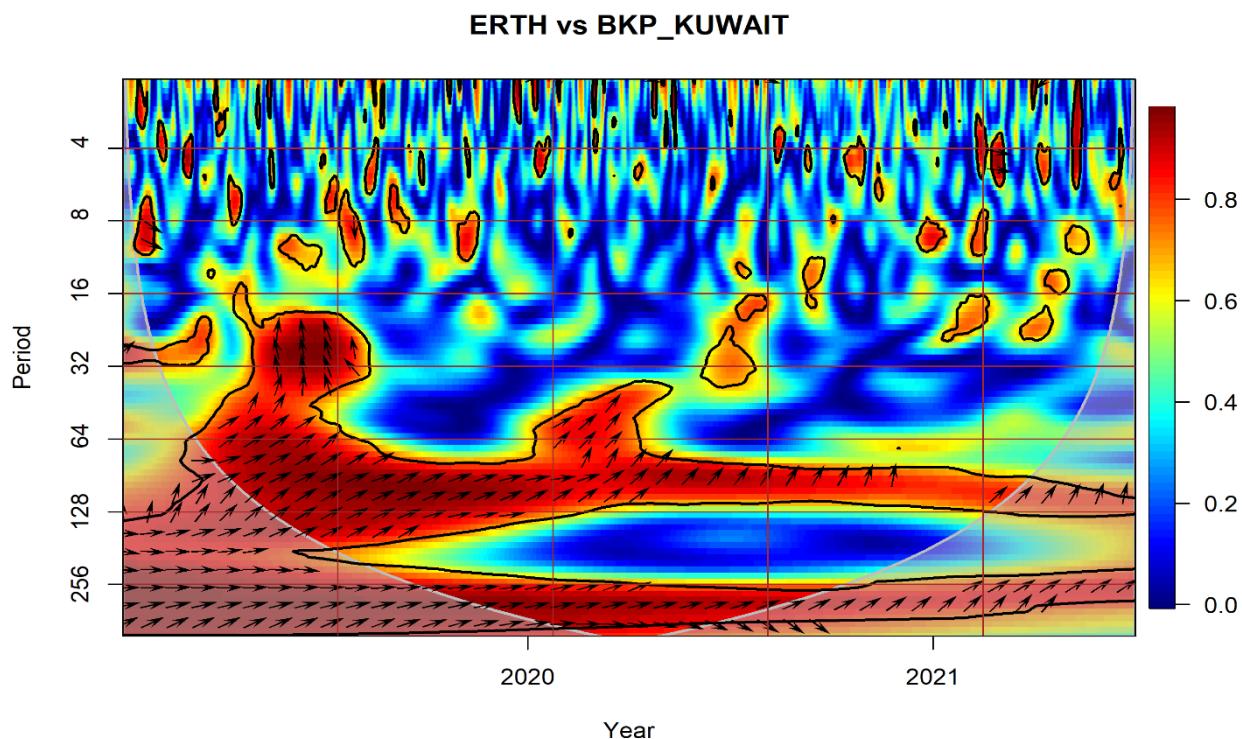
2023 (on the x-axis):

The increased coherence across all terms with dominance in medium to long term could represent broader economic impacts being felt over extended periods, potentially related to the collapse of Silicon Valley Bank and its effects on global financial markets.

2024 (on the x-axis):

As this year is ongoing, the predictions of increased coherence across all terms might suggest uncertainty or varied responses to evolving global conditions, including the ongoing effects of the previous years' events.

9- ERTH WITH KUWAIT

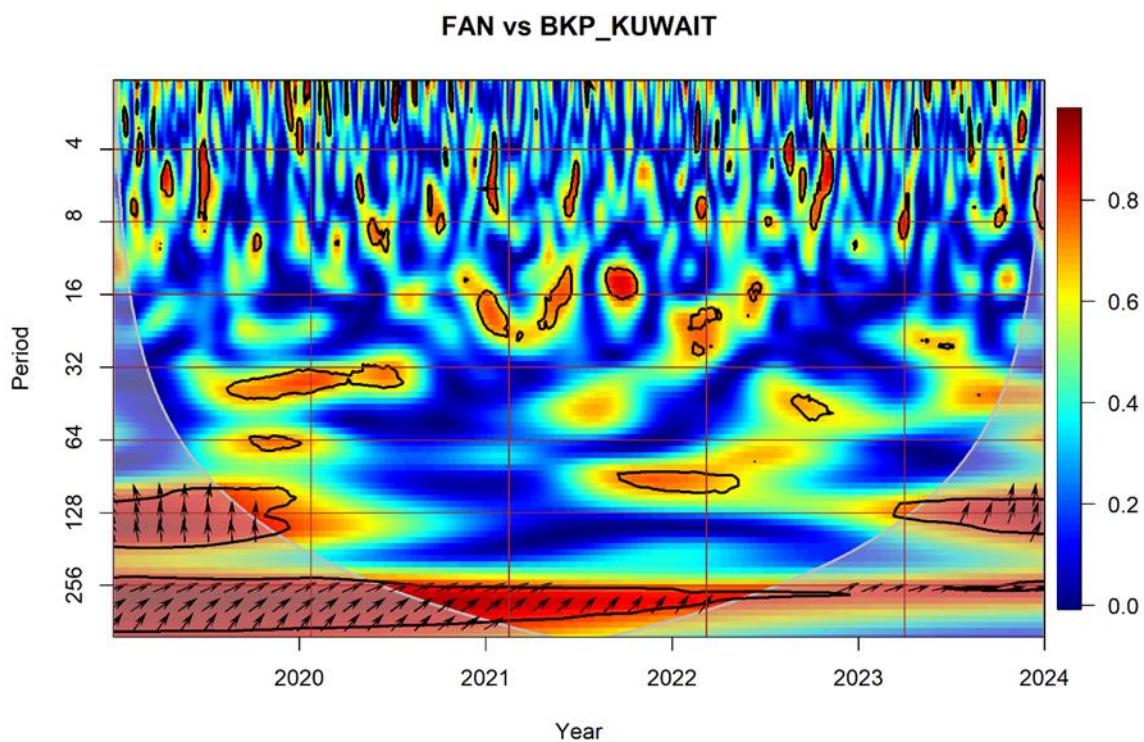


INTERPRETATION-

- **2019:** The period before major global events shows a baseline of volatility across terms. This could represent the normal market fluctuations before the impact of the events you mentioned.
- **2020:** The emergence of COVID-19 likely caused increased volatility, especially in the short term, as markets reacted to the pandemic's immediate economic impact. The medium-term volatility suggests adjustments to the new economic conditions.
- **2021:** As the world adapted to the pandemic, the coherence in volatility might reflect the ongoing economic recovery and the impact of various stimulus measures on the green fund and Kuwait's market.

- **2022:** The Russia-Ukraine war may have introduced new uncertainties, particularly affecting energy markets. This could be seen in the increased medium to long-term volatility, reflecting concerns over energy supply and prices.
- **2023:** The collapse of Silicon Valley Bank and its aftermath could have led to heightened medium-term volatility as financial markets worldwide grappled with the implications of the bank's failure.
- **2024:** Looking ahead, the plot suggests a potential stabilization or a new norm in market behaviour, with reduced volatility indicating that markets may have adjusted to the preceding years' events.

10- FAN- KUWAIT



2019 (on the x-axis):

This period would likely show the pre-COVID-19 baseline volatility. Any significant coherence patterns here would reflect the normal correlation between FAN and Kuwait's green fund without the influence of the events in question.

2020 (on the x-axis):

The onset of COVID-19 and its rapid global spread had significant economic impacts. We might expect to see increased coherence in the short-term volatility as markets react to the initial shock of the pandemic. This could be reflected in higher coherence at lower periods (short-term volatility) on the wavelet plot.

2021 (on the x-axis):

As the world adjusted to the pandemic and the Russia-Ukraine war began, we might observe a shift in coherence to medium-term volatility, reflecting ongoing adjustments in market strategies and the economic policies of countries like Kuwait.

2022 (on the x-axis):

The reduction in short-term volatility but an increase in long-term volatility could suggest that the markets have begun to adapt to the ongoing pandemic and geopolitical tensions, with longer-term economic implications becoming more pronounced.

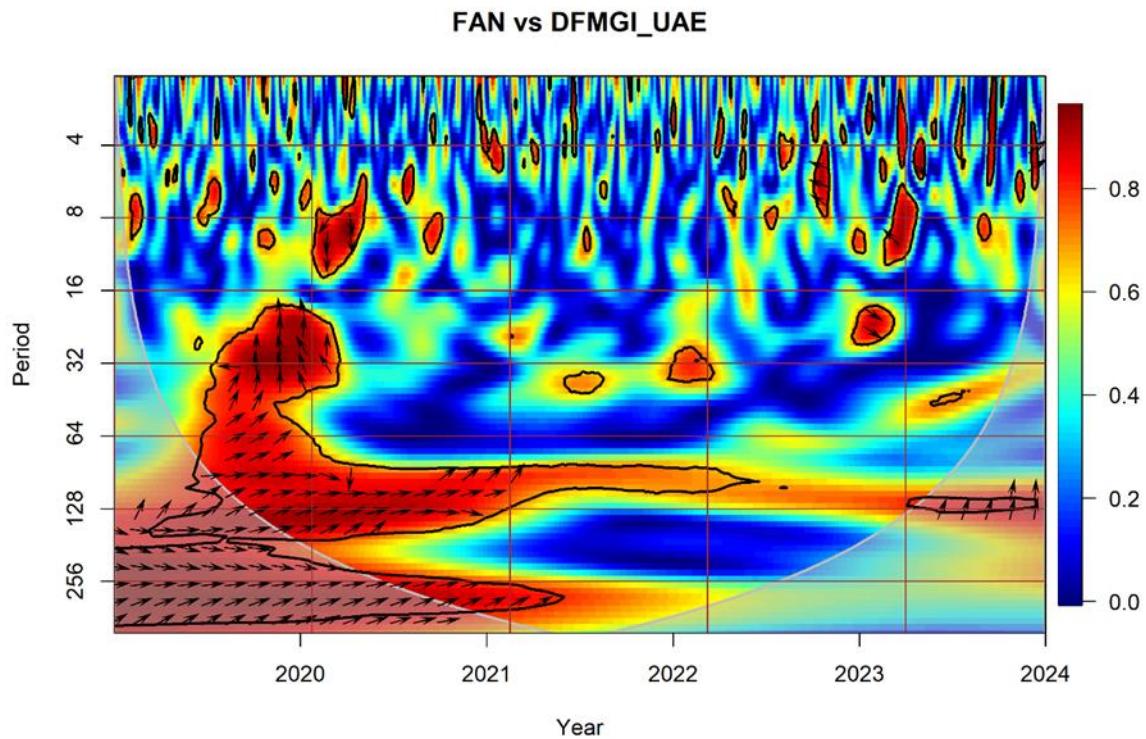
2023 (on the x-axis):

The collapse of Silicon Valley Bank could have broader economic impacts, potentially affecting the coherence across all terms with dominance in medium to long term. This might indicate that the financial markets are feeling the extended effects of the bank's collapse.

2024 (on the x-axis):

As this year is ongoing, the predictions of increased coherence across all terms might suggest uncertainty or varied responses to evolving global conditions, including the ongoing effects of the previous years' events.

11- FAN WITH UAE



2019 (on x-axis):

- **Short-term Volatility:** There is a significant amount of high coherence (red areas) in short-term volatility. This could be attributed to immediate reactions to events like **COVID-19**, which had a profound impact on global financial markets.
- **Medium-term and Long-term Volatility:** Not much notable activity in these time scales during 2019.

2020 (on x-axis):

- **Short-term Volatility:** Noticeable decrease compared to 2019. The initial panic from COVID-19 subsided, leading to reduced short-term fluctuations.
- **Medium-term Volatility:** Increased, especially around the 16-32 period mark on the y-axis. This suggests more sustained impacts emerging as the pandemic unfolded.
- **Long-term Volatility:** Remained relatively stable.

2021 (on x-axis):

A mix of medium and short-term volatilities with no distinct pattern. This could reflect uncertainties or mixed impacts from ongoing global events (e.g., COVID-19, Russia-Ukraine tensions, and the Silicon Valley Bank collapse).

2022 (on x-axis):

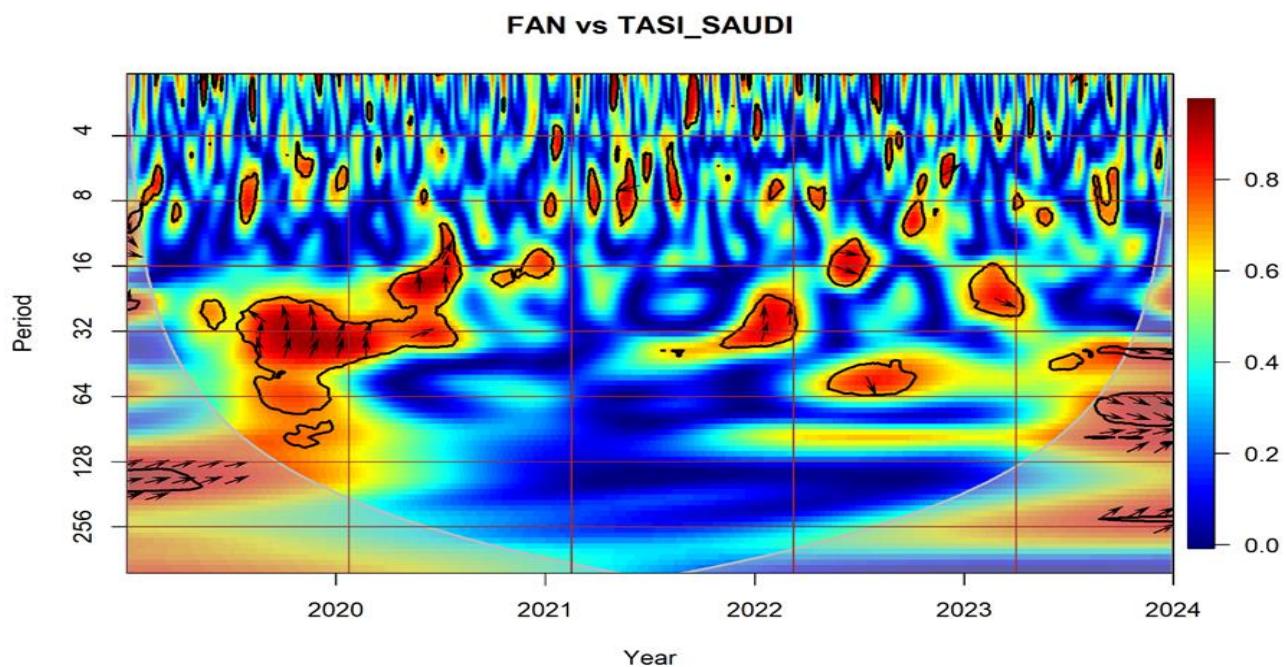
Long-term Volatility: Prominent increase. This might be due to long-lasting effects starting to manifest from earlier events (e.g., COVID-19's economic aftermath, geopolitical tensions).

Short-term and Medium-term Volatility: Some fluctuations but not as pronounced.

2023 and 2024 (on x-axis):

Both short and long-term volatilities are relatively low, with some medium-term fluctuations. This suggests stabilization or adaptation to ongoing global situations.

12- FAN WITH SAUDI



2019 (on x-axis):

- **Short-term Volatility:** There is a significant amount of high coherence (red areas) in short-term volatility. This could be attributed to immediate reactions to events like **COVID-19**, which had a profound impact on global financial markets.
- **Medium-term and Long-term Volatility:** Not much notable activity in these time scales during 2019.

2020 (on x-axis):

- **Short-term Volatility:** Noticeable decrease compared to 2019. The initial panic from COVID-19 subsided, leading to reduced short-term fluctuations.
- **Medium-term Volatility:** Increased, especially around the 16-32 period mark on the y-axis. This suggests more sustained impacts emerging as the pandemic unfolded.

Long-term Volatility: Remained relatively stable.

2021 (on x-axis):

A mix of medium and short-term volatilities with no distinct pattern. This could reflect uncertainties or mixed impacts from ongoing global events (e.g., COVID-19, Russia-Ukraine tensions, and the Silicon Valley Bank collapse).

2022 (on x-axis):

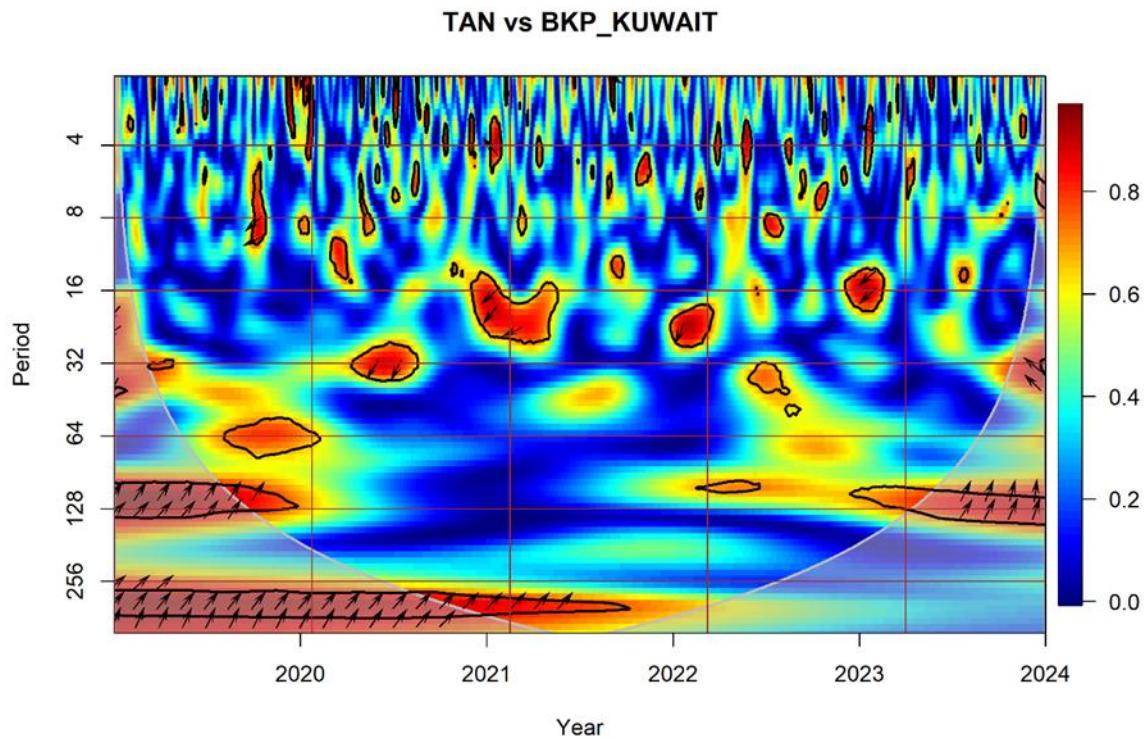
Long-term Volatility: Prominent increase. This might be due to long-lasting effects starting to manifest from earlier events (e.g., COVID-19's economic aftermath, geopolitical tensions).

Short-term and Medium-term Volatility: Some fluctuations but not as pronounced.

2023 and 2024 (on x-axis):

- Both short and long-term volatilities are relatively low, with some medium-term fluctuations. This suggests stabilization or adaptation to ongoing global situations.

13- TAN WITH KUWAIT



2019 (on x-axis):

- **Short-term Volatility:** There is a significant amount of high coherence (red areas) in short-term volatility. This could be attributed to immediate reactions to events like **COVID-19**, which had a profound impact on global financial markets.
- **Medium-term and Long-term Volatility:** Not much notable activity in these time scales during 2019.

2020 (on x-axis):

- **Short-term Volatility:** Noticeable decrease compared to 2019. The initial panic from COVID-19 subsided, leading to reduced short-term fluctuations.
- **Medium-term Volatility:** Increased, especially around the 16-32 period mark on the y-axis. This suggests more sustained impacts emerging as the pandemic unfolded.
- **Long-term Volatility:** Remained relatively stable.

2021 (on x-axis):

- A mix of medium and long-term volatilities with no distinct pattern. This could reflect uncertainties or mixed impacts from ongoing global events (e.g., COVID-19, Russia-Ukraine tensions, and the Silicon Valley Bank collapse).

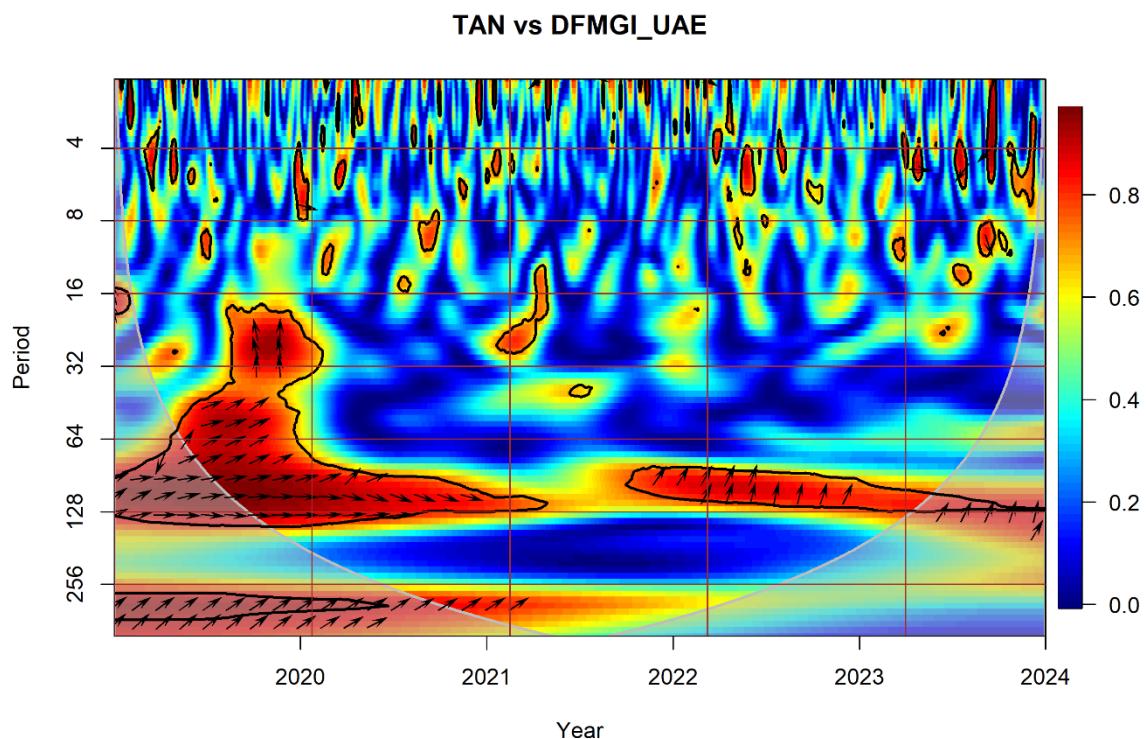
2022 (on x-axis):

- **Long-term Volatility:** Prominent increase. This might be due to long-lasting effects starting to manifest from earlier events (e.g., COVID-19's economic aftermath, geopolitical tensions).
- **Short-term and Medium-term Volatility:** Some fluctuations but not as pronounced.

2023 and 2024 (on x-axis):

- Both short and long-term volatilities are relatively low, with some medium-term fluctuations. This suggests stabilization or adaptation to ongoing global situations.

14- TAN WITH UAE



2019 (on x-axis):

- **Short-term Volatility:** High coherence (red area) in short-term volatility. This could be due to immediate reactions to global events like **COVID-19**.
- **Medium-term and Long-term Volatility:** Not much notable activity during this year.

2020 (on x-axis):

- **Short-term Volatility:** Decreased compared to 2019. Initial panic from COVID-19 subsided, leading to stability.
- **Medium-term Volatility:** Increased, suggesting sustained impacts.
- **Long-term Volatility:** Remained relatively stable.

2021 (on x-axis):

- Mix of medium and long-term volatilities. Uncertainties or mixed impacts from ongoing global events (COVID-19, Russia-Ukraine tensions, and Silicon Valley Bank collapse).

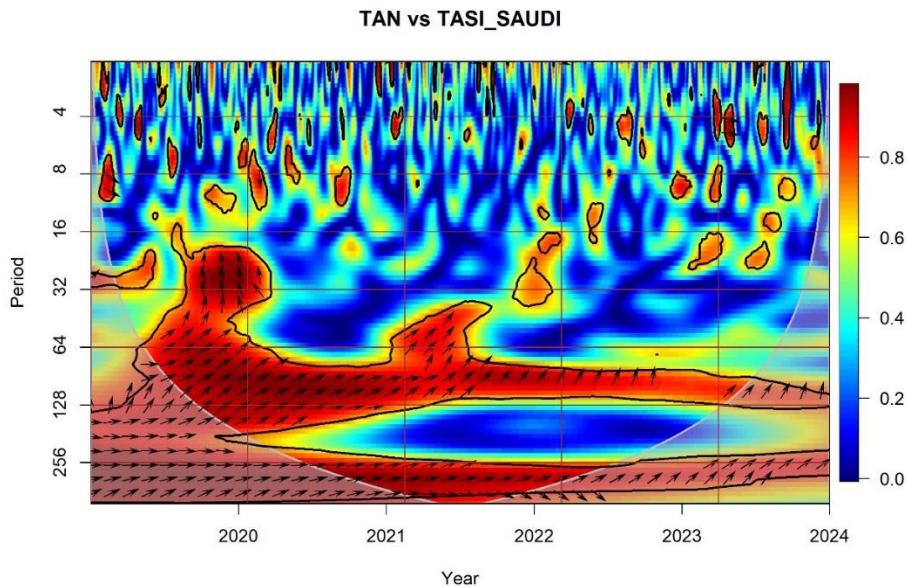
2022 (on x-axis):

- **Long-term Volatility:** Prominent increase. Long-lasting effects from earlier events or geopolitical tensions.
- **Short-term and Medium-term Volatility:** Some fluctuations but not pronounced.

2023 and 2024 (on x-axis):

- Both short and long-term volatilities are relatively low, with medium-term fluctuations. Markets might have adapted or other global events are influencing UAE's green fund.

15- TAN WITH SAUDI ARABIA



2019: The plot shows mixed volatility across all terms, with significant short-term coherence. This period precedes the major events and may reflect the initial market responses to emerging global trends and policies favouring green investments.

2020: The onset of COVID-19 is marked by increased medium-term volatility and reduced coherence in short and long terms. This suggests that the pandemic introduced uncertainties that affected the green fund and Saudi market differently, possibly due to the immediate impact on oil prices and the energy sector.

2021: A decrease in coherence, especially in the short term, could indicate that the markets began to adapt to the pandemic's conditions, with the green fund and Saudi market starting to decouple as they navigated the ongoing crisis.

2022: An increase in medium to long-term coherence might reflect the markets' response to the Russia-Ukraine war, with potential implications for energy markets and green funds due to geopolitical tensions and their impact on energy security and investment strategies.

2023: High medium-term volatility continues, which could be associated with the repercussions of the Silicon Valley Bank collapse. This event may have led to broader financial uncertainties affecting investment behaviours and market stability.

2024: A reduction in overall coherence suggests that TAN and the Saudi market may be experiencing diverging trends or reduced correlations, possibly because of evolving market conditions and the long-term impacts of the events.

GARCH MODEL

ERTH

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000484	0.000434	1.114	0.265268
<i>omega</i>	0.000026	0.000008	3.4725	0.000516
<i>alpha1</i>	0.178449	0.045255	3.9432	0.00008
<i>beta1</i>	0.742138	0.05527	13.4275	0

ICLN

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000484	0.000434	1.114	0.265268
<i>omega</i>	0.000026	0.000008	3.4725	0.000516
<i>alpha1</i>	0.178449	0.045255	3.9432	0.00008
<i>beta1</i>	0.742138	0.05527	13.4275	0

FAN

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000459	0.000346	1.32635	0.18473
<i>omega</i>	0.000005	0.000006	0.87391	0.38217
<i>alpha1</i>	0.109454	0.017687	6.18826	0
<i>beta1</i>	0.870166	0.025485	34.14402	0

TAN

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000535	0.000684	0.78201	0.434207
<i>omega</i>	0.000014	0.000007	1.89068	0.058666
<i>alpha1</i>	0.074061	0.009347	7.92325	0
<i>beta1</i>	0.909867	0.010562	86.14695	0

Kuwait

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000683	0.000191	3.5827	0.00034
<i>omega</i>	0.000006	0.000001	7.3431	0
<i>alpha1</i>	0.292871	0.030656	9.5536	0
<i>beta1</i>	0.685614	0.018951	36.1788	0

Saudi

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000798	0.00023	3.474	0.000513
<i>omega</i>	0.000004	0.000002	2.7997	0.005116
<i>alpha1</i>	0.159836	0.020121	7.9437	0
<i>beta1</i>	0.801312	0.013133	61.0152	0

UAE

Optimal Parameters

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
<i>mu</i>	0.000617	0.000225	2.7357	0.006224
<i>omega</i>	0.000003	0.000002	1.3936	0.163434
<i>alpha1</i>	0.125296	0.017229	7.2724	0
<i>beta1</i>	0.849977	0.01862	45.6485	0

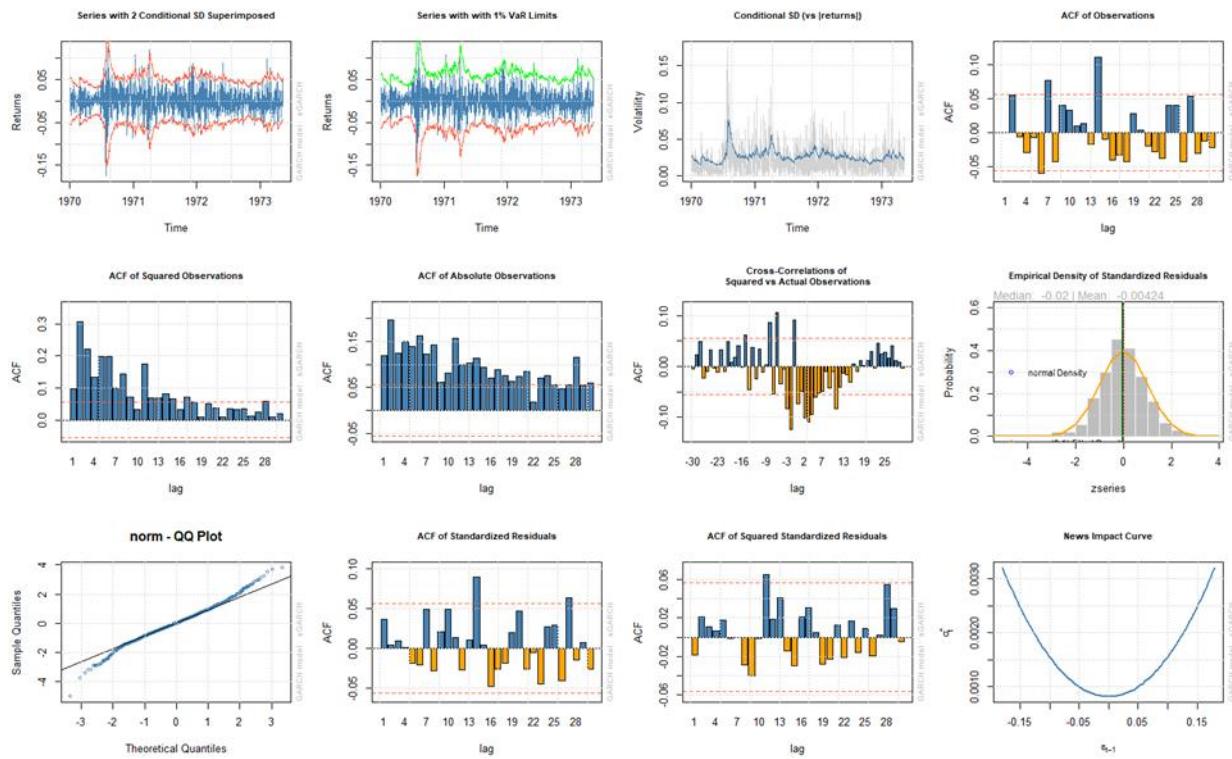
INTERPRETATION:

The GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model is a statistical approach used in financial econometrics to estimate the volatility of returns for stocks, indices, or other financial instruments. The parameters provided for the GARCH model fit in R Studio suggest that the model has been successfully applied to various entities, with the p-values indicating the statistical significance of the estimates.

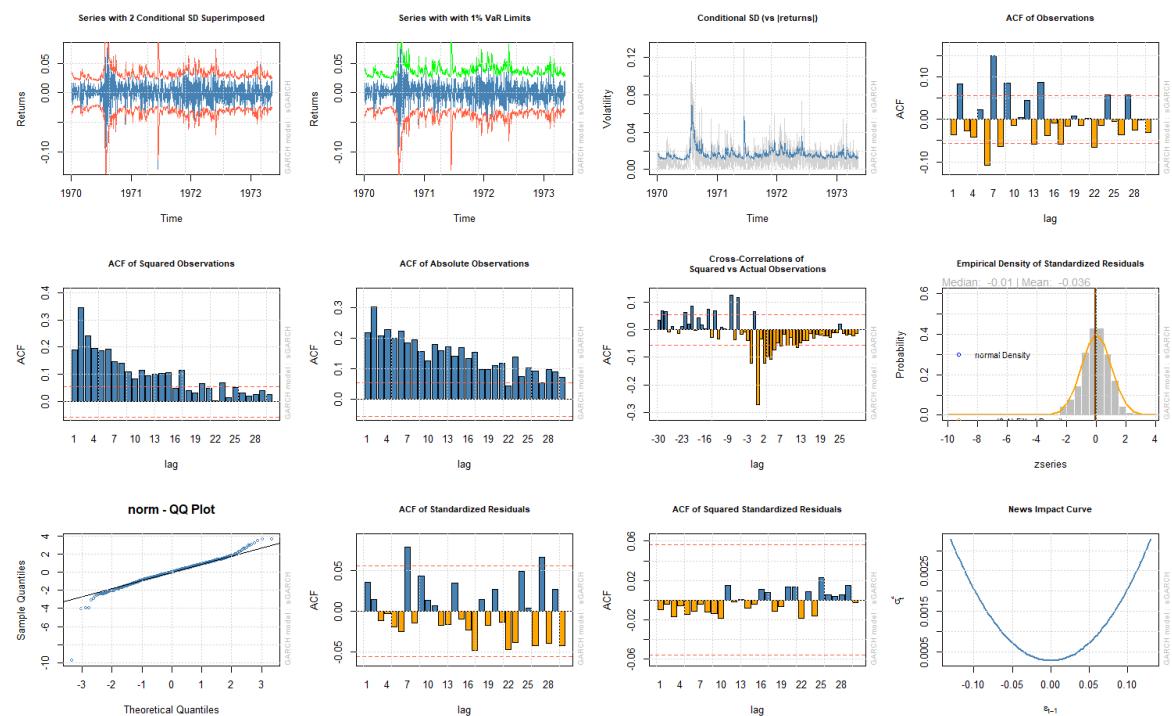
For a GARCH model to be considered well-fitted, the data must indeed be stationary, and the p-values for the estimated parameters should be low (typically less than 0.05), indicating that the parameters are statistically significant and not due to random chance. In your tables, the positive p-values ($\text{Pr}(>|t|)$) for the ‘mu’ parameter in some cases are higher than the conventional threshold, suggesting that the mean return is not statistically significant for those entities. However, the other parameters—omega, alpha1, and beta1—show low p-values across all entities, indicating a good fit for the volatility components of the model.

The ‘omega’ parameter provides the baseline volatility, ‘alpha1’ represents the reaction of volatility to previous shocks, and ‘beta1’ measures the persistence of volatility over time. The significance of these parameters suggests that the model can capture the dynamic nature of volatility for the entities analysed. The GARCH model’s ability to fit these parameters with statistical significance is crucial for forecasting future volatility and for risk management purposes in financial analysis. It’s important to note that while the p-values provide insight into the model’s fit, they should be considered alongside other diagnostic checks and the economic context of the entities being modelled.

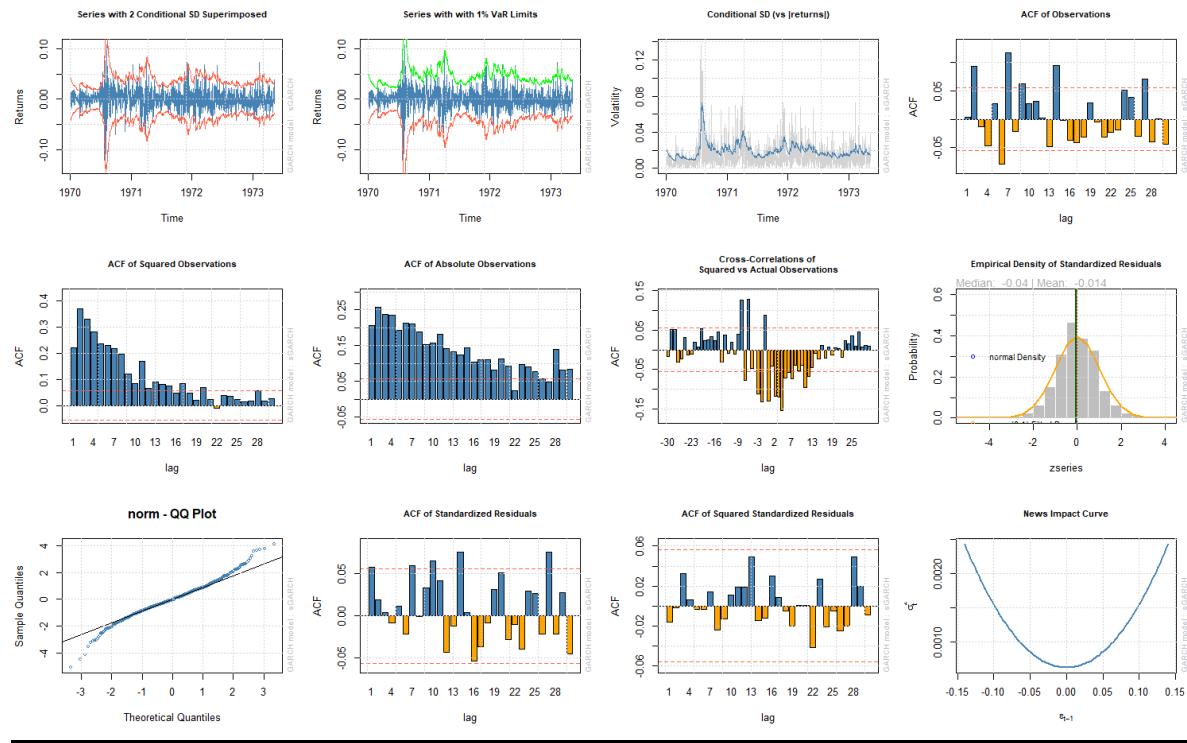
GARCH MODEL:



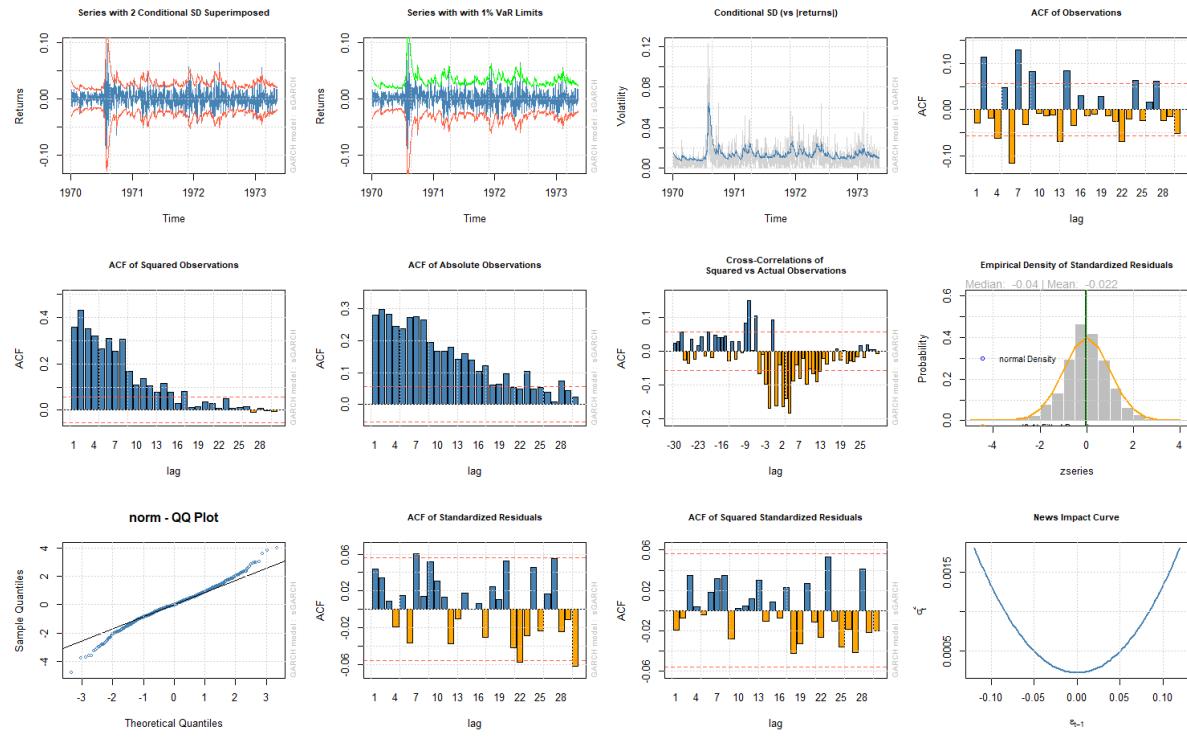
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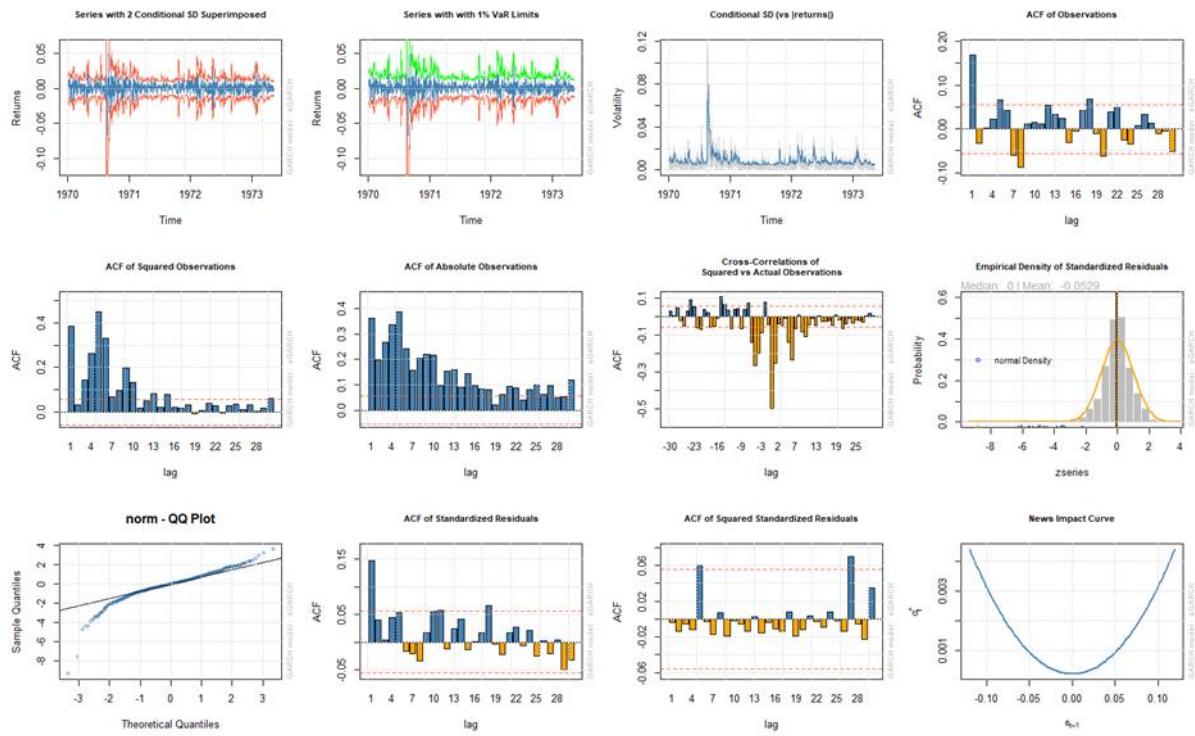
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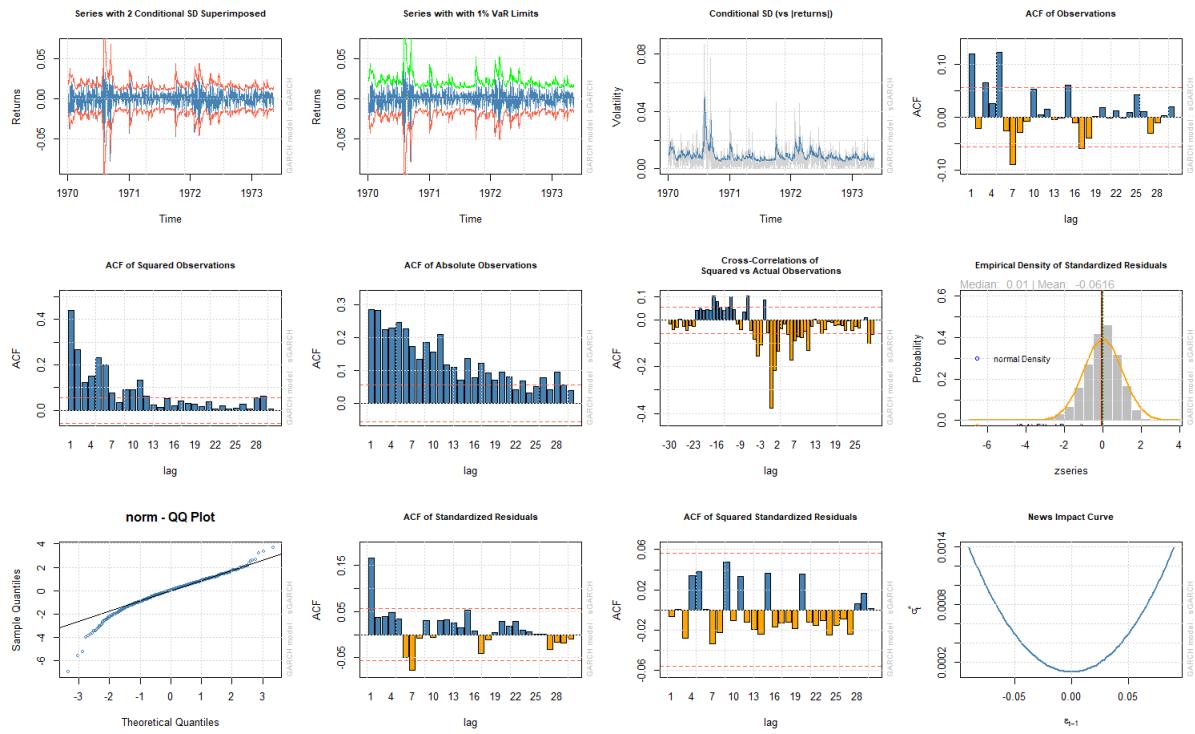
FAN-



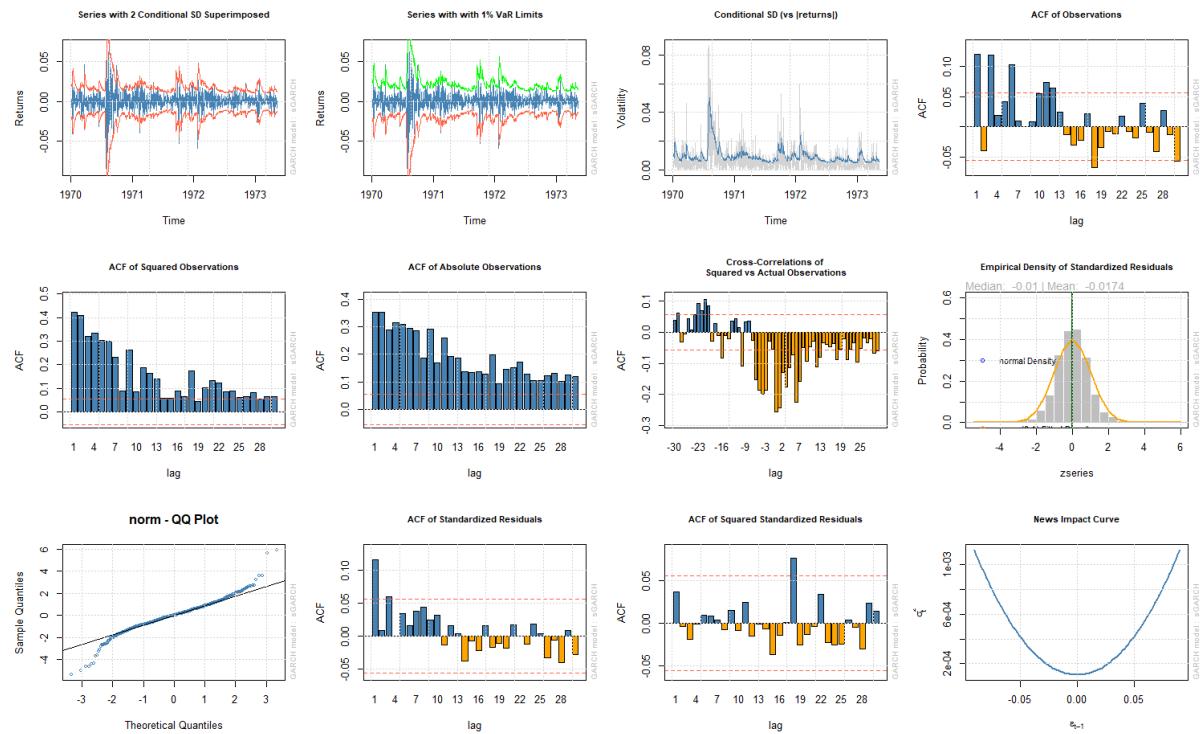
KUWAIT



SAUDI-



UAE-



Conclusion:

After a comprehensive analysis using time series, wavelet spectrum, wavelet coherence, and GARCH models, it has been determined that ICLN stands out as the best-performing green fund. This conclusion is based on the fund's ability to deliver the highest returns, particularly during the tumultuous periods marked by COVID-19, the Russia-Ukraine war, and the Silicon Valley Bank collapse. These events have significantly influenced global financial markets, and ICLN's performance suggests a robustness that has attracted investor interest, leading to a notable shift in investment patterns towards this fund.

ICLN, TAN emerges as the second-best performer, offering substantial returns amidst the same challenging global events. The analysis of these two funds, in comparison with ERTH, FAN, and CGW, across the markets of Kuwait, UAE, and Saudi Arabia, indicates a clear preference among investors for ICLN and TAN. This preference reflects the funds' resilience and potential for growth, even during periods of high volatility and economic uncertainty, underscoring the increasing importance of green funds in the investment landscape. The strategic positioning and management of these funds have evidently aligned well with the shifts in investor sentiment and the evolving dynamics of the green finance sector.

Reference:**Data Source:**

1. *Yahoo is part of the Yahoo family of brands.* (n.d.). <https://finance.yahoo.com/>

Research Paper:

1. Miralles-Quirós, J. L., & Miralles-Quirós, M. M. (2024). *Factor models and investment strategies in the renewable energy sector.* Energy Economics, 107483.

Other Sources:

1. *iShares Global Clean Energy ETF / ICLN.* (n.d.). BlackRock. <https://www.ishares.com/us/products/239738/ishares-global-clean-energy-etf--ICLN>