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Stock market performance under COVID-19: Evidence from investor behavior

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Abstract

This paper aims to complete the literature of the stock markets' responses to COVID-19 news by investigating the issue of investors' psychological factors. More interestingly, we aim to assess whether investor behavior might be the transmission channel between the recent health crisis and financial markets. Empirically, we employ a time-frequency approach based on the continuous wavelet methodology to take into account the investors' heterogeneity and the potential nonlinear co-dynamics on the studied relationships. Based on daily data ranging from February to September 2020, our paper shows two interesting findings. First, we highlight that the G7 stock markets are sensitive to the severity of the health crisis over short and long horizons. Second, our results support fear of investor behavior during the period of the pandemic, as investor attention to the sell stock markets is negatively connected to G7 equity market performance.

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Special issue “In memory of Professor Michel Terraza”

1. Introduction

As mentioned by Baker et al. (2020) "*No previous infectious disease outbreak, including the Spanish Flu, has affected the stock market as forcefully as the COVID-19 pandemic*". In fact, the COVID-19 outbreak has generated double shocks, affecting both the supply and the demand sides, leading to a large impact on economic and financial systems (Ftiti et al., 2021; Illanes and Casas, 2020; Louhichi et al., 2021). The spread and the intensity of this crisis has been assessed through the numbers of infections and confirmed deaths, which has subjected the stock markets to an unprecedented adverse shock (Baker et al., 2020; Ramelli and Wagner, 2020; among others). Abundant studies have investigated the effect of the COVID-19 outbreak on the economy as well as on the financial markets, (Al-Awadhi, 2020; Albulescu, 2020; Ashraf, 2020; Ashraf, 2021; Harjoto et al., 2020; Yousfi et al., 2021a, b). They document that the stock market returns and volatilities are sensitive to health news (Ftiti et al., 2021; Smales, 2021). Interestingly, the important information flow related to the financial markets due to the pandemic crisis has attracted attention and influenced investor behavior. Smales (2020, 2021) indicates that investor attention negatively influenced returns during the COVID-19 period.

From a theoretical point of view, modern finance and particularly the behavioral finance literature stipulates that stock markets are sensitive to the cognitive as well as the investors' sentimental behavior. More interestingly, the equity price asset might react to fundamental as well as to nonfundamental factors due to the presence of sophisticated and unsophisticated investors (Jawadi et al., 2017). Barber and Odean (2008) stipulate that individual tend to buy salient stocks because of the limits on attention. Merton (1987) considers that attention might be the source of market valuation increases through the alleviation of the informational frictions. Several theoretical and empirical studies investigate the connection between stock market performance and investor attention (Andrei, D., & Hasler, M., 2015; Kacperczyk et al, 2016; Philippas et al., 2021). Most of the studies use the Google search volume (GSV) index as a proxy measure for investor attention to investigate the reactions of the stock market. Their findings are still nonconclusive. For example, Chen (2017) exhibit a negative linkage, as an increase in investor attention leads to stock returns decline. While Da et al. (2011) and Tang and Zhu (2017) identify a positive relationship, Kim et al. (2019) support a non-significant relation.

Our paper contributes to the relevant previous literature by focusing on a new type of exogenous shocks, that leads to large demand and supply shocks in the economy. First, the study aims to assess the effect of the COVID-19 on financial markets by measuring its intensity on the stock market performance. Then, we intend to assess whether investor attention might play the role of the transmission mechanism between health news and stock markets through measuring the connection between stock market performance and investor attention during the pandemic period. Empirically, we employ the wavelet approach to take into account the investors' heterogeneity and the potential nonlinear co-dynamics between the studied variables. Based on the G7 countries' data from February 2 to September 29, 2020, our study shows three main findings. First, we support the assertion that the stock markets react to the pandemic as well as investor's attention to selling and buying stocks. More specifically, we find that the G7 equity markets co-move with the health crisis's intensity over the short and the long term and that the severity of the crisis drives this relationship. Second, we support a negative relationship between the investor's attention to selling stocks and the G7 equity market, which can be explained by the fear of the investors about declining profits on their investments during the first wave of the pandemic and their tendency to sell stocks to mitigate their losses. The causality linkages indicate that there is bidirectional causality between the pairs. Conversely, we detect negative connectedness between the investor attention of buying stock markets and the G7 equities during the first wave, which suggests that any new investment in the financial

markets will lead to losses. Meanwhile, after the first wave, we identify a positive co-movement between the stocks and the investor attention index for buy stocks, which coincides with the lockdown and travel restrictions in most nations in the world and the gradual recovery of the financial markets. The latter result indicates that, after the serious repercussions of the first wave, investors' tend to focus on buying stocks to compensate for their losses. Third, at the end of the sample period, the correlation between the pairs changes again to negative co-movements, and this change is related to the change in the policy to mitigate the continuous spread of the COVID-19 pandemic.

The paper is structured as follows. Section 2 presents the empirical methodology. Section 3 summarizes the main findings. Section 4 provides concluding remarks.

2. Empirical design and data

We employ wavelet analysis, proposing several advantages. First, it allows us to capture slow and persistent connectedness, leading to a more nuanced understanding of the co-movement and causality between pairs of time series in both time and frequency domains. Second, the continuous wavelet transform (Morlet set to 6), that we use in this study, allows for differently scaled localization (Rua and Nunes, 2009). Third, the continuous wavelet transform enables us to measure the time-varying relationship and the time-varying causality between the studied series. In our analysis, we employ the well-known continuous wavelet transform and wavelet coherence methodologies (Grinsted et al., 2004) to measure the relationship and the causality between the studies, respectively. To save space, please refer to Ftiti et al., (2016, pages 315-318).[1]

Our sample concerns G7 stock indices, the US stock market (S&P500), the Canadian market (S&P/TSX60), the French market (CAC 40), the German market (DAX), the UK market (FTSE 100), the Italian market (FTSE MIB) and the Japanese market (Nikkei 225) as well as an overall weighted index for all G7 countries (MSCI G7). Daily returns are computed as the difference in the logarithm daily prices. These data are collected from Refinitiv.

To measure the intensity and the spread of COVID-19 health crisis, we followed recent literature, using world cumulative daily observations of changes in the number of infected cases and deaths generated by the virus in the world. Data related to the number of infected cases and deaths are collected from the World Data website.[2]

The Google search volume (GSV) index is used as a proxy of investor attention to sell and buy stock markets worldwide, which we obtain from the Google Trends website. The GSV index indicates the volume of search queries and ranges from 0 to 100.

Table I presents the descriptive statistics of our data. We identify that all studied financial markets exhibit a negative average return, except the US and Japan but with very low performance. The means of the infection cases and deaths are positive and very high, which traducing the high spread and the severity of the pandemic. These preliminary observations predict negative stock market reaction during the pandemic. For the GSV index, we can see that the mean is positive and high, which suggests that the investor attention is very high during the pandemic crisis. Moreover, the Japanese market has a smaller standard deviation while the Italian and US stock indices exhibit a greater one. The Jarque–Bera test indicates that the series are not normally distributed.

[1] Other interesting studies have used this approach such as Kamdem et al. (2016) and Mestre and Terraza (2018). Moreover, for more details on the use of spectral analysis, please refer to Terraza and Bourbonnais (2010).

[2] https://ourworldindata.org/coronavirus-testing

Table I: Descriptive statistics

	Mean	Median	Maximum	Minimum	S.D.	Jarque–Bera
S&P500	0.023669	0.323690	8.968323	-12.76522	2.801964	159.1795
S&P/TSX60	-0.049789	0.184909	11.29453	-13.17580	2.744930	439.2843
CAC 40	-0.147156	-0.006220	8.056082	-13.09835	2.463895	250.4410
DAX	-0.027111	-0.034653	10.41429	-13.05486	2.523693	269.1032
FTSE 100	-0.155097	0.046756	8.666807	-11.51243	2.251852	208.7117
FETS MIB	-0.155228	0.063129	8.549457	-18.54114	2.844818	1181.158
Nikkei 225	0.014248	-0.092000	7.731376	-6.273569	1.989341	42.38380
MSCI-G7	0.010020	0.260595	8.673492	-10.72764	2.481936	184.0684
Cases	5.627570	2.500012	57.00313	0.705031	7.807812	2105.876
Deaths	5.858930	2.186063	53.03520	0.392043	8.922021	830.7743
Sell Volume	9.118056	0.000000	100.0000	0.000000	24.32516	351.7019
Buy Volume	16.28472	0.000000	100.0000	0.000000	22.44641	57.97803

Note: S.D denotes the standard deviation.

3. Empirical findings

3.1.The continuous wavelet transform (CWT) analysis

The CWT plots summarizing the behavior of stock markets, the COVID-19 measures and the GSV index in the time scales and frequency bands, are reported in Figure 1. A visual inspection of the infection cases and deaths count plots reveals small islands of high volatility in the short term (1- to 8-day frequency) from the inception of the sample period. Another small island of high volatility in the long term is observed around the 32-day frequency band. These areas of high movement correspond to the beginning of the COVID-19 crisis across the world. The Google search index of the investor attention to sell and buy stocks establishes small islands of high volatility during the first wave of the pandemic in the short-run day frequency bands, while the vast areas of high volatility are distributed in the short run during the second wave of the COVID-19 outbreak, between July and the end of September. In these two areas, the volume of searches reaches its maximum (100), indicating that this particular search term is very active. For the G7 stock market indices, the CWT plots of each stock market show the regions of high volatility in the short to long term day frequency bands. This coincides with the higher volatility area of the fast spread of infection cases and the rise in the confirmed deaths in the world (March to April 2020). These results show that all the markets of our sample react to the COVID-19 crisis.

3.2.Wavelet coherence between stock markets and COVID-19

We apply the wavelet coherence between the daily change in the worldwide numbers of cumulative infection cases and deaths and the stock market returns of the individual G7 indices and an overall weighted index for all G7 countries (MSCI-G7) to investigate the connectedness between them. The wavelet coherence plots for each pair are reported in Figure 2. The direction of the arrows establishes the causality linkages (Torrence and Webster, 1999; among others). We conclude that there is positive (negative) correlation between the pandemic and stock markets when we observe that arrows point to the right (left). Furthermore, the up-right and down-left (↗↙) arrows mean that the COVID-19 daily observation leads the G7 stock markets, whereas the down-right and up-left (↘↖) arrows indicate that the G7 stock markets lead COVID-19. Meanwhile, the straight up (↑) and down (↓) arrows imply that the COVID-19 pandemic is leading and lagging, respectively.

For each pair, we identify a significant degree of co-movement between the COVID-19 pandemic and all the G7 stock markets, and we detect the existence of many small islands,

which indicate strong dependence at the beginning, in the middle and at the end of the sample period from the 1- to 8-day frequency bands. We notice that particularly meaningful and significant coherence can be observed around the 32-day frequency cycles. The direction of the arrows is mostly up-right (↗), which means that the COVID-19 pandemic and the individual stock market returns of the G7 countries, as well as the overall weighted index for all the G7 countries (MSCI G7), are positively correlated. The direction of arrows highlights that the COVID-19 news (deaths and cases) lead all the stock markets. The relationship between COVID-19 news (infection cases and deaths) and G7 stock market indices is very strong at different scales during the sample period, which covers the first and the second waves of the COVID-19 pandemic outbreak. Our findings confirm the short- and long-term relationships between the COVID-19 pandemic and all the G7 stock markets. Even after the the lockdown, the co-movement persists during the second wave. It seems that the growth in cases generated by the COVID-19 virus across the world during the first and second waves still affects the G7 markets through the restriction policy and quarantine.

Our findings are intuitive and are in line with those of recent studies developed since the trigger of COVID-19 crisis. Ftiti et al (2021) shows that the Chinese stock market reacts to health crisis news through affecting negatively the volatility and liquidity. Ashraf (2020) conclude that the stock market reaction of 64 countries is proactive, during the first wave on the cases growth rather than to the deaths. Our study aims to complete this literature through assessing whether investor attention drive this relationship.

3.3.Wavelet coherence between stock markets and investor attention

Our second goal is to investigate the correlation between the investor attention to sell/buy stocks and the G7 equity markets using wavelet coherence. The results are presented in Figure 3. As reported in the preceding subsection, the direction of the arrows can enable us to interpret the direction of interdependence and causality linkages between the Google search index for sell and buy stock markets and the G7 equities.

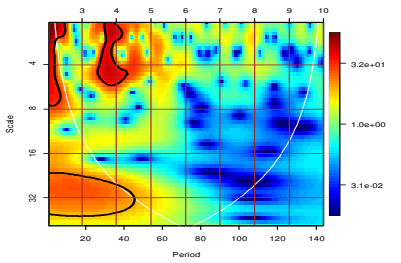
An in-depth examination of the co-movement plots between the stock markets and the investor attention to sell stocks shows that there is a vast area with a high degree of connectedness between each pair at the low scale observed during the period of general lockdown and when the financial market prices decline. Most of the arrows point in the down-left and up-left directions, which indicate that the investor attention to the sell is negatively correlated with the G7 markets and that there is a bidirectional causality between most of the variable couples. The negative relation between the investor attention to the sell and the G7 equities can be explained by the fear of the investors about the declining profits of their investments during the first wave of the pandemic and their tendency to sell their stocks to mitigate their losses. On the other hand, the time scale connectedness between investor attention to buy stocks and G7 equities exhibits many areas of strong co-movement. We can see that, at the beginning of the sample period, over the low scale, there is a negative correlation between each pair. This result can be explained by the effect of the lockdown policy during the first wave of the pandemic, when all the stock markets experience a significant drop in prices, so new investment in the financial markets will lead to losses. After the end of the first wave, from May to July, we can see over the middle scale that there is a vast region with a high positive correlation between the investor attention to buy and the G7 markets. Moreover, we identify another island of significant positive co-movement around the 4-day frequency band during August. Through the direction of the arrows, we explore whether the investor attention leads the G7 stock markets. We notice that the positive relationships coincide with the easing of the lockdown and travel restrictions in most nations in the world and the gradual recovery of the financial markets. After the hard repercussion of the first wave, investors tend to buy stocks to compensate for their losses. We also note that, at the end of the period, there is another region of co-movement around the middle scale, but it is characterized by a negative correlation. The

change in the connectedness between investor attention and financial performance over time can be explained by the effect of the spread of the pandemic and restriction policy.

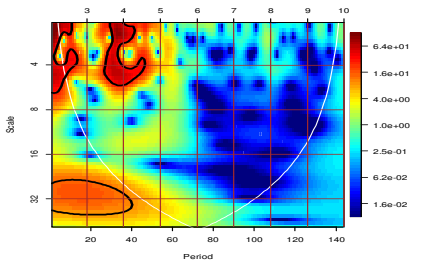
The existing literature have investigated the effect of COVID-19 news on the financial markets. However, this effect is examined based on various aspects. Talwar et al. (2021) have examined the role of the financial attitudes on the trading activity of retail investors. They assessed whether investor psychology is proactive during pandemic period. Based on six dimensional of financial attitudes (financial anxiety, optimism, financial security, deliberative thinking, interest in financial issues, and needs for precautionary savings), they highlighted a positive effect. Smales (2020) has investigated the investor behaviour sharp during the pandemic of COVID-19 based on the investor attention. He shows that investor attention negatively impacts the global financial markets during the health crisis. Smales (2020) explains that investor attention is perceived as an information flows this for the financial markets generating high volatility. Pagano et al. (2021) show that the behaviour of retail investors is affected by the COVID-19 outbreak. Our findings complete those of previous studies as we highlight that the financial markets response to the health crisis news. Interestingly, we show that this relationship is driven by the psychology factor related to the investor emotions. Based on previous literature on investor attention, we can conclude that the rise in investor attention is related to higher levels of stock market liquidity (Bank et al., 2021; Ding and Hou, 2015) or trading volume and volatility (Aouadi et al., 2013; Dimpfl and Jank, 2015; Vlastakis and Markellos, 2012). This finding explains the high degree of coherence between financial markets' performance and investor attention during the pandemic period and its effect on the financial markets. Indeed, according to Lim and Teoh (2010), high investor attention exacerbates the influence of investor behavior.

Figure 1: Continuous wavelet transform plots

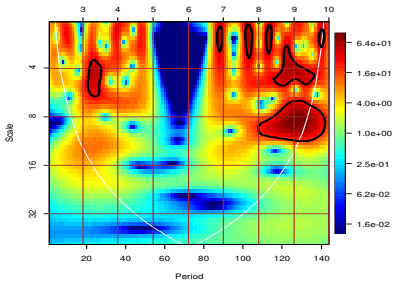
Continuous wavelet transform : Cases



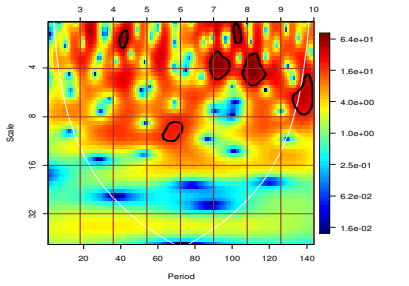
Continuous wavelet transform : Deaths



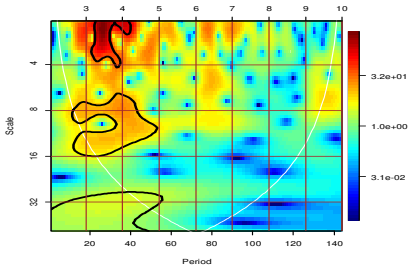
Continuous wavelet transform : GSV Sell



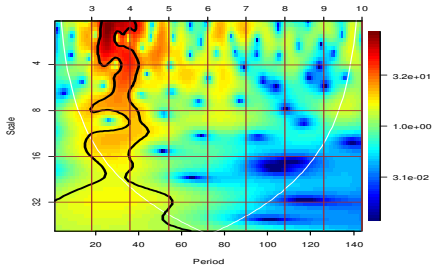
Continuous wavelet transform : GSV Buy



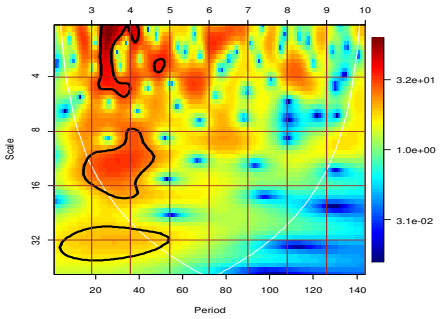
Continuous wavelet transform : S&P500



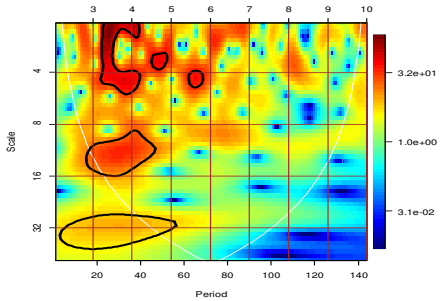
Continuous wavelet transform : S&P/TSX 60



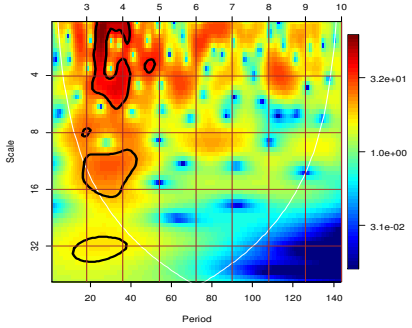
Continuous wavelet transform : CAC 40



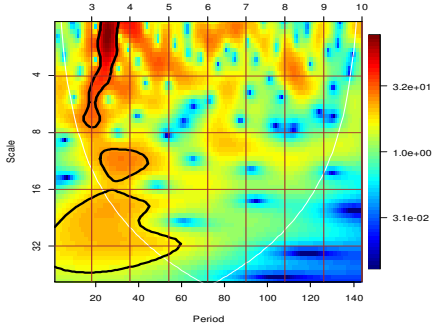
Continuous wavelet transform : DAX

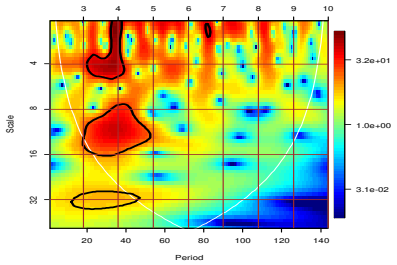
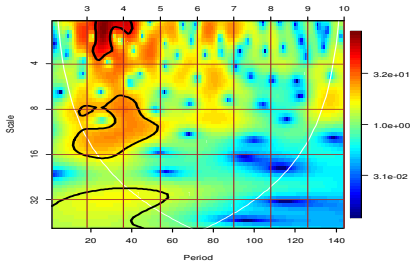


Continuous wavelet transform : FETSE 100



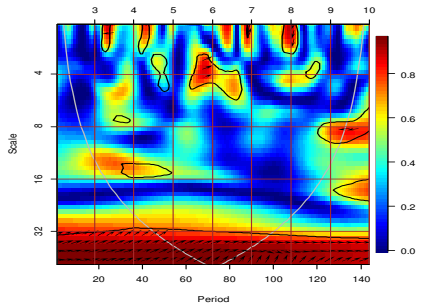
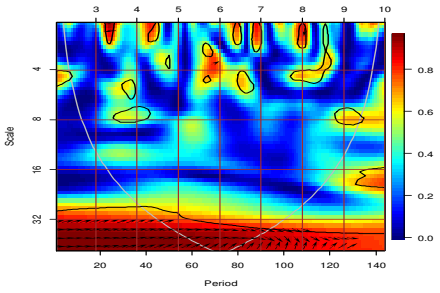
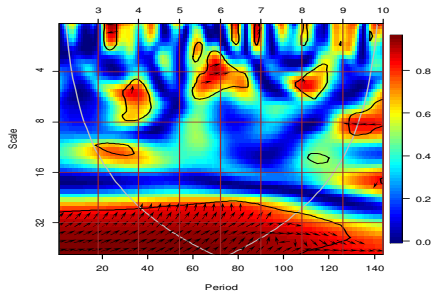
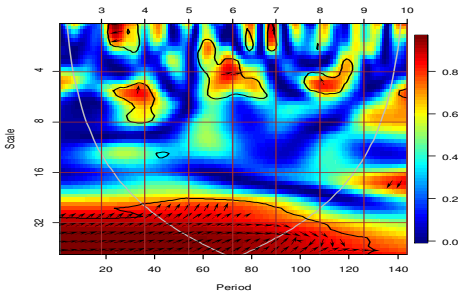
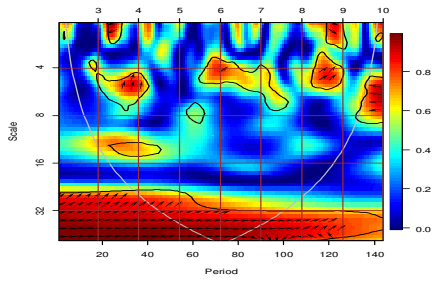
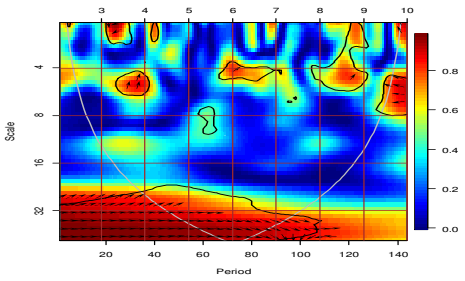
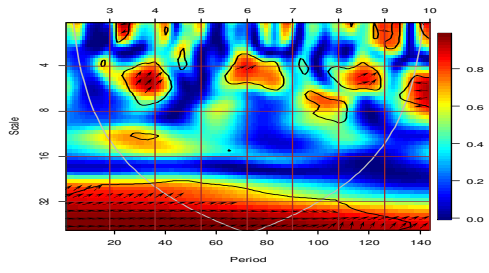
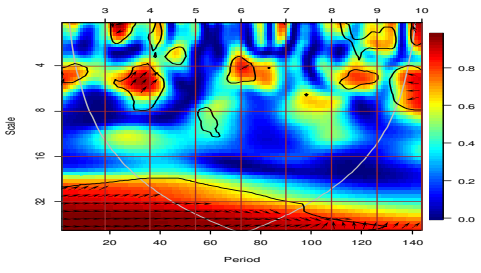
Continuous wavelet transform : FTSE MIB

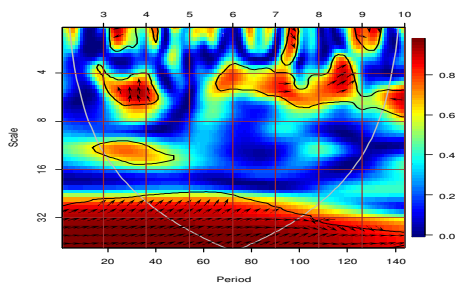


Continuous wavelet transform : Nikkei 225	Continuous wavelet transform : MSCI-G7
	

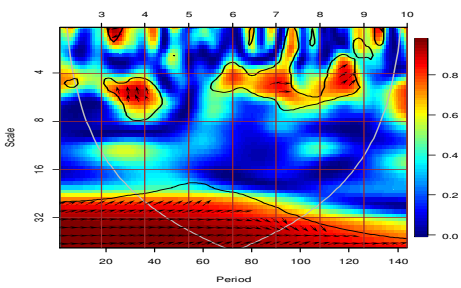
The horizontal axis reported our period of study (February, 2020 to September, 2020). The vertical axis displays the frequency component. The black contours indicate significant regions (5% level).

Figure 2: Wavelet coherence between COVID-19 pandemic and G7 stock markets

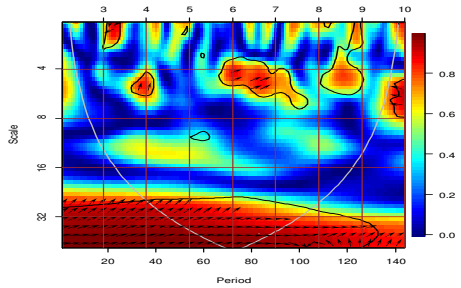
Wavelet coherence : Cases vs S&P500	Wavelet coherence : Deaths vs S&P500
	
Wavelet coherence : Cases vs S&P/TSX 60	Wavelet coherence : Deaths vs S&P/TSX 60
	
Wavelet coherence : Cases vs CAC 40	Wavelet coherence : Deaths vs CAC 40
	
Wavelet coherence : Cases vs DAX	Wavelet coherence : Deaths vs DAX
	
Wavelet coherence : Cases vs FETSE 100	Wavelet coherence : Deaths vs FETSE 100



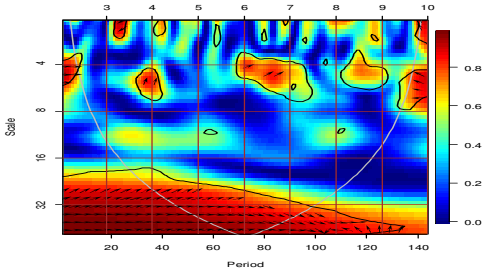
Wavelet coherence : Cases vs FTSE MIB



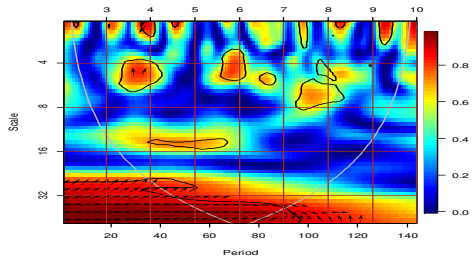
Wavelet coherence : Deaths vs FTSE MIB



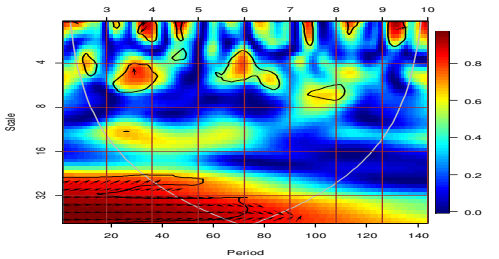
Wavelet coherence : Cases vs Nikkei 225



Wavelet coherence : Deaths vs Nikkei 225



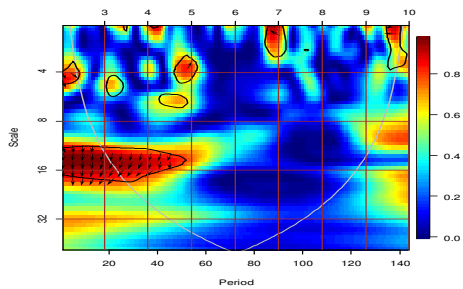
Wavelet coherence : Cases vs MSCI-G7



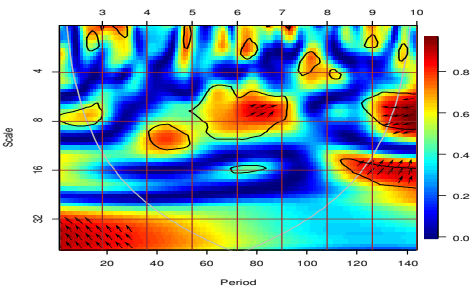
Wavelet coherence : Deaths vs MSCI-G7

The horizontal axis reported our period of study (February, 2020 to September, 2020). The vertical axis displays the frequency component. The black contours indicate significant regions (5% level). The warmer colors (red) indicate strong relationship, whereas colder colors (blue) indicate weak relationship.

Figure 3: Wavelet coherence between GSV index and G7 stock markets



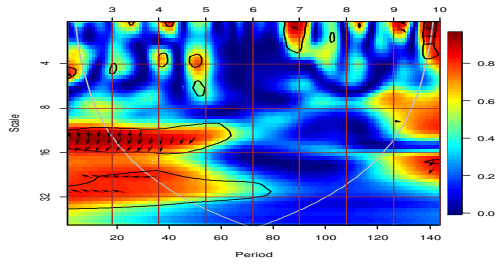
Wavelet coherence : Sell vs S&P500



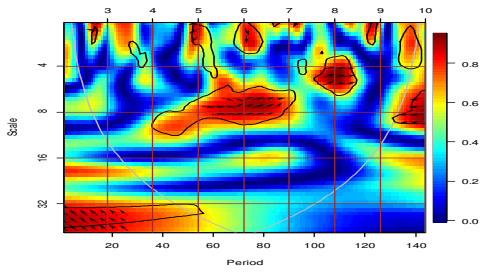
Wavelet coherence : Buy S&P500

Wavelet coherence : Sell vs S&PTSX 60

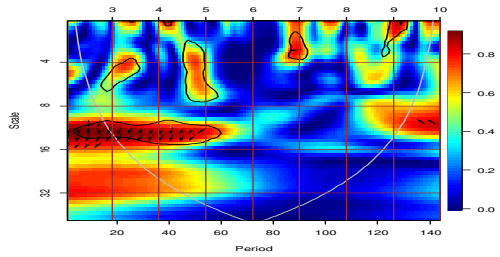
Wavelet coherence : Buy vs S&PTSX 60



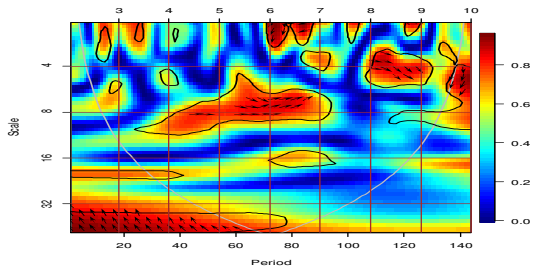
Wavelet coherence : Sell vs CAC 40



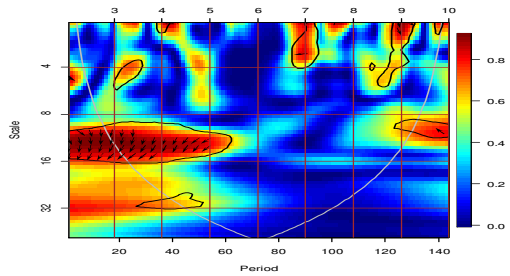
Wavelet coherence : Buy vs CAC 40



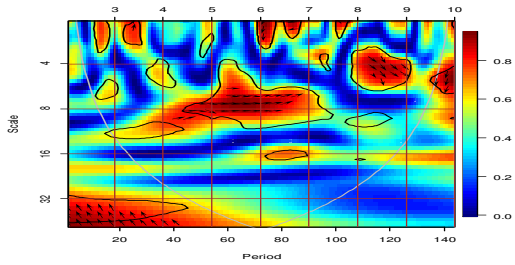
Wavelet coherence : Sell vs DAX



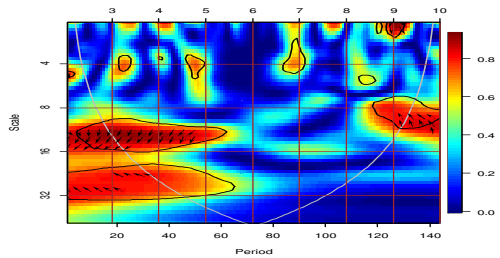
Wavelet coherence : Buy vs DAX



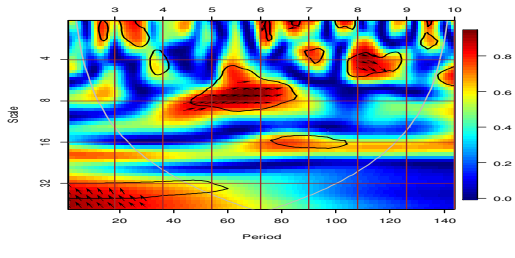
Wavelet coherence : Sell vs FETSE 100



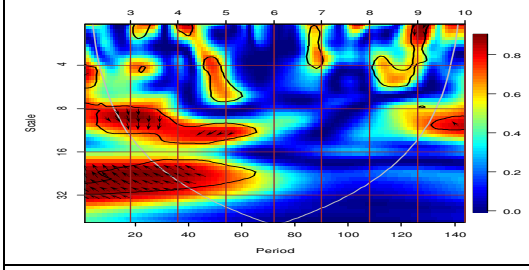
Wavelet coherence : Buy vs FETSE 100



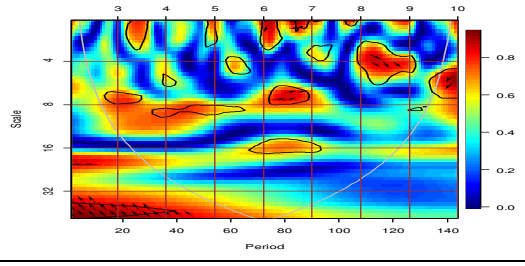
Wavelet coherence : Sell vs FTSE MIB



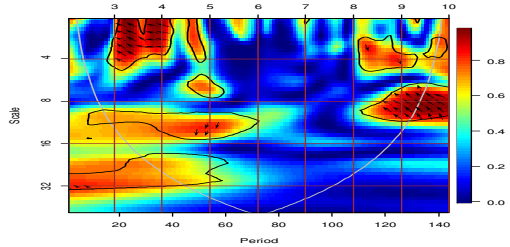
Wavelet coherence : Buy vs FTSE MIB



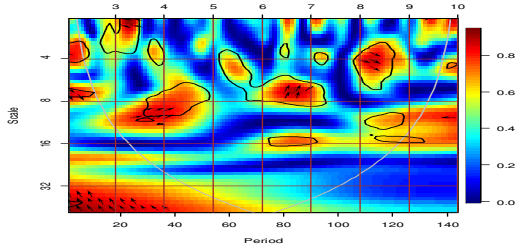
Wavelet coherence : Sell vs Nikkei 225



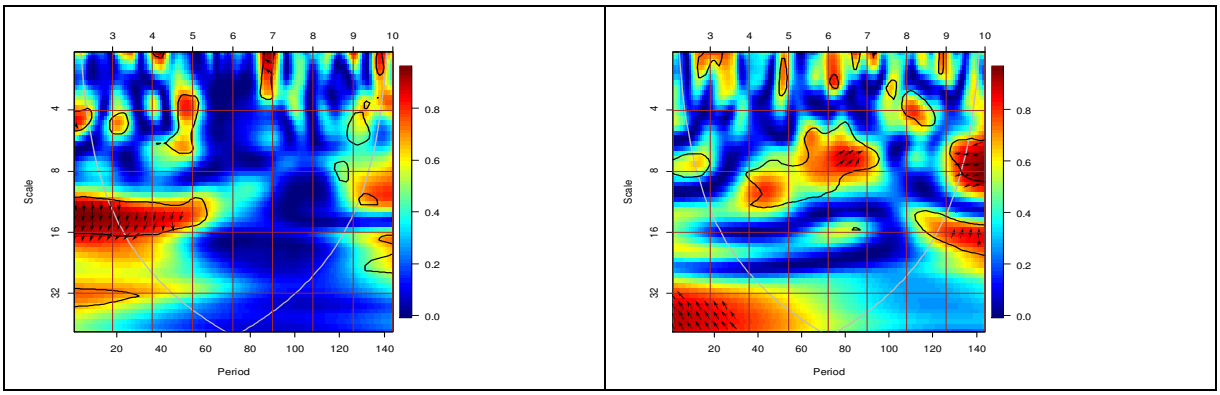
Wavelet coherence : Buy vs Nikkei 225



Wavelet coherence : Sell vs MSCI G7



Wavelet coherence : Buy vs MSCI7 G7



The horizontal axis reported our period of study (February, 2020 to September, 2020). The vertical axis displays the frequency component. The black contours indicate significant regions (5% level). The warmer colors (red) indicate strong relationship, whereas colder colors (blue) indicate weak relationship.

4. Concluding remarks

This paper contributes to the literature by investigating the sensitivity of financial markets' performance to the recent health crisis and investor attention. We show that the individual G7 stock markets as well as the MSCI G7 index co-move with the pandemic and the investor attention. We find that the pandemic has a significant correlation with equities. Moreover, we document that the G7 markets respond to the change in the investor attention during the pandemic. Our results indicate that the investor attention varies over time and affects asset prices. We explore whether the G7 markets react negatively to the GSV index for sell stocks during the first wave and during the lockdown, when there is bidirectional causality between the GSV index and the equity markets. Our results are consistent with Smales (2020, 2021) and confirms that investor attention negatively (positively) affects stock returns (volatility) during the COVID-19 pandemic. Finally, we find that the GSV for buy stocks is positively correlated with the G7 markets after the first wave, when the financial markets make a gradual recovery and the investor attention to buy leads.

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