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## Impact of the Covid-19 induced panic on the Environmental, Social and Governance leaders equity volatility: A time-frequency analysis

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### ABSTRACT

We apply wavelet analyses to study how the Covid-19 fueled panic influenced the volatility of ESG (environmental, social and governance) leaders' indices encompassing the World, the USA, Europe, China, and the Emerging Markets. We document intervals of the low, medium, and high coherence between the Coronavirus Panic Index and the price moves of the ESG Leaders indices. The low coherence intervals signify the diversification potential of ESG investments during a systemic pandemic such as Covid-19. We document differences in the pattern exhibited by various geographical indices highlighting their potential role for designing cross-geography hedge strategies, both now and in the future.

## 1. Introduction

Financial markets worldwide have been severely affected by the global pandemic of Covid-19 (Al-Awadi et al., 2020; Goodell John, 2020; Iqbal et al., 2020; Umar et al., 2020c; Sharif et al., 2020; Zhang et al., 2020; Goodell, 2021; Akhtaruzzaman et al., 2021; Umar and Gubareva, 2021). As a consequence of such a huge global impact, the literature on the financial effects of Covid-19 has witnessed a rapid expansion (Baker et al., 2020; Conlon and McGee, 2020; Conlon et al., 2020; Okorie and Lin, 2020; Umar et al., 2021; Ramelli and Wagner, 2020; Zaremba et al., 2021; Umar and Gubareva, 2021a). In particular, the Covid-19 crisis has adversely affected the

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diversification attributes of various asset classes, as most of the financial assets have exhibited much-synchronized co-movements through the Covid-19 bear market and initial recovery from it. Thus, underscoring the importance of alternative investments can provide attractive returns coupled with the desirable hedging attributes. Even before this pandemic, we have seen a surge in finance literature focused on factors such as sustainability, ethics, faith-based, environment friendly and socially responsible investing and financing decisions (Umar, 2017; Shahzad et al., 2017; Umar et al., 2020a; and Gomes and Gubareva, 2020). Consequently, we have seen the emergence of new assets such as Islamic finance assets and Environmental, Social, and Governance (ESG) securities. Several studies have analyzed the return and volatility attributes of these assets (Umar et al., 2018; Alda, 2019; Umar et al., 2020b; Wong et al., 2020; Umar and Gubareva, 2021; and Umar and Gubareva, 2021a).

We contribute to the above strand of literature by investigating the performance of ESG leader indices during the Covid-19 pandemic. The literature on the spillover, safe-haven, cross-market interdependence, and hedging opportunities across assets and financial markets has attracted a lot of attention since the subprime crisis of 2007 (Gubareva and Borges, 2016; Umar and Suleman, 2017; Umar, 2017a; Riaz et al., 2019, 2020; Umar et al., 2019a, 2019b; Naeem et al., 2020; Stereńczak et al., 2020; and Kenourgios et al., 2020). The recent Covid-19 pandemic has presented a unique challenge and inspired a new stream of literature focused on the impact of this pandemic on financial markets. Our research contributes to the incipient and sparse literature by documenting the ESG investments reaction to the Covid-19 induced crisis.

We employ the wavelet coherence and wavelet phase difference techniques to investigate the impact of Covid-19 induced panic on the volatility of the MSCI ESG Leaders' indices. We use the Ravenpack Panic Index (PI) as a proxy for the panic sentiment. This index measures the panic by accounting for the level of the news that refers to panic or hysteria and coronavirus. The wavelet techniques allow us to gain insights into the joint behavior of ESG and PI in both the time and frequency domains.

The contribution of our research to the contemporaneous state of the art literature on the ESG investing is three-fold. First, we fill in the existing gap related to the lack of academic research on the dynamic interdependence maps of sentiment variables, such as the panic levels and the ESG Leaders' volatility. The impact of investor sentiment on financial markets has attracted much attention in recent times. Second, our paper adds to the current literature on the ESG investment response to the Covid-19 economic impacts. As our sample period covers the most recent global crisis caused by the pandemic, our findings can provide valuable insights for socially responsible investors. Third, we document the high coherence between the panic level and the price dynamics of the MSCI ESG Leaders' indices.

The rest of the paper is organized as follows. Section 2 discusses the data and the methodology employed. Section 3 presents the results and provides their interpretation. Section 4 concludes.

## 2. Data and methods

We analyze interdependencies between the Covid-19 panic, measured by the PI, and the volatility of diverse MSCI ESG leaders' indices encompassing the World, the USA, Europe, China, and the Emerging Markets (EM). We employ daily data ranging from 01/01/2020 to 01/06/2020. The ESG data is obtained from Bloomberg. The Coronavirus PI index data is obtained from Ravenpack and measures panic through the level of news that refer to panic or hysteria fueled by a coronavirus. Its value ranges from 0 to 100, with 0 meaning 0% news talking about panic and coronavirus and 100 meaning vice versa. Table 1 reports the summary statistics.

We employ the wavelet coherence technique to disentangle the multi-scale interdependency between the PI and the MSCI ESG Leaders' indices. We employ the continuous wavelet transformation to obtain squared wavelet coherency measures following Torrence and Webster (1999) and Vacha and Barunik (2012). The single coherence number for any day at any frequency from high (daily) to low (32-day period) is bounded by 0 (depicting zero correlation) and 1 (depicting perfect correlation between two time-series). To supplement our coherence analysis and get a deeper insight into the lead-lag relations among PI and ESG Leaders' indices, we employ the phase difference technique following Sun and Xu (2018), Zaremba et al. (2019), Umar and Gubareva (2020), and Goodell and Goutte (2020).

## 3. Results

We begin our analysis by examining the wavelet coherence and Phase-difference results between the PI and the ESG World Index

**Table 1**  
Descriptive statistics for ESG leaders and PI.

	World	USA	Europe	China	Emerging Markets	Panic Index
Average	30.80	37.98	28.63	27.06	25.89	3.08
Standard deviation	27.01	33.10	20.37	12.04	16.88	2.24
Skewness	1.25	1.28	1.15	1.45	1.57	0.40
Kurtosis	0.64	0.74	0.73	1.48	1.56	-0.51
Minimum	3.80	5.91	4.14	8.99	6.69	0.00
1st quartile	10.39	12.52	14.16	19.21	14.21	1.05
Median	22.63	27.21	26.35	22.53	21.57	3.11
3rd quartile	39.62	51.87	32.83	29.93	26.50	4.66
Maximum	107.66	128.60	93.00	64.84	76.85	9.24
Observations	109.00	109.00	109.00	109.00	109.00	109.00

shown in Fig. 1. The legends on the right-hand sides show the keys for reading the heatmaps. Time is displayed on the horizontal axis and frequency is shown on the vertical axis. In general, the warmer the color (yellow to red), the greater the coherence or interdependence between the indices. The cooler colors (blue to green) imply less coherence.

For the PI-World pair we document the varying coherence levels ranging from low to medium to high coherence over the entire timescale. The initial period until mid-February shows high coherence followed by intervals with green shade, implying a lower level of coherence during those intervals. Over the frequency scale, coherence is high across most frequencies, but more specifically, it changes from high to medium-low for higher frequencies, with the lowest coherence observed for the 3-day's frequency periods. In accordance with the above interpretation, we associate this interval of the Covid-19 provoked crisis with the panic-leads-market phase. The predominantly red colored intervals imply that the volatility of World-ESG-leaders is highly correlated with the Covid-19 induced panic, leaving less room for diversification through these indices. However, the intervals of the green region imply that the World-ESG-leaders exhibited some diversification attributes despite the panic.

We also identify causality and phase differences between the PI and the World-ESG-Leaders. Arrows indicate the phase differences between the PI and the World ESG index moves. For example,  $\rightarrow$  and  $\leftarrow$  indicate that both the PI and the ESG are in phase and out of phase, respectively.  $\nearrow$  and  $\swarrow$  indicate that the PI moves are leading those of the ESG, while  $\searrow$  and  $\nwarrow$  indicate that the PI moves are lagging those of the ESG. In the left-hand heatmap of Fig. 1, we observe, for the first half of January, the arrows  $\rightarrow$ , signifying an in-phase relationship in the 2-day to 2-weeks band, indicating the positive correlation between the PI and ESG. We ascribe this period to the beginning of the pandemic when Covid-19 starts to spread on a global scale. We also see the cloud of the arrows  $\nearrow$  between mid-February and mid-April in the 2-weeks-plus band, indicating that the escalation in the Covid-19 fueled panic leads the worldwide ESG Leaders' index. We attribute this period to the effects of the full-swing social distancing and once again demonstrate that the wavelet analysis correctly reflects the underlying Covid-19 reality.

To gain further insight into the interdependency analysis, the right-hand heatmap of Fig. 1 identifies the lead-lag relationship between the PI and the World ESG Leaders. We notice two important factors here. Firstly, for the in-phase intervals, the PI is leading, implying that the panic induced by the pandemic influences the ESG World leaders. Secondly, we notice intervals of anti-phase, particularly around mid-April and early May, where the blue color evidences the lead by the world ESG leaders. On the frequency scale, this is more evident for an interval of 3–8 days. The alternating patterns imply unsynchronized behavior of the two indexes, although over the larger investment horizons in the 1–2 weeks band, these asynchronies are self-cancelled out, resulting in an overall leading role of the PI index. However, the overall average tonality of the phase heatmap could be characterized as green, bearing in mind that blue zones fairly compensate red/yellow spots on average. This finding could be of use for investors assessing the attractiveness of the ESG investments as possessing some hedging attributes, which may fail during crisis periods.

### 3.1. Sub-Index analysis for the USA and Europe

We extend our analysis and report the results for various sub-indices of the ESG leaders for various geographies in this sub-section.

Fig. 2 displays the results for the wavelet coherence measure and phase-difference between the Coronavirus Panic Index (PI) and the USA ESG Leaders index. The overall pattern exhibited is like the heatmaps of Fig. 1 and the respective findings regarding the impact of the PI on the volatility of the World-ESG-Leaders. However, we see that the intervals of low coherence are relatively more frequent here. In particular, we see green shaded areas towards the end of January and February, implying that the US-ESG-Leaders exhibited less coherence with the PI during these intervals. Similarly, the phase-difference graph shows intervals where the US-ESG-Leaders lead the negative anti-phase pattern evident by the blue shaded area.

Fig. 3 displays the results for the wavelet coherence measure and phase-difference between the PI and Europe-ESG-Leaders. We observe alternating high and low coherence patterns across time and frequency scale as with the other two indices. Over the frequency scale, similarly to the previous cases, we also observe that coherence is high in the 5-days-plus band; however, it decreases towards the

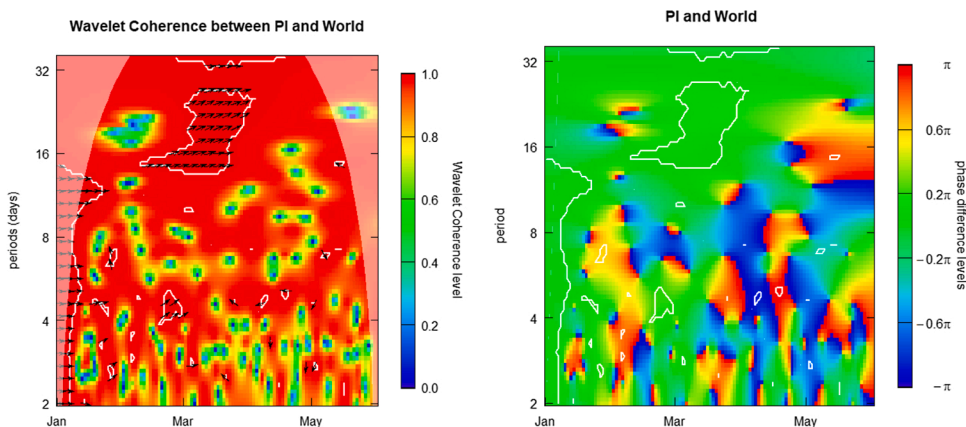


Fig. 1. Wavelet analysis: Panic Index (PI) versus the World-ESG-Leaders' index.

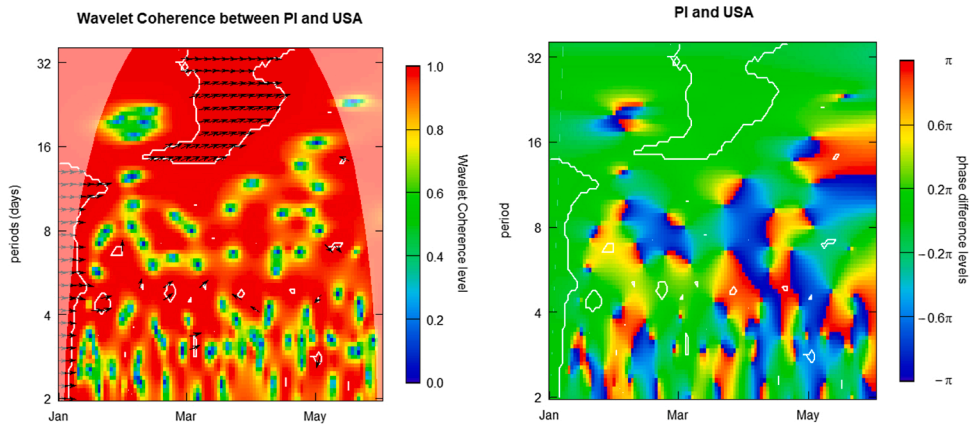


Fig. 2. Wavelet analysis: Panic Index (PI) versus the USA ESG Leaders' index.

panel's bottom – 1-to-4-day's band. The phase difference analysis shows anti-phase periods, predominantly since mid-April. The blue shaded anti-phase intervals signify that Europe ESG leaders lead the low movement for corresponding time and frequency.

### 3.2. Sub-index analysis for China and emerging markets

Fig. 4 displays the results for the wavelet coherence measure and phase-difference between the Panic Index (PI) and the China-ESG-Leaders index. Here again, while the predominant tonality of the coherence is high (red), there are intervals of low coherence (green) across the time-frequency scale. In particular, for higher frequencies (1–8 days), we observe recurrent intervals of low coherence.

The arrows depicting  $\rightarrow$  in Fig. 4, signify an in-phase relationship, indicating the positive correlation between the PI and China ESG Leaders' index during different time-frequency scales. However, in the case of China, this region is thinner than in the previously analyzed geographies. We ascribe this period to the initial phase of the Covid-19 epidemic in China, which preceded the transformation of this epidemic into a pandemic. We also see the cloud of the arrows  $\nearrow$  around the late-March early-April in the 2-weeks-plus band, indicating that the escalation in the Covid-19 fueled panic leads the China ESG Leaders' index. We ascribe this period to the apogee of the Covid-19-fueled uncertainty. In addition, differently from the previous cases, in May, in the 1-to-2-week's band, we observe the cloud of the arrows  $\searrow$ , meaning that the PI lags the moves in the China ESG Leaders index. This is consistent with the fact that the Chinese economy started to recover from the Covid-19 crisis lows preceding both the worldwide economic recovery and the worldwide panic attenuation. Hence, the heatmaps correctly account for the time differences in Covid-19 spreading across the regions.

To gain further insight into the interdependency of the indices, the right-hand heatmap of Fig. 4 identifies the lead-lag relationship between the PI and China ESG. We observe that the China ESG leaders' index is the main driver of causality predominantly for frequency bands of 4–9 days.

Fig. 5 displays the results for the wavelet coherence measure and phase-difference between the PI and the EM MSCI ESG Leaders' index.

Similarly to the previous cases, the periods with higher coherence are seen in the 1-week-plus frequency band, from mid-February to mid-April; see the red zone in the middle of the right-hand panel, and additionally in May, the latter being the influence of the already analyzed major EM economy of China. However, as in the case with Europe, we observe a small spot of the arrows  $\downarrow$ , indicating

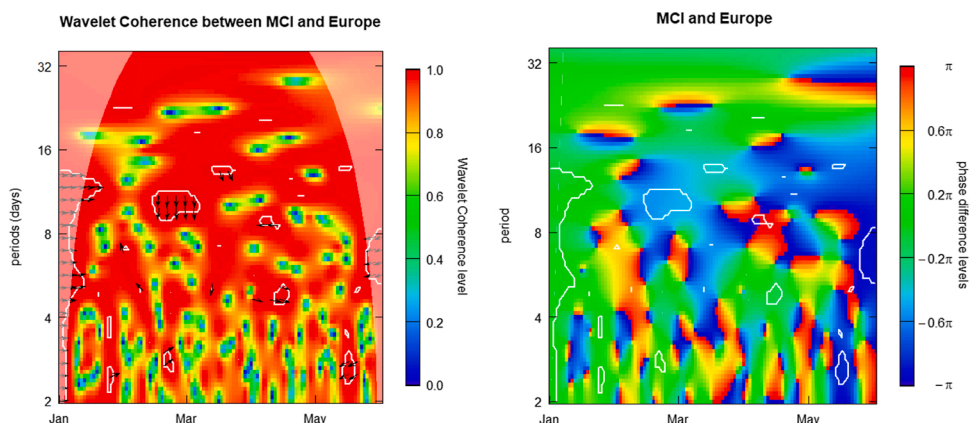


Fig. 3. Wavelet analysis: Panic Index (PI) versus the Europe ESG Leaders' index.



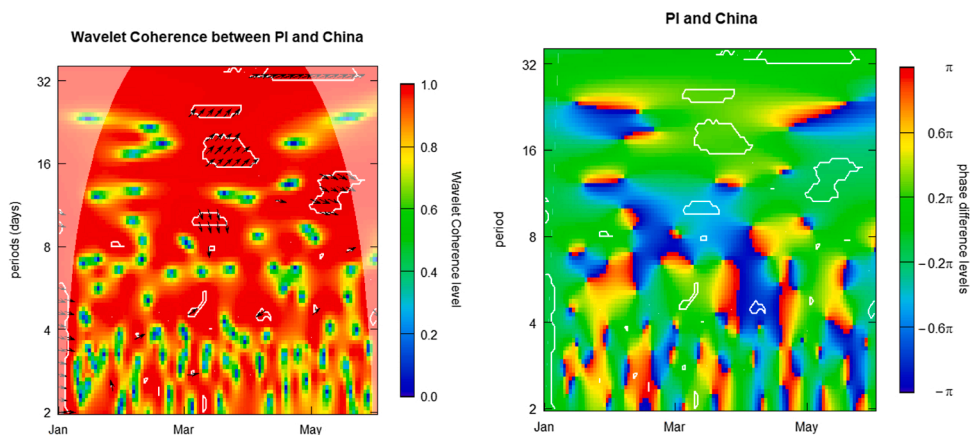


Fig. 4. Wavelet analysis: Panic Index (PI) versus the China ESG Leaders' index.

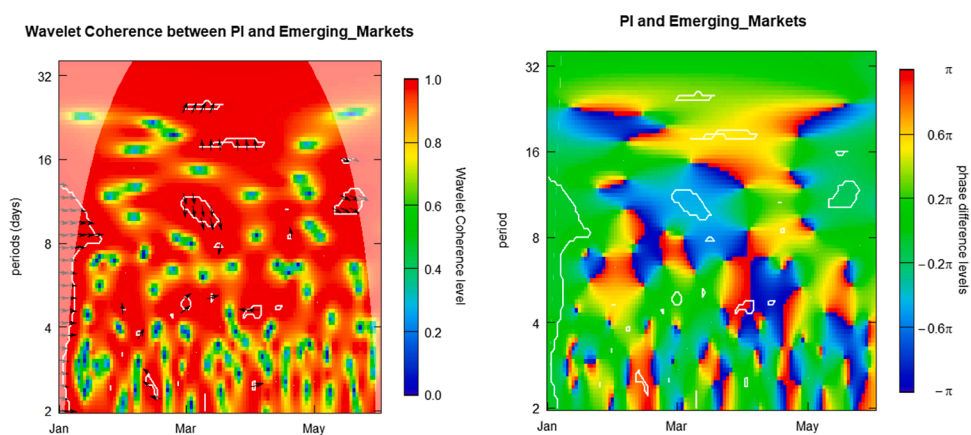


Fig. 5. Wavelet analysis: Panic Index (PI) versus the EM ESG Leaders' index.

that in March, the movements of the PI and the EM ESG Leaders' index are unsynchronized. We attribute this feature to the fact that in EM, due to the huge differences in the Covid-19 propagation, the contingency measures of social distancing were implemented on a country level at different timings, resulting in not coherent outcomes, which we correctly identify by the wavelet approach. The right-hand heatmap of Fig. 5 identifies the lead-lag relationship between the PI and EM ESG. Similar to the previous cases, the overall average tonality of the phase heatmap could be characterized as green; bearing in mind that blue zones fairly compensate red/yellow spots on average.

#### 4. Conclusion

This study examines the interdependence between the Coronavirus Panic Index (PI) and the volatility of five ESG Leaders indices encompassing the World, the USA, Europe, China, and the Emerging Markets from January to May 2020. We employ wavelet coherence and wavelet phase difference methodologies. The results show predominantly medium to high coherence between the various ESG indices and the PI. However, there are intervals of low coherence across various time and frequency scales for these indices. The predominantly high coherence implies the high correlation between a systemic event, such as the Covid-19 pandemic, and the financial markets volatility, highlighting the importance of alternative assets for hedging.

The low coherence intervals show that ESG indices exhibit some diversification benefits and can serve as a potential safe heaven even during a global catastrophe such as the Covid-19. We also observe slight differences in the patterns of coherence exhibited by various indices encompassing various regions, reflecting a rather slight segmentation of markets across various geographic regions. The results of this study have important implications for market practitioners, policymakers, and future research. Our findings can be useful for portfolio managers and investors for designing cross-geography hedge strategies, which could work in periods of global crisis, as evidenced by the Covid-19 pandemic. Similarly, policymakers can use these results for designing policies to reduce market volatility during such highly uncertain time. Moreover, future research can extend these results by using alternative techniques and measuring the portfolio implications of including such ESG investments in a portfolio choice framework.

## CRediT authorship contribution statement

**Zaghum Umar:** Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Validation, Visualization, Writing - review & editing, Resources. **Mariya Gubareva:** Conceptualization, Methodology, Investigation, Resources, Writing - original draft, Writing - review & editing, Validation, Project administration, Funding acquisition. **Dang Khoa Tran:** Conceptualization, Methodology, Writing - review & editing, Validation. **Tamara Teplova:** Conceptualization, Methodology, Writing - review & editing, Validation.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ribaf.2021.101493>.

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