Social Media's Influence on Cryptocurrency Investments: Environmental Awareness and Market Dynamics

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Abstract: - The rise of social media sites has far-reaching effects on numerous areas in our life, including money decision-making. In the context of cryptocurrency, a novel alternative asset class for investment the roles of social media have taken on more and more powerful roles in determining investors' behaviors, market structure, and even eco-consciousness. This paper aims to explore the intricate relationship between social media engagement and cryptocurrency investment trends, with a special emphasis on environmental considerations and market volatility. In this paper, we use wavelet comovement and coherence analysis to explore the multifaceted relationship between social media, environmental awareness, and cryptocurrency investment dynamics. Empirical results show a positive relationship between the Cryptocurrency Environmental Attention index-based social media which highlights the significant influence on investor attitudes. The interactions between the Index of Cryptocurrency Environmental Attention, cryptocurrency uncertainty, financial market, and gold demonstrate complex relationships shaped by market volatility, investor behavior, and social pressures. The quick investor responses to environmental concerns and regulatory changes highlight the short-term negative relationship, while the positive influence of social media underscores the significant impact of social awareness on investment decisions and corporate practices. This underscores the importance of integrating environmental criteria into financial strategies to meet evolving investor expectations and societal demands.

Key-Words: - Index of Cryptocurrency Environmental Attention (ICEA), social media, gold, financial market index, SP500, cryptocurrency market uncertainty index, wavelet approach.

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1 Introduction

The media performs an essential function in our modern society and is our most powerful tool for forming our perceptions, attitudes, and behaviors. Their power stretches unfathomably deep within all of our lives, yet their visible influence seems most pronounced in the way we perceive international events to the very intimate realm of our individual interpersonal relationships.

Above all, the media serves as a portal to the global society, keeping people privy to what is happening on the domestic and international fronts. It is the number one source in terms of supplying the populace with the sort of intel that lets the average citizen comprehend the events that are molding and shaping the contemporary world.

Conveying information rapidly and effectively allows us a deeper, broader understanding of the collective workings of society—be they social, political, or economic.

The media can significantly shape our perceptions and attitudes. Its coverage can make some issues seem more important while making others seem less so or even unimportant. Media can highlight some ideas, some issues, or some viewpoints while neglecting others. This selective dissemination of information can surely shape our beliefs and opinions.

Our understanding of the world and our actions are often influenced, and even shaped, by the people we're not even aware of as being influential. For most of us, the main people from whom we gain understanding and in whose judgments we have confidence are close to us—our families, friends, and colleagues.

This influence must be acknowledged and countered by developing not just thinking skills but critical thinking skills. Info-enhanced social media, especially Wikipedia can veil the inversions of investment information, largely because of whom and what is reflected in the inchoate, über-public-sphere that Twitter—home to 400 million opinions à la minute—has become. Yet if we're bold enough to whirl and twirl with our investment thesis in such an

arena, we might as well make like a dancer and use all our limbs to reach toward the public sphere; both ways, but especially via the right way, the path of least resistance. [1] used Ramona to generate an investment thesis on "sustainable management and greenhouse gases."

Other research has scrutinized Twitter conversation concerning climate change [2], sentiments tied to climate occurrences, and the emotional "triggers" that lead to public expression [3]. Public opinion has also been the raw material for studying air quality [4] and climate legislation [5]. Some have used surveys to venture into the still scant domain of cryptocurrencies and public opinion.Indeed, our knowledge of the environmental impacts of digital assets like Bitcoin and Ethereum remains limited. Few indeed have explored this under-discussed and under theorized territory from a range of essential (not just financial) perspectives. The multitude of complaints raised against cryptocurrencies stems from their unique qualities which distinguish them from conventional currencies. The list of criticisms includes volatility issues in cryptocurrency prices together with security risks and insufficient regulatory oversight of cryptocurrency markets. A new debate has started to emerge about the energy usage and environmental implications of these digital currencies in recent times. The "mining" processes of Bitcoin and other similar cryptocurrencies have attracted particular attention because they need enormous amounts of energy. The reason for this substantial energy consumption lies in the necessary complex computational tasks that computers execute to confirm transactions and maintain network security. The Bitcoin network runs on so much electricity that it compares to that of a small nation which sparks doubts regarding its future viability. The carbon footprint of cryptocurrencies has now become a critical issue. Most of the energy deployed for mining activities comes from fossil fuels which produces hazardous emissions that worsen climate change. Industry players are searching for sustainable solutions to cryptocurrency challenges by developing alternative systems that either use low-energy consensus methods or promote renewable power usage. Research evidence proves that both cryptocurrency transactions and mining operations maintain strong environmental links to energy usage and pollution as well as CO2 emissions. This paper examines how public environmental concerns affect the cryptocurrency market yet finds no consensus on the relationship between these variables. There is a notable gap in the availability of data or proxies that can reflect and capture attention on cryptocurrency environmental issues, hindering the analysis of how environmental awareness of cryptocurrencies affects financial markets and economic development. Therefore, building on the literature regarding the role of media coverage, public environmental awareness, and government policy in financial markets, this paper explores an index (the ICEA) designed to capture awareness of cryptocurrency energy consumption and sustainability issues and their subsequent impacts on financial markets and economic development. The increasing popularity of cryptocurrencies has brought about significant attention to their environmental impact, particularly the energy-intensive mining processes. This environmental scrutiny is captured through the Cryptocurrency Environmental Attention Index (ICEA), [6]. As environmental sustainability becomes a crucial factor in investment decisions, understanding its impact on market dynamics is imperative. Building on this foundational work, which introduced a cryptocurrency environmental attention index (ICEA) based on news coverage, this paper aims to extend the analysis by investigating the relationship between ICEA and key financial indicators, including market uncertainty (UCPI), the S&P 500 and gold prices as market uncertainty (measured by the Cryptocurrency Uncertainty Perception Index, UCPI), the financial market (represented by the S&P 500) and gold prices. This study employs a wavelet approach to analyze how fluctuations in environmental attention toward cryptocurrencies influence these markets. The wavelet method excels in simultaneous time-frequency decomposition, [7]. It helps rethink investment horizons and offers insights for portfolio management and investor behavior, detecting lead/lag and phase/causality relationships between time series. Our paper highlights new dynamics and perspectives on the complex relationships between stock markets, cryptocurrencies, gold, and environmental attention. This analysis offers valuable insights for a better understanding of portfolio design. It also provides crucial perspectives for investors, policymakers, and researchers interested in the impact of media on environmental concerns and financial markets, thereby contributing to the field of environmental finance. The remainder of the paper is organized as follows: section two presents a brief literature review in order to underline the paper's contribution. The methodology and basic concepts of wavelet coherence theory are outlined in section three. Then, Data description and empirical results are given in

section four. Finally, we end this paper with concluding remarks.

2 Literature Review

Early studies [8], [9], [10] highlighted that cryptocurrencies acted as excellent safe havens, and negatively correlated with traditional financial assets. During the 2020 financial crisis, cryptocurrency prices surged due to monetary policies (e.g., interest rate cuts, asset purchases) and investors seeking to protect against currency devaluation by purchasing cryptocurrencies not controlled by central authorities Bitcoin has been compared to traditional safe havens like gold and oil, often referred to as "digital gold. Studies, [8] indicate that Bitcoin shares hedging capabilities similar to gold, useful against significant drops in stock markets, especially in Asia. Some studies as [11] find Bitcoin effective as a hedge against stock indices and oil but less effective than gold. Other research [12] and [13] classifies Bitcoin more as a speculative asset due to its high volatility and fixed supply, unlike traditional currencies.During the COVID-19 pandemic, gold outperformed Bitcoin as a safe haven for oil and stock markets, [14]. Bitcoin can increase portfolio returns but also adds risk due to its volatility, [15]. Although the environmental impact of cryptocurrencies has been extensively debated in academic circles, awareness of this issue varies among cryptocurrency investors and the general public, leading to mixed opinions. Both mainstream and scholarly literature have investigated the energy and environmental footprints of cryptocurrencies, starting with the pioneering study [16], which concluded that Bitcoin mining consumesas much electricity as Ireland. However, this finding does not imply that researchers deemed cryptocurrency mining activities wasteful. For example [17], argued that cryptocurrency mining appears significantly less wasteful because it can generate more value than it consumes. an electricity consumption index by the Cambridge Centre for Alternative Investments is also a foundational contribution to Additionally, [18], demonstrated that cryptocurrency mining consumed more energy than mineral mining to produce equivalent market value (except for aluminum mining) and also raised concerns about CO2 emissions.

Bitcoin's carbon footprint is a reminder that environmental concerns should not be put on the backburner when analyzing the potential benefits of Bitcoin. [19] put the energy use of more than 500 cryptocurrencies and tokens that could be mined into perspective and discovered that two-thirds of the total energy use of the cryptocurrencies was the use of Bitcoin, whereas the remaining two-thirds consisted of the remaining cryptocurrencies. Cryptocurrency energy consumption and environmental pollution studies are still ongoing with more recent research probing the connection between attention to cryptocurrency energy use and the performance of financial markets, [20], [21].The DCC-GARCH (Dynamic Conditional Correlation-Generalized AutoRegressive Conditional Heteroskedasticity) model was employed to investigate the impact of Bitcoin volatility and cryptocurrency mining operations on energy markets and power utility firms, [20]. Their results indicate that cryptocurrency energy consumption exhibits a strongly positive correlation with the performance of specific companies. [21] further explored the connection between Bitcoin and green financial assets based on atime-varying optimal copula, and this led to the conclusion that all green assets would be good hedges against Bitcoin.

First, we draw from research on drivers of environmental awareness. [22] observed that climate change and environmental issues, along with general social educational attainment, drive awareness of climate and environmental risks in financial markets, aligning with the findings of [23]. Second, [24] found that the importance of climate change and environmental issues is strongly correlated with future economic and financial market uncertainty, supporting [25] conclusions. Third, [26] demonstrated that the lagged effects of extreme climate events can drive media coverage, causing financial market panic. However, many studies on awareness and sensitivity to climate and environmental issues have been conducted at individual, organizational, or governmental levels, with few addressing long-term macro-level drivers. For example, in evaluating the effects of low energy-consumption tax reduction policies, [27] observed that positive policies could improve companies' innovation investments by alleviating financial constraints. The influential force of media and the discussions initiated by internet users have played a pivotal role in shaping societal perspectives, particularly regarding emerging technologies like cryptocurrencies. This dynamic landscape of information exchange and dialogue has sparked the attention of researchers, leading to innovative approaches to understanding public sentiment and concerns.

For example, [28] created a cryptocurrency environmental attention index from news coverage that measures how much talk there is about

environmental sustainability in relation to cryptocurrencies. In their investigation, they examine the effects of this environmental attention on several financial and economic performance variables. They also provide some really helpful insights into the use of online databases in developing new indices for financial research. They show how online discourse, as well as the discourse in the news media, can be tapped to provide a better understanding of how cryptocurrencies are interacting with sustainability. Their index also serves as a good demonstration of the index idea, really highlighting both the pros and the cons of a high-profile index like the Bitcoin one.

New developments have shed fresh light on the complex interaction among the energy consumption of cryptocurrencies, their environmental impact, and their relationship with financial markets. One significant development is the increased use of renewable energy in cryptocurrency mining. This shift toward sustainable energy sources is crucial for rectifying the negative environmental profile of cryptocurrencies—an unsustainable one captured by the ICEA, [28]. But the interplay among energy consumption, environmental awareness, and investment in cryptocurrencies is also about policy and regulation. Governments and regulatory bodies are paying more attention to the environmental impact of cryptocurrencies—and specifically to the energy consumption of cryptocurrencies like Bitcoin. Policies aimed at reducing energy consumption and its attendant carbon emissions are likely to influence the future dynamics of the ICEA. Innovations in both the design and the technology of cryptocurrencies are also important. They can significantly reduce the amount of energy consumed by what are now the most popular cryptocurrencies and lessen if not completely eliminate, the negative sentiment now associated with them.

In addition, financial markets are increasingly sensitive to environmental, social, and governance (ESG) matters. Companies that neglect to consider their environmental impact may watch as their investors pull out or their stock prices sink. Increasingly, these matters are reflected in financial performance, with a big number showing up in the aftermath of our big federal climate change assessments: the 10% to 20% annual cost that careening toward a climate-ravaged world is expected to impose on the U.S. economy.

The emerging research into how cryptocurrencies impact energy usage and environmental sustainability is producing significant and useful results. Researchers are studying the wider economic impacts, such as the impacts on energy markets and costs of carbon emissions, as well as the potential for regulatory responses. Including these additional details and recent updates, we can build a more complete picture of the complex interactions between cryptocurrency energy consumption, environmental impact, and financial markets. Our finding contributes to the literature by providing a more complete view of the interconnectedness of environmental concerns in cryptocurrency and financial markets. We investigate the time-varying linkages among these factors by applying wavelet comovement and coherence analysis. This approach enables a more accurate analysis of how media and environmental attention (captured by the ICEA) influence behaviours in cryptocurrency markets, the financial market, and gold. We are able to create more tailored policies and strategies to mitigate the environmental impacts of cryptocurrencies while harnessing their economic advantages through this thorough examination.

3 Data and Methodology

This study analyzes weekly time-series data for ICEA, UCPI, the S&P500 index, and gold prices from January 19, 2020, to January 15, 2023, with 157 observations. Data sources for this study are publicly available.

ICEA is news coverage data-based and employs the model discussed by [6].

UCPI is employed here as a proxy for cryptocurrency market uncertainty, according to [28].

S&P500 and gold prices are indicators of financial market performance and a classic safe-haven asset, respectively.

The method employed by this adapted methodology is designed to provide a deeper insight into the relationships between environmental awareness in terms of cryptocurrency power consumption, and other markets. It is based on wavelet correlation wavelet coherence analysis, and descriptive statistics. The employment of the above together enables research of both overall trends and intricate temporal structures in the dataset, enabling thorough exploration of these relationships.

More precisely, descriptive statistics give the initial overview of the data set, indicating the most prominent features and trends. Wavelet correlation allows for the examination of interdependencies between different time series on a variety of time and frequency scales, providing a more detailed perspective of their interdependence, [29]. Wavelet coherence uncovers localized correlation,

identifying those time periods when the variables are synchronized, and offering a better insight into their dynamic interactions, [30], [31]. As wavelet methodology is not parametric, it provides scholars with the facility of selecting wavelets based on data size and type. It provides a stable analysis of time series that often surpasses standard parametric procedures for handling complex, noisy, and non-stationary data. In fact, the methodology illustrated here is properly equipped to tackle non-stationary data. It provides a means to compare time series features at an assortment of diverse scales simultaneously and provides proper detection of important events as it possesses temporal and frequency localization. Wavelet coherence analysis also investigates causally dynamic relationships among variables that are observed overlong as well as short time, [32].

The stepsfor the process of analysis are multiple:
- Applying a wavelet decomposition that permits one to observe a time series at several scales.

Calculation of the continuous wavelet transform (CWT) by convolving the series with the wavelet function yields to local phase information.

Cross wavelet transform for two time series$x(t)$ and $y(t)$ s, indicated by W_{xy}, which marks the areas of high power and shows local phase relationships. The cross wavelet transform is mathematically formulated as:

$$W_{xy}(s,t) = W_x(s,t).W_y(s,t)^* \quad (1)$$

where $W_x(s,t)$ and $W_y(s,t)$ are the continuous wavelet transform of $x(t)$ and $y(t)$ respectively. $W_y(s,t)^*$is the complex conjugate of $W_y(s,t)$
s is the scale parameter and t is the time parameter.

Therefore, wavelet coherence (WTC) estimates the local correlation between two wavelet transforms in order to detect synchronized behaviors in the time-frequency domain.it's defined as:

$$WTC_{xy}(s,t) = \frac{|S(W_{xy}(s,t))|^2}{S(|W_x(s,t)|^2).S(|W_y(s,t)|^2)} \quad (2)$$

where $S(.)$ is a smoothing operator in time and scale.

Phase relationship analysis investigates potential physical mechanisms connecting the time series by estimating the circular mean of phase angles to measure the phase relationship. Mechanistic models are then challenged to guarantee that identified associations do not exist to a greater degree between causes by spurious relationships. [30], [31] demonstrated the process by performing an association analysis of geophysical time series. Intervals having high common power and coherent phase association were displayed, indicating causality association of the phenomena involved. In general, the cross wavelet and wavelet coherence method gives a solid framework for the investigation of intricate relations between time series space-frequency. An empirical application is carried out in R-Studio by executing different packages such as biwavelet package.

4 Results and Discussion

Table 1 (Appendix) has descriptive statistics. The heavier tails and more peaked (kurtosis > 3) in all the series of data show a non-normal distribution except UCPI. It means that the extreme values are characteristics of the data distributions, and these are more centralized around the mean than the normal distribution. The nature of the various variables used is varied, which indicates the heterogeneity of the series. The ICEA and SP500 variables, for example, have long left-tailed distribution tails (negative skewness), while Gold and UCPI have positive skewness. More significantly, the ICEA as well as the UCPI series significantly deviate from normality based on the Jarque Bera test, and p-values approach zero. In addition, the ADF test also indicates that these series are non-stationary at a 5% significance level, i.e., not stable over time. On the other hand, while for the Gold variable and SP500 index, the distribution also seems to be significantly non-normal as per the Jarque Bera test, the series are also stationary according to the ADF test. These results underscore the paramount importance of performing a careful examination of attributes of data prior to attempting any modeling or decision-making activity.

According to the correlation matrix (Table 2), there is a general independence among the initial variables, characterized by negative coefficients close to zero. This indicates that most of the variables do not have a significant linear relationship with each other. The positive correlation between the indices linked to cryptocurrency is a noteworthy exception, though. A singular exception to this is the positive correlation between cryptocurrency indicators. Exactly, the ICEA and UCPI correlation stands at 0.3081823, which is the greatest in the matrix. This is a moderate level of correlation implying a positive association of some nature between these two indicators, maybe because of similar dynamics or root determinants impacting ICEA and UCPI. This observation deserves special attention in data

analysis, as it could reveal important insights into the interactions between cryptocurrency-related variables.

Table 2. Correlation matrix

	ICEA	Gold	SP500
ICEA	1		
Gold	-0.009296635	1	
SP500	-0.01073302	-0.05365004	1
UCPI	0.3081823	-0.06322754	-0.03288951

Table 3 and Figure 1 describe the time-varying correlation between variables. The relationship between GOLD and ICEA is weakly positive to strongly negative, representing a more reversed relationship in the long run. The relationship between SP500 and ICEA is weakly positive or negative in the short run, rising to slightly positive in the long run, representing an unstable but weakly positive relationship in the long run. There is a positive overall correlation between UCPI and ICEA with a peak in the medium term (scale 8) before it decreases in the long term to indicate a moderate but unstable positive correlation. Such results emphasize the need to take into account the time scale while performing analysis of correlations between variables since correlation differs substantially based on the term taken.

ICEA and GOLD are quite different in the correlation across the time scales. Inthe short term (time-varying scales 2 and 4), it is weakly positive but very weak, indicating that there is not a significant trend. At the medium term (time-varying scale 8), it is negative, indicating a weakly inverse relationship. At the long term (time-varying scales 16 and 32), they are strongly negatively correlated (-0.51048764 and -0.50141965), indicating that there is an inverse significant relationship.

The SP500 and ICEA also have differing correlations. In the short term (time-varying scales 2 and 4), it is weak and positive. On the medium term (time-varying scale 8), it is negative. In the long term (time-varying scales 16 and 32), it turns positive, reflecting a closer relationship.

For UCPI and ICEA, the short-term relation (scales 2 and 4) is positive but less strong compared to the very short-term (time-varying scales 1). In the medium term (time-varying scale 8), it is stronger(0.418441380), which indicates a strong relation. In the long term (time-varying scales 16 and 32), the positive relation becomes weaker, i.e., the relation becomes weaker with time.

Table 3. Wavelet Correlation matrix

	Time-varying scale	ICEA vs GOLD	ICEA vs SP500	ICEA vs UCPI
D0	**1**	-0.009296635	-0.010733302	0.3081823
D1=[2, 4]	**2**	0.03264241	0.010421 43	0.0768974 48
D2=[4, 8]	**4**	0.00958037	0.037573 06	0.1655866 80
D3=[8, 16]	**8**	-0.05801403	-0.061327 07	0.4184413 80
D4=[16, 32]	**16**	-0.51048764	0.105809 11	0.2677360 94
D5=[32, 64]	**32**	-0.50141965	0.078239 05	0.0081236 62

Figure 1 tracesthe time varying correlation between variables.

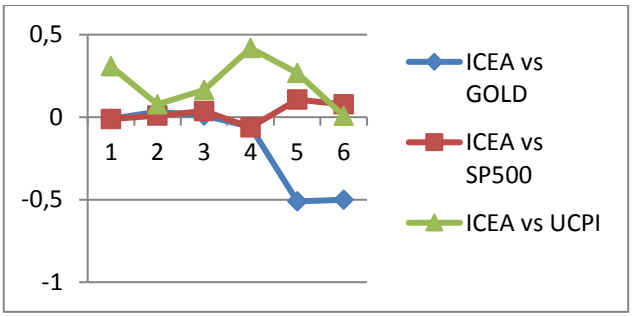

Fig. 1: Wavelet correlation

The positive relationship between the Index of Cryptocurrency Environmental Attention (ICEA) based on social media can be understood through various perspectives from previous research. Influential social groups raise awareness of environmental issues, encouraging more responsible investment decisions within the cryptocurrency sector. Cryptocurrency companies strive to enhance their brand image by adopting sustainable practices, driven by the expectations of social media groups. The significance of ESG (Environmental, Social, and Governance) criteria in investment decisions also contributes to this relationship, as does the alignment of interests between social actors and environmental initiatives. This dynamic illustrates how social concerns shape the environmental practices of cryptocurrencies.

The short-term negative relationship between the ICEA, SP500, and gold reflects the volatility of cryptocurrency markets and the quick reactions of investors to environmental concerns.

Investors dynamically adjusted their portfolios in response to emerging environmental developments leading to short-term price variations. Gold which is historically perceived as a safe-haven asset, often experiences increased demand during periods of environmental and regulatory uncertainty within the cryptocurrency sector.

As shown in Figure 2, the phase relationship between ICEA and UCPI is traduced by arrows pointing to the right which indicates that both series are in phase. The environmental awareness "ICEA" and "Market uncertainty" of cryptocurrency vary simultaneously in the same direction.

By examining the periods and scales involved the phase-in relationship observed during this period suggests that the indices followed a common dynamic in response to economic shocks. In fact, in the period 2020-2021, the synchronization appears on the short and middle scales, implying that the average fluctuations of these indices can be explained by global economic events, such as the COVID-19 pandemic crisis. In addition, in 2023 high synchronized change are observed on the first scale (2, 4 weeks) corresponding to short–term variations that may reflect a rapid reaction to several events, such as the war in Ukraine.

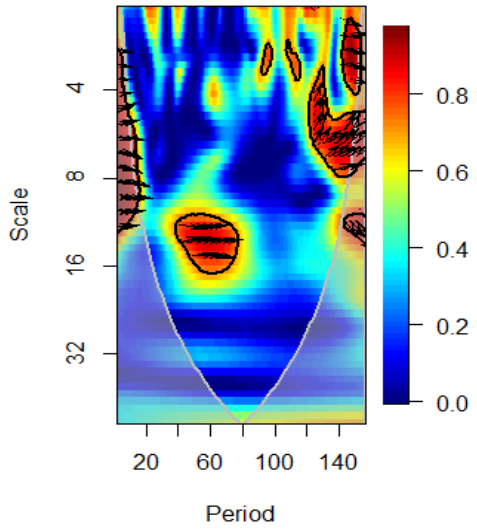

Fig. 2: Wavelet Coherence: ICEA vs UCPI

In Figure 3, the oriented arrows to the left indicate that ICEA and SP500 are in phase opposition. The environmental conscience and financial market evolve in opposite directions. Particularly, this negative correlation appears towards the end of the studied period (in 2023) and on medium-term fluctuations (about 8 to 16 weeks scale). This opposite trends can be explained by market cycles where investors reallocate their assets between the sectors represented by ICEA and the global stock market represented by the SP 500.

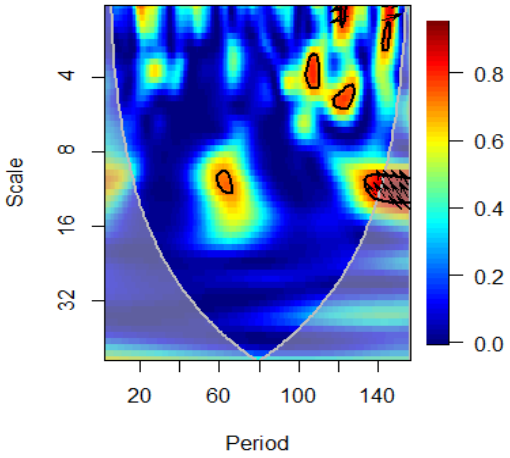

Fig. 3: Wavelet Coherence: ICEA vs SP500

Gold is mostly viewed as a safe haven with prices rising in the event of economic instability or financial crisis. Figure 4 indicates that the gold prices act in the same way as the ICEA which accounts for the consciousness of the environment towards cryptocurrency and resulted in increased uncertainty in this market.

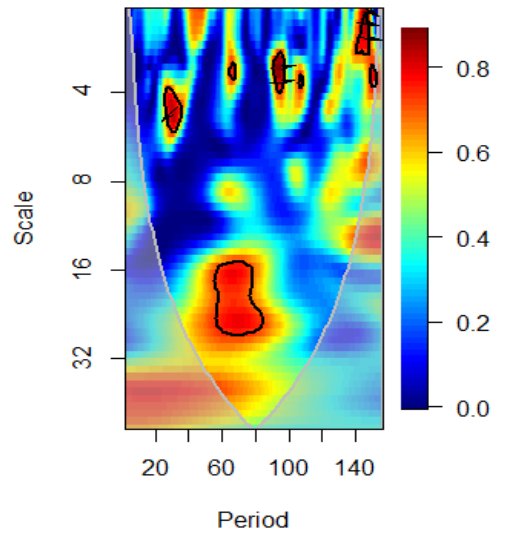

Fig. 4: wavelet coherence: ICEA vs GOLD

Environmental awareness and investor sentiment influence gold prices and exhibit different movements depending on the time events. These insights build upon the findings of [21] who demonstrate that investor decision-making and financial market behavior, particularly in relation to cryptocurrency and gold, are significantly shaped by environmental considerations and environmental, social, and governance (ESG) principles.

Gold is often seen as a hedge against market volatility, which corresponds to its reverse evolution compared to cryptocurrencies in periods of uncertainty. This reaction is consistent with traditional financial theories which underline that the market responds swiftly to economic and environmental disruptions.

The interplay between the environmental index, cryptocurrency market, gold, and traditional financial market reveals a multifaceted relationship between evolving social dynamics and investor behavior towards uncertainty. Firstly, we underline, as a rapidinvestor response to environmental risks, that an increase of the cryptocurrency environmental attention index increases, on the one hand, the cryptocurrency market uncertainty, and on the other hand it positively impactsthe movements on the gold market.

In addition, the financial market (SP500) is experiencing a movement opposite to that of the cryptocurrency market uncertainty following the growth of the ICEA.This results highlightthe profound influence of public awareness and socially conscious investment groupsabout sustainability and advocacy on investment decisions and corporate practices. Thus, integrating the ESG criteria is key to the growing emphasis on sustainability and responsible investing that is reshaping financial markets, reinforcing the crucial role that environmental and social factors play in determining the long-term trajectory of the cryptocurrency sector and the broader financial ecosystems.

5 Conclusion

This paper highlights new dynamics and perspectives on the complex relationships between stock markets, cryptocurrencies, gold, and environmental attention. This analysis offers valuable insights for a better understanding of the portfolio design. It investigates how the cryptocurrency environment attention influences market volatility, investor sentiment, and gold prices.

The studied dynamics reflect a complex and evolving financial landscape driven by investor behavior and social media activism. The observed short-term significant coherence underscores how markets react to environmental awareness. This insight reinforces the importance of incorporating environmental and social considerationsinto financial decision-making, in order to meet evolving regulatory expectations, investor preferences, and global sustainability goals.

The findings highlight the increasing significance of environmental concerns in shaping financial market trends and offer a framework for future research at the intersection of sustainability and financial markets.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the authors used ChatGPT in order to improve the readability and language of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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APPENDIX

Table 1. Descriptive statistics

	Mean	Sd Error	Skewness	Kurtosis	Jarque Bera test	ADF test
ICEA	103.1291	8.567091	-10.01398	116.6943	86629 (< 2.2e-16)	-0.3409 (0.5057)
Gold	0.1540385	2.42643	0.09609389	5.821291	51.978, (5.166e-12)	-9.1925 (0.01)
SP500	0.1742949	3.287794	-0.469179	7.123514	116.25 (< 2.2e-16)	-8.6362 (0.01)
UCPI	103.7756	3.488003	0.6866645	2.699707	12.845 (0.001624)	0.3964 (0.7407)

p-value isgiven in parenthesis

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