"Lessons for Euro markets from the first wave of COVID-19"

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LESSONS FOR EURO MARKETS FROM THE FIRST WAVE OF COVID-19

Abstract

Although the coronavirus pandemic hit Europe in the early days of 2020, European stock markets had signaled fluctuations in the days before. This paper assesses the observed volatility on European stock exchanges and searches for its sources during the first four months of 2020. To investigate the issue, a panel VAR model is adopted, and the generalized impulse response function and the variance decomposition methods are used. The estimations show that about 34% of the volatility in European stock markets is due to the Chinese stock market, while 7% is due to international uncertainty, as measured by VIX. The impact of pandemic cases and deaths on European stock markets is negligible, below 1%. This means that the European stock market faced two risk elements: the first is the transmission volatility from the Chinese stock market, and the second is the international uncertainty. The findings also support the view that COVID-19 is more like a systematic risk.

Keywords	stock returns, pandemic, volatility, spillovers, coronavirus
JEL Classification	G15, G17, G24

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INTRODUCTION

The paper deals with the reaction of the major European stock exchanges to the coronavirus pandemic. The virus started in China and soon spread to Europe and the rest of the world, causing concerns about its effects on both humans' health and the economy. The first economic impact was observed in the stock markets. There was a sharp drop in all stock indices during February and March 2020, but then markets began to recover.

There is little evidence of the effects of the health epidemic on financial markets, but it does indicate a negative response of stock returns toepidemics such as SARS and Ebola (Nippani & & Washer, 2004; Chen et al., 2018; Ichev & Marinč, 2018). This reaction of the market can be justified due to the influence of the disease on the overall behavior of population within the economies affected by the disease (Lee & McKibben, 2004) or because of the fear and anxiety that affected investor decisions(Ichev & Marinč, 2018). Baker et al. (2020) point that COVID-19 caused the biggest stock market volatility compared to other epidemics, while the spread of COVID-19 increases the financial volatility, and its persistence can generate a new episode of international financial stress (Albulescu, 2020).

The first COVID-19 case in Europe was recorded in January 2020 in Italy, while after a few daysCOVID-19 cases occurred in all European countries, forcing one country after another to adopt strict restrictive measures (known as lockdowns) during the months of February and March. European land is heavily affected by the virus in both the first

and the second waves. Over the past decade, the European countries have experienced a severe debt crisis, which has threatened their unity and highlighted their fragility. A sequent crisis, such as COVID-19, can cause additional financial stress in this area due to the uncertainty and the fear not only of the pandemic itself but also of financial cost of lockdown measures in some countries. On the other hand, the observed volatility worldwide strengthens the view that COVID-19 creates a systematic risk across markets (Sharif et al., 2020). It would be interesting to assess the volatility in the European stock market and investigate whether systematic or non-systematic risk elements existed from February 2020 to March 2020. Understanding the observed volatility in the European stock market is a valuable and useful tool to know if the conditions are being created for a new financial crisis in the Europe, and to make better policy decisions and take appropriate measures towards a future unknown event, such as COVID-19 a year ago.

1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The spread of COVID-19 increases the financial volatility, as many authors have previously pointed out (among others Albulescu, 2020 and Zhang et al., 2020). The source of volatility stems from different channels. Some authors directly associated COVID-19 cases and deaths with market volatility (Al-Awadhi et al., 2020; Sharif et al., 2020; Zhang et al., 2020), while others indicate that an indirect impact mainly stems from the market drop (Papadamou et al., 2020), the world-wide influence of China (Akhtaruzzaman et al., 2020) and the governance measures towards COVID-19 (Zaremba et al., 2020).

Direct and indirect impacts of COVID-19 may be first viewed as an economic crisis (Sharif et al., 2020). The virus creates economic uncertainty, and financial markets have become more volatile and unpredictable (Sharif et al., 2020; Zhang et al., 2020). Second, its effects had an impact on all sectors of the economy (Fernandez, 2020; Fotiadis et al. 2021). The recent empirical research detects negative effects not only on the stock markets, but also on the oil and on the cryptocurrency market, which is considered as a hedging instrument by investors (Ali et al., 2020; Corbet et al., 2020; Sharif et al., 2020).

The developments of the stock markets during the outbreak of COVID-19 confirms the familiar hypothesis of the interdependence of stocks markets (Grubel & Fadner, 1971; Ashley & Patterson, 1986). Indeed, financial markets react to crises, wars, terrorist events etc. (Kollias et al., 2013; Barkman et al., 2013). About health crises, some researchers have identified negative responses of stock returns to epidemics such as SARS and Ebola (Nippani & Washer, 2004; Chen et al., 2018; Ichev & Marinč, 2018).

During the COVID-19 crisis, China seems to be the main transmitter of financial spillovers to other financial markets (Akhtaruzzaman et al., 2020; Siddiqui et al., 2020; Hanif et al., 2021). But the influence of the Chinese market has become increasingly important in international financial markets creating a channel of transmission in the last twenty years (Zhou et al., 2012; Loh, 2013; Changqing et al., 2015).

This study focuses directly on the analysis of spillovers during the first wave of the COVID-19 pandemic in Europe, with the particular emphasis on the coronavirus cases and deaths on the main European stock market indices. Ali et al. (2020) study various financial securities (such as MSCI indices, bitcoin, gold and bonds) and associate their returns and volatility to the COVID-19 deaths. Al-Awadhi et al. (2020) analyzed China's stock market and reported a negative market reaction to the daily cases and the daily deaths caused by COVID-19. In the same line of research, Zhang et al. (2020) offered similar evidence for a group of Asian and European countries and linked the severity of the virus to the magnitude of the negative market reaction.

Given the above evidence, this paper investigates whether the recorded deaths and cases of COVID-19 are linked to the stock returns for a longer period, covering the first four months of

2020 and focusing only on the European stock market. The evidence for Europe points contagion and spillover effects between European countries and the US, and show that Europe reacts more to COVID-19 confirmed cases (Reis & Pinho, 2020).

Thus, the hypotheses are formulated as follows:

H1: *The coronavirus cases or deaths in Europe influence European stock market returns.*

H2: *Chinese stock returns affect the European stock market returns.*

H3: *The overall uncertainty in financial markets affects European stock market returns.*

2. DATA AND METHODOLOGY

The data set contains daily observations for 16 major European stock indices and the Chinese Stock Index from January3 to April 30, 2020. More specifically, the data set comprises stock closing prices of major stock indices[1]. The indices of each country are presented in Appendix A, Table A1. It also included daily COVID-19 infection data obtained from the European Data Portal[2]. Finally, CBOE Volatility index is used (VIX)[3], which is the standard measure accounting the market volatility and investors' sentiments.

The study is interested in exploring the degree of volatility during the first wave of COVID-19 in the European stock market. The first wave is defined from January 2020, where the first COVID-19 case was recorded, to April 2020. The first announcements for easing the restrictive measures are considered as an indication that Europe has overcome the first wave of the virus.

First, the degree of market volatility is assessed by calculating the standard deviation of the daily stock returns for each month of the sample (Zhang et al., 2020). The estimations are presented in Appendix A, Table A2. The data show that the volatility levels of all the European countries have increased from January to March. The peak of volatility was during March 2020. Furthermore, volatility analysis illustrates some useful diagnostic remarks. First, although European market seems to calm down during April, COVID-19 cases and deaths are still increasing. Second, it is observed that the peak in both Chinese market volatility and Chinese COVID-19 cases happened during February 2020; afterwards an essentially decreasing trend is observed in China. Third, the most volatile European market is Greek, while it has the fewest COVID-19 cases and deaths during the first wave.

The analysis is deepened by studying the response of European returns to COVID-19 variables, Chinese returns and VIX index, implementing a panel VAR model and conducting two methods: a) the variance decomposition and b) the GIRF analysis. The variance decomposition defines how much of the forecast error variance decomposition of European stock returns may be explained by shocks to COVID-19 variables, Chinese returns and VIX. Impulse response function allows investigating how European stock returns react to a shock in COVID-19 cases and deaths, Chinese market and VIX. A panel VAR approach has many advantages as it permits more degrees of freedom by analyzing a panel of countries, while this study models the spillovers from one country to another in a better way, since the panel captures country-level heterogeneity. More specifically, the following equation is estimated:

$$Z_{it} = A(L)Z_{it-1} + e_{it}, \qquad (1)$$

where $A(L)$ is the polynomial matrix in the lag operator L, Z_{it} is a matrix of endogenous variables, while the vector Z includes the endogenous variables, and e_{it} is the stochastic error terms.

While estimating a VAR model, some important issues must be taking into consideration. The needed conditions for the use of VAR model are the stationarity of variables and the correct selection of the lag length. Panel unit root tests are conducted, as reported in Appendix A, Table A3. The three information criteria of Schwarz (SC), Akaike (AIC) and Hannan-Quinn (HQ) are used, and these criteria indicate the choice of 8 lags.

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1   The stock market data were obtained from www.investing.com

2   Avail.:https://data.europa.eu/euodp/el/data/dataset/covid-19-coronavirus-data

3   VIX data was derived from http://www.cboe.com

The data are examined in three different ways. First, the whole time-period is investigated. Second, to be able to study and deal with a crisis, its phases, and its causes every time should be recognized (Philippas and Siriopoulos 2013). According to the volatility analysis, they are recognized as three separate phases: a) the incubation period, which expands from January 3 to February 28, 2020, b) the outbreak period during March 01-30, and c) after-outbreak period. As shown in Figure 1, the most of COVID-19 cases are recorded during the last days of March. However, an increased volatilityinEuropean stock markets is observed, which starts in January and peaks during March (see Figure 2). Third, the sample of countries is classified based on the total deaths per million recorded by each country during the first four months of 2020, and they aredivided into two separate groups (group A and group B). Group A includes the countries with the lowest values, and group B includes those with the highest. The formation

of these two groups directly links COVID-19 deaths to stock returns. This analysis makes it possible to more clearly distinguish the effect of the COVID-19 variables.

3. EMPIRICAL RESULTS

3.1. The GIRF method

This section presents the responses of European stock returns to shocks derived from the COVID-19 variables, VIX and China returns. Figure 3 shows the impulse responses of European stock returns when an innovation of other variables occurs over the next 15 days. The solid lines are the impulse responses, and the dotted lines illustrate 95% confidence intervals.

The response of stock returns is close to zero whenever there is a shock in the COVID-19 variables. This is an indication that COVID-19 cases
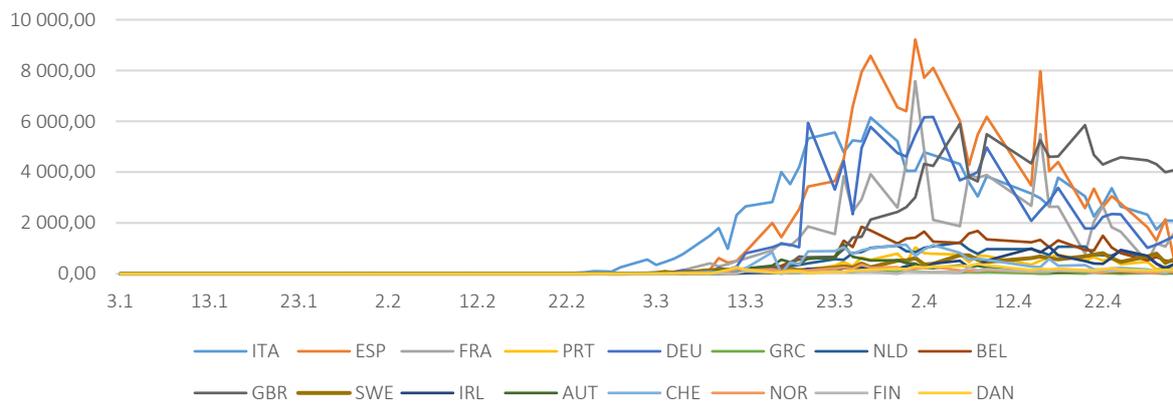

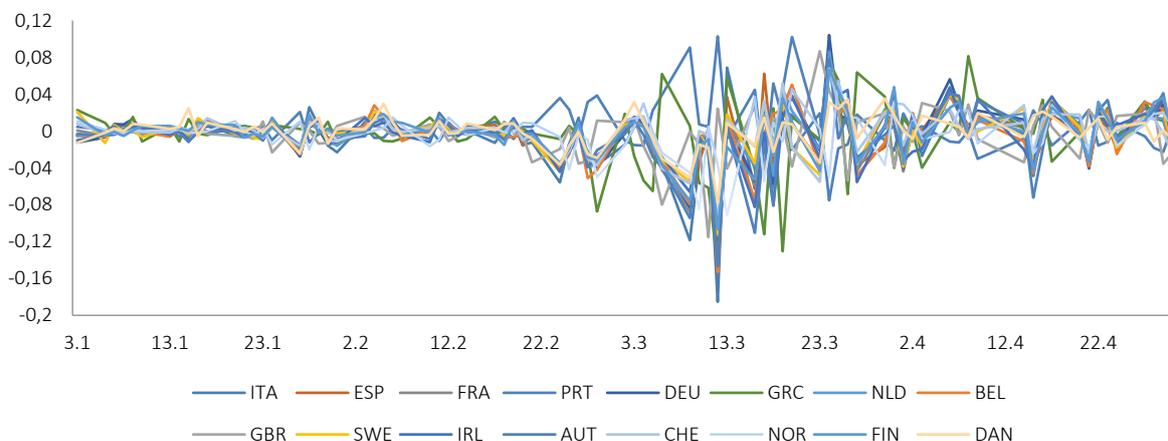**Figure 1.** COVID-19 cases per European countries

Figure 2. Stock returns per European countries
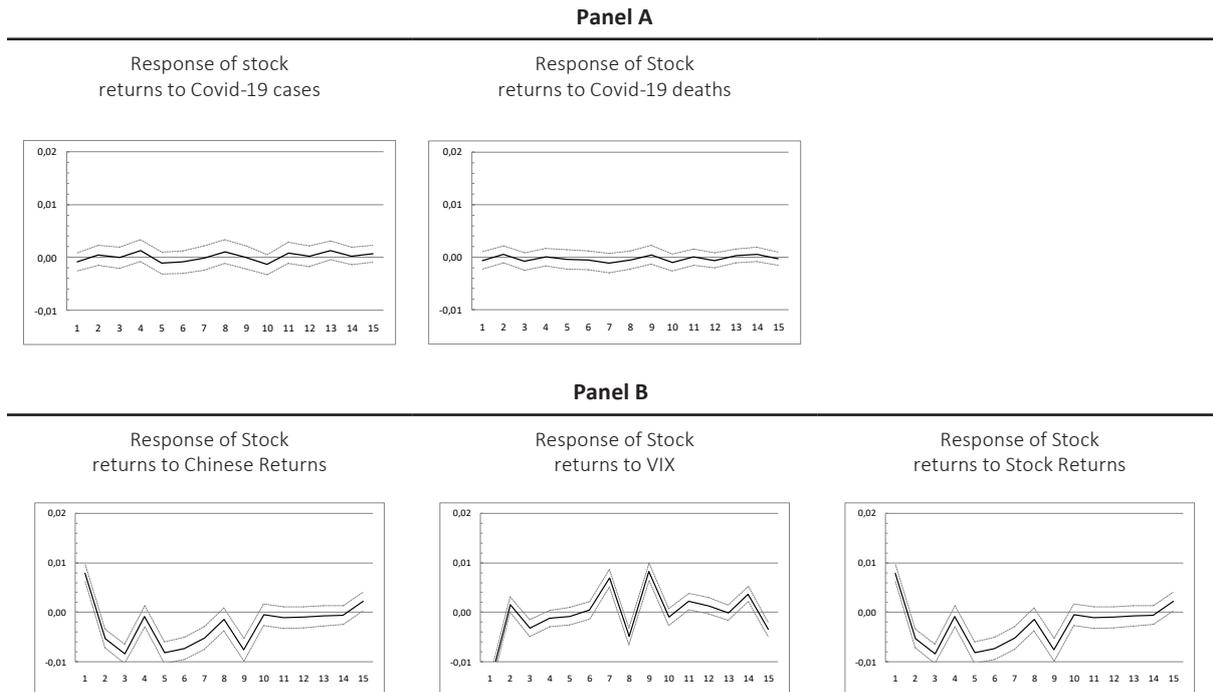
Panel A

Panel B

Figure 3. Generalized impulse response of European stock returns to COVID-19 cases and deaths, Chinese returns and VIX index

and deaths have no impact on the European stock returns (panelA). Conversely, a Chinese shock negatively influences European stock returns, creating turbulence in the European stock market. VIX index show the overall uncertainty in international markets and negatively affects European stock markets, but its impact is smaller compared to the Chinese shock. Also, the results show that shocks derived from the European stock markets have an impact on their own volatility, the effect is stronger during the first days, after that the response patterns are ambiguous (panel B).

3.2. Variance decomposition method

The forecast error variance decomposition of European stock returns is estimated. Table 1 reports the variables' influence on the forecast error variance of stock returns at a 15-day horizon. The estimations show that the volatility of European stock returns is due to approximately 34% of Chinese returns. The greatest impact of Chinese market is detected between the 9thand 10thdays. VIX shocks contribute to the fluctuation in European stock markets at approximately 7% within 15 days. European shocks explain the

greatest part of its own forecast error variance. However, as the time passed, European markets are increasingly influenced by external forces, especially from the Chinese market.

Table 1. Contribution of Chinese returns, COVID-19 deaths and cases, and VIX to the forecast error variance of European stock returns

Period	S.E.	China returns	COVID-19 cases	COVID-19 deaths	Stock returns	VIX
1	0.02	11.18	0.07	0.02	88.71	0.00
2	0.02	15.47	0.08	0.06	84.36	0.01
3	0.02	23.20	0.07	0.14	73.03	3.53
4	0.02	23.10	0.32	0.16	72.41	4.00
5	0.02	28.70	0.48	0.14	67.07	3.60
6	0.02	32.81	0.57	0.14	63.09	3.36
7	0.03	33.24	0.54	0.27	61.94	3.98
8	0.03	32.02	0.63	0.33	62.02	4.97
9	0.03	34.42	0.57	0.33	58.79	5.86
10	0.03	34.31	0.74	0.37	58.56	5.99
11	0.03	34.25	0.80	0.37	58.32	6.24
12	0.03	34.25	0.80	0.41	58.19	6.32
13	0.03	34.13	0.96	0.41	58.14	6.33
14	0.03	33.72	0.96	0.43	57.84	7.02
15	0.03	33.72	1.00	0.45	57.46	7.34

4. RESULTS PER SUB-PERIOD

The sample is divided into three sub-periods, and the data are re-run to have a deeper insight about the development of the detected effects overtime. Selective results are reported, which add value to the analysis (Figure 4). All results are available upon request.

When investigating the sub-periods, the influence of the Chinese market on the European market is confirmed. The detected influence is from the outbreak period. It is also observed that VIX causes negative returns in the incubation period, while it is a source of volatility for European returns in the subsequent sub-periods. The response of returns to COVID-19 cases is slightly insignificant apart

fromthe outbreak period during which some limited fluctuations are displayed.

4.1. Ranking countries

In this section, the countries are classified according to the index of total deaths per million recorded by each country during the first four months of 2020, and two separate groups are formed (group A and group B). Group A includes the countries with the lowest values, and group B includes those with the highest. This allows one to have a deeper investigation of the relationship between COVID-19 and stock returns, and the robustness of the results is also checked. Table 2 presents the groups of countries.

Figure 4. Sub-periods' generalized impulse response of European stock returns to COVID-19 cases and deaths, Chinese returns and VIX index

Table 2. Countries of each group

Group A	Greece, Finland, Norway, Germany, Austria, Denmark, Portugal, Ireland
Group B	Switzerland, France, Sweden, the Netherlands, the United Kingdom, Italy, Spain, Belgium

The GIRF and the variance decomposition are calculated for each group separately. Figure 5 presents the impulse response of stock returns to the

COVID-19 variables, VIX and Chinese stock returns. In group A, there is a limited reaction of European returns to the shock of COVID-19 cases and deaths for the first two days, after which the effects are insignificant. The cases do not have an effect on the returns, but the deaths have a small and short influence on the returns for the group B countries. A shock from Chinese returns decreases the returns of Europe's market, which become

GROUP A

Response of stock returns to Covid-19 cases

Response of Stock returns to Covid-19 deaths

Response of Stock returns to Chinese Returns

Response of Stock returns to VIX

Response of Stock returns to Stock Returns

GROUP B

Response of stock returns to Covid-19 cases

Response of Stock returns to Covid-19 deaths

Response of Stock returns to Chinese Returns

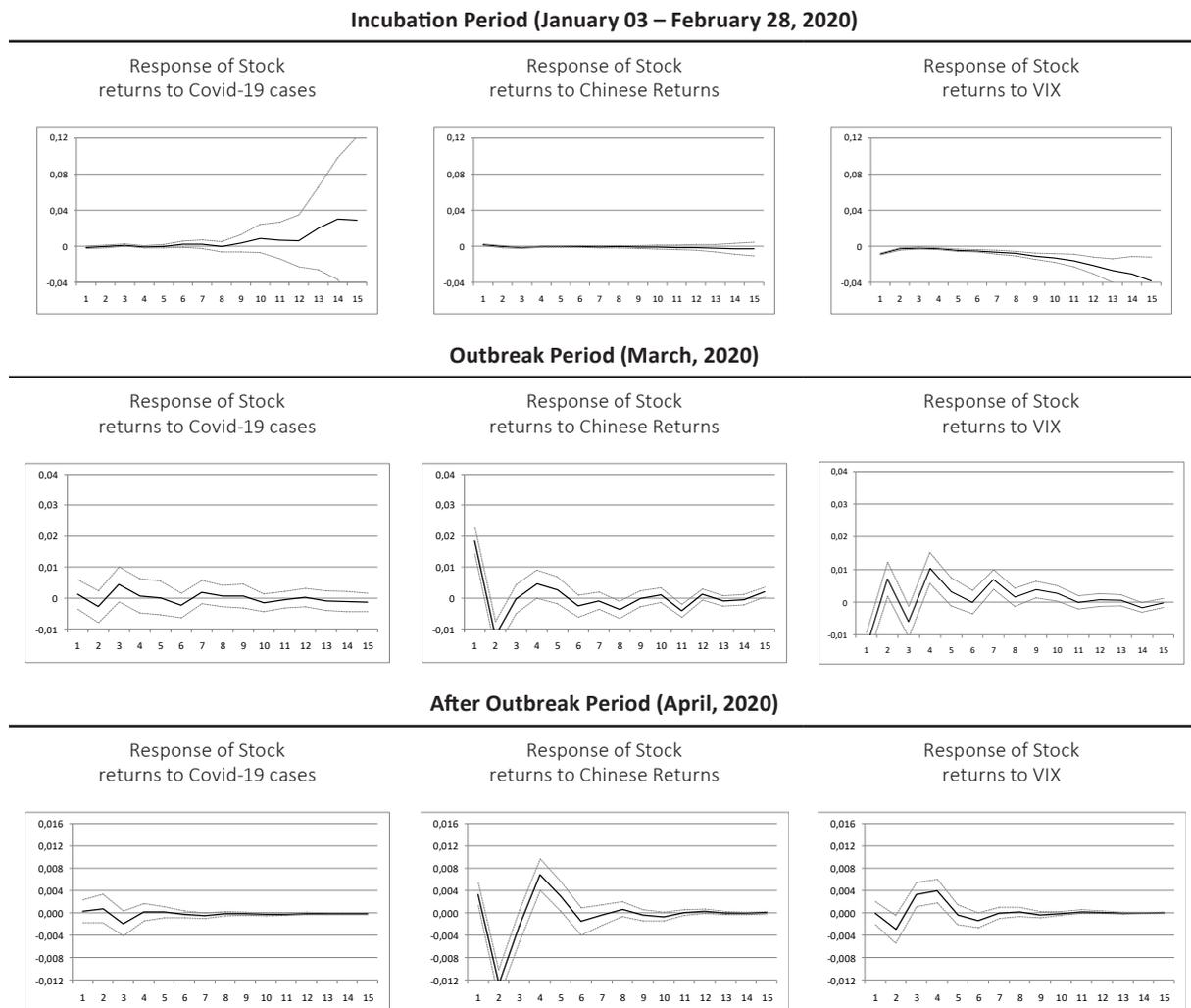Response of Stock returns to VIX

Response of Stock returns to Stock Returns

Figure 5. Generalized impulse response of European stock returns to COVID-19 cases and deaths, Chinese returns and VIX index per group

negative after two days. The duration of this effect lasts until the tenth day, after which the influences are insignificant for both groups. VIX index causes negative responses. Hence, there is evidence that the variables of COVID-19 do not essentially affect the European returns, although some limited effects are detected in the short term. Negative responses are detected from VIX and Chinese returns.

Table 3 shows the influence of COVID-19 variables (deaths and cases)on the forecast error variance of stock returns. In general, the results confirm the limited influence of COVID-19 variables, but it is observed that the group A countries are more sensitive to COVID-19 cases compared to the group B countries. Also, there is evidence that COVID-19 cases may explain approximately 2.5%

of fluctuations in the European stock returns for the group A countries, but only 0.23% in group B. Conversely, group B seems to be more susceptible to COVID deaths, since this variable may explain approximately 0.90% of the European return volatility, but only 0.59% in group A.

Furthermore, the contribution of the Chinese market to the forecast error variance of European returns is greater in countries of group B. At the15-day horizon, Chinese return shock can explain approximately 20.3% of fluctuationsin the European returns of group B. The corresponding result is smaller (12.05%) for group A. Countries of group A are affected more by the VIX compared to those of group B. Moreover, the estimations show that the main impact of European returns is derived from their own shocks.

Table 3. Contribution of Chinese returns, COVID-19 deaths and cases, and VIX to the forecast error variance of European stock returns per group

Period	S.E.	COVID-19 cases	COVID-19 deaths	Stock returns	China returns	VIX
Group A						
1	0.02	0.18	0.01	99.80	0.00	0.00
2	0.02	0.39	0.50	95.53	2.77	0.79
3	0.02	2.37	0.53	86.86	6.64	3.57
4	0.02	2.34	0.53	86.65	6.76	3.69
5	0.03	2.27	0.51	84.16	9.41	3.63
6	0.03	2.24	0.58	82.73	10.90	3.52
7	0.03	2.47	0.58	82.11	10.92	3.90
8	0.03	2.52	0.57	81.11	11.92	3.85
9	0.03	2.51	0.57	80.74	11.87	4.27
10	0.03	2.51	0.57	80.55	11.91	4.43
11	0.03	2.51	0.59	80.38	11.94	4.55
12	0.03	2.54	0.59	80.16	11.99	4.70
13	0.03	2.54	0.59	80.10	12.00	4.75
14	0.03	2.53	0.59	80.04	12.03	4.78
15	0.03	2.53	0.59	79.99	12.05	4.82
Group B						
1	0.02	0.04	0.11	99.83	0.00	0.00
2	0.02	0.04	0.51	92.67	5.61	1.13
3	0.02	0.07	0.62	84.45	11.46	3.39
4	0.02	0.07	0.67	84.15	11.65	3.43
5	0.03	0.09	0.64	81.32	14.44	3.49
6	0.03	0.10	0.70	77.08	18.80	3.29
7	0.03	0.10	0.71	77.039	18.78	3.35
8	0.03	0.21	0.70	75.78	19.97	3.31
9	0.03	0.21	0.75	75.75	19.96	3.31
10	0.03	0.22	0.79	75.51	19.93	3.52
11	0.03	0.22	0.85	75.44	19.96	3.51
12	0.03	0.22	0.85	75.19	20.20	3.51
13	0.03	0.23	0.86	75.15	20.20	3.54
14	0.03	0.23	0.88	75.11	20.21	3.55
15	0.03	0.23	0.90	74.95	20.33	3.57

In conclusion, the results are consistent with the previous section about COVID-19 variables. Some different patterns are detected between the two groups;the countries of group A are more susceptible to reported cases than those of group B, which appear to be most affected by deaths, although these effects are small. In addition, VIX has a greater impact on the group A countries than on countries from group B, while China's influence is greater in group B.

5. DISCUSSION

This study examines the influence of the COVID-19pandemic on European stock markets. The empirical evidence shows no indication that stock market fluctuations were derived from the recorded COVID-19 cases or deaths during the first wave of the virus. This paper highlights how the negative consequences of the health crisis can be strengthened through the financial sector and the importance of financial transmission channels when an external shock occurs.

COVID-19 is an exogenous shock that has a significant impact on the economy and financial markets (Fernandez, 2020; Albulescu, 2020) andcarries characteristics of a systematic risk (Sharif et al., 2020; Vasileiou et al., 2020). Increased volatility in European stock markets and the observed response of the returns to the VIX further reinforce this view.

In the European stock market, investors priced the pandemic before it spreads. The results show an increased volatility from January to March in stock markets, which stems initially from VIX and afterwards from the Chinese stock market. At all stages of the analysis, the response of European stock returns of China is clear obvious, indicating a transmission channel between Europe and China during the first wave of COVID-19. This result is in line with the studies that indicate China as the main transmitter of financial spillovers (Akhtaruzzaman et al., 2020; Siddiqui et al., 2020; Hanif et al., 2021). Moreover, the analysis of countries in two groups show that China's influence is greater on the stock returns of countries with the highest value in the index number of deaths per million. This result is an additional indication of the transmission capacity of China.

CONCLUSION

Market volatility is the reaction of investors to uncertainty. Indeed, the pandemic has caused uncertainty and fear for both human health and the economy. This paper focuses on the Europe stock market, assesses the market volatility and explores its source. The study of the pandemic in Europe is a challenge. Europe has been a common market for decades and recently faced a severe sovereign debt crisis. This paper contributes to understanding the financial risks in this sensitive area during the current health crisis as there is little evidence.

The results are clear; volatility in the European market is not a consequence of the pandemic, as it is evolving in Europe. The volatility of European stock markets stems from the Chinese market and international uncertainty. The detected influence of the Chinese market indicates a channel risk transmission, which reflects the increased bilateral trade exchange between China and Europe. The effect of VIX indicates that investors view the European financial market as an internationalized market, and this prospect inevitably makes Europe vulnerable to worldwide risks. All in all, the study of the first wave shows that the volatility in European markets reflects concerns about the developments of the Chinese stock market and international uncertainty.

AUTHOR CONTRIBUTIONS

Conceptualization: Costas Siriopoulos, Argyro Svingou, Jagadish Dandu.
Data curation: Argyro Svingou.
Formal analysis: Costas Siriopoulos, Argyro Svingou.

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APPENDIX A

Table A1. Country and indices sample

Country	Symbol	Index
Italy	ITA	FTSE MIB
Spain	ESP	IBEX 35
France	FRA	CAC 40
Portugal	PRT	PSI 20
Germany	DEU	DAX
Greece	GRC	ASE/ATG
Netherland	NLD	AEX
Belgium	BEL	BEL
United Kingdom	GBR	FTSE 100
Sweden	SWE	OMXS30
Ireland	IRL	ISEQ
Austria	AUT	ATX
Switzerland	CHE	SMI
Norway	NOR	OSEBX
Finland	FIN	OMXH25
Danmark	DNK	OMXC20
China	CHI	SSEC

Table A2. Confirmed COVID-19 cases, deaths and market volatility

	01/2020	02/2020	03/2020	04/2020
Italy				
Standard deviation	0,0114	0,0190	0,0567	0,0240
Cases	3	885	100.851	101.852
Deaths	0	21	11.570	16.091
Spain				
Standard deviation	0,0074	0,0169	0,0506	0,0213
Cases	0	34	85.161	128.240
Deaths	0	0	7.340	17.203
France				
Standard deviation	0,0088	0,0158	0,0485	0,0242
Cases	6	51	44.493	83.892
Deaths	0	2	3.022	21.063
Portugal				
Standard deviation	0,0067	0,0153	0,0408	0,0152
Cases	NA	NA	6.408	1.809
Deaths	NA	NA	140	833
Germany				
Standard deviation	0,0101	0,0167	0,0471	0,0262
Cases	5	52	61.856	97.206
Deaths	0	0	583	5.705
Greece				
Standard deviation	0,0083	0,0276	0,0667	0,0290
Cases	0	2	1.208	1.364
Deaths	0	0	43	96
Netherland				
Standard deviation	0,0090	0,0171	0,0429	0,0208
Cases	0	2	11.748	27.052
Deaths	0	0	864	3.847
Belgium				
Standard deviation	0,0085	0,0200	0,0489	0,0253
Cases	0	1	11.898	35.960
Deaths	0	0	513	6.988

Table A2 (cont.). Confirmed COVID-19 cases, deaths and market volatility

	01/2020	02/2020	03/2020	04/2020
United Kingdom				
Standard deviation	0,0082	0,0147	0,0440	0,0232
Cases	0	16	22.123	143.080
Deaths	0	0	2043	24054
Sweden				
Standard deviation	0,0095	0,0168	0,0393	0,0236
Cases	0	12	4.016	16.274
Deaths	0	0	146	2.316
Ireland				
Standard deviation	0,0088	0,0161	0,0457	0,0259
Cases	0	0	2.910	17.343
Deaths	0	0	54	1.136
Austria				
Standard deviation	0,0069	0,0153	0,0567	0,0297
Cases	0	7	9.611	5.746
Deaths	0	0	108	472
Switzerland				
Standard deviation	0,0071	0,0155	0,0383	0,0146
Cases	0	12	15.400	13.912
Deaths	0	0	295	1.112
Norway				
Standard deviation	0,0073	0,0166	0,0409	0,0174
Cases	0	6	4.220	3.441
Deaths	0	0	26	176
Finland				
Standard deviation	0,0087	0,0156	0,0412	0,0234
Cases	0	2	1.310	3.593
Deaths	0	0	13	193
Danmark				
Standard deviation	0,0100	0,0155	0,0293	0,0109
Cases	0	2	2.575	6.431
Deaths	0	0	77	366
Total Europe				
Average st deviation	0,0085	0,0172	0,0461	0,0218
Total cases	14	1.084	385.788	687.195
Total deaths	0	23	26.542	100.539
China				
Standard deviation	0,0101	0,0225	0,0190	0,0090
Cases	9.687	69.641	2.886	1.703
Deaths	213	2.624	472	1.328

Notes: Table A2 shows the COVID-19cases and deaths and the market risks. Market risks are approximated by calculating the standard deviation of the main indices daily returns per country from January to April 2020, for sixteen European countries and China. COVID-19 cases and depths is the average of daily records.

Table A3. Panel data unit root test

Variables	In levels		In the 1st difference	
Stock returns	Statistic	Prob.	Statistic	Prob.
Im, Pesaran and Shin W–stat	−10,6830	0,0000	−33,0675	0,0000
ADF – Fisher Chi–square	179,3770	0,0000	462,8140	0,0000
PP – Fisher Chi–square	488,3200	0,0000	294,7310	0,0000
Handri	−0,6272	0,7347	−0,9762	0,8355
China returns				
Im, Pesaran and Shin W–stat	−11,1407	0,0000	−30,2942	0,0000
ADF – Fisher Chi–square	186,0050	0,0000	655,8440	0,0000
PP – Fisher Chi–square	294,7310	0,0000	294,7310	0,0000
Handri	−1,5439	0,9387	−3,0086	0,9987
Covid cases				
Im, Pesaran and Shin W–stat	1,1302	0,8708	−24,9364	0,0000
ADF – Fisher Chi–square	17,4943	0,9825	426,8120	0,0000
PP – Fisher Chi–square	43,9448	0,0777	345,9150	0,0000
Handri	15,4540	0,0000	−0,1955	0,5775
Covid depths				
Im, Pesaran and Shin W–stat	0,5250	0,7002	−27,6820	0,0000
ADF – Fisher Chi–square	23,2527	0,8702	396,4430	0,0000
PP – Fisher Chi–square	122,8470	0,0000	318,7090	0,0000
Handri	17,2494	0,0000	−0,3034	0,6192
VIX				
Im, Pesaran and Shin W–stat	1,4314	0,9238	−9,7159	0,0000
ADF – Fisher Chi–square	12,5805	0,9992	157,3460	0,0000
PP – Fisher Chi–square	16,7591	0,9877	294,7310	0,0000
Handri	14,6806	0,0000	0,4869	0,3132