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JOSEF KLEMENT
Faculty of Economics, University of Economics, Prague, Czech Republic

ADELA ZUBIKOVA
Faculty of Economics, University of Economics, Prague, Czech Republic

MIROSLAV SEVCIK
Faculty of Economics, University of Economics, Prague, Czech Republic

TOMAS LEJSEK
Faculty of Economics, University of Economics, Prague, Czech Republic

THE IMPACT OF THE GLOBAL COVID-19 PANDEMIC ON THE STOCK MARKET INDICES OF SELECTED COUNTRIES

Abstract:

The worldwide spread of coronavirus has shaken stock markets and significantly increased risk. The most-watched US stock index S&P 500 fell by 35% from 19th February to 23rd March. Indices of other countries registered a similar development. Although the spread of the virus has been brought under control in many countries currently, the worldwide number of infections is still growing. Unprecedented monetary and fiscal stimuli, on the other hand, have reversed sentiment in the markets. From 23rd March 2020, stock markets gradually had been growing until the S&P 500 index reached only 5% below historical highs on 8th June 2020. The paper deals with the development of volatility of selected stock indices, their mutual correlations, and the relationship with the number of infected in a given country.

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Keywords:

coronavirus, COVID-19, volatility, stock indices, financial markets

JEL Classification: F44, F65, G15

Introduction

The coronavirus pandemic is a specific external shock whose very nature allows us to classify it as both a demand and a supply shock. Demand shock usually pushes prices down while supply shock pushes them upwards. As of now, the medium- and long-term impact on the price level in individual countries remains unclear. What is certain, however, is that the shutdown of much of the world's economy has significantly reduced wealth creation and economically endangered many companies and individuals. Financial markets, in contrast to other economic sectors, had an immediate response to the coronavirus pandemic. We can therefore study the pandemic's effects, even in the short amount of time that has elapsed since its outbreak. S&P 500, the most-watched US stock index fell by 35% between the 19th of February 2020 and the 23rd of March 2020. The indices of other countries registered similar developments.

After the global crisis of 2008-2009, it took stock indices 66 months to return to pre-crisis values. After the initial response to the coronavirus pandemic outbreak, it has taken only 4 months for the stock markets to return to a value only 4.5 % lower (in comparison to pre-crisis levels). Their recovery has therefore been much faster than during the global crisis of 2008-2009. At present, the stock markets can still be described as overheated.

The aim of this article is to analyze the effects of the new coronavirus pandemic on the financial market indices of selected countries, and to monitor how increased risk (in the form of five-day historical volatility) manifests itself in the stock markets. The two hypotheses proposed and examined in this research paper are as follows:

H1: The volatility of all examined stock indices first increased significantly in synchronization, only to subsequently decrease with the announcement of state fiscal and monetary stimuli.

H2: The volatility of a country's stock index correlates with information released on a given day about the number of newly infected within that country and with the number of infected worldwide.

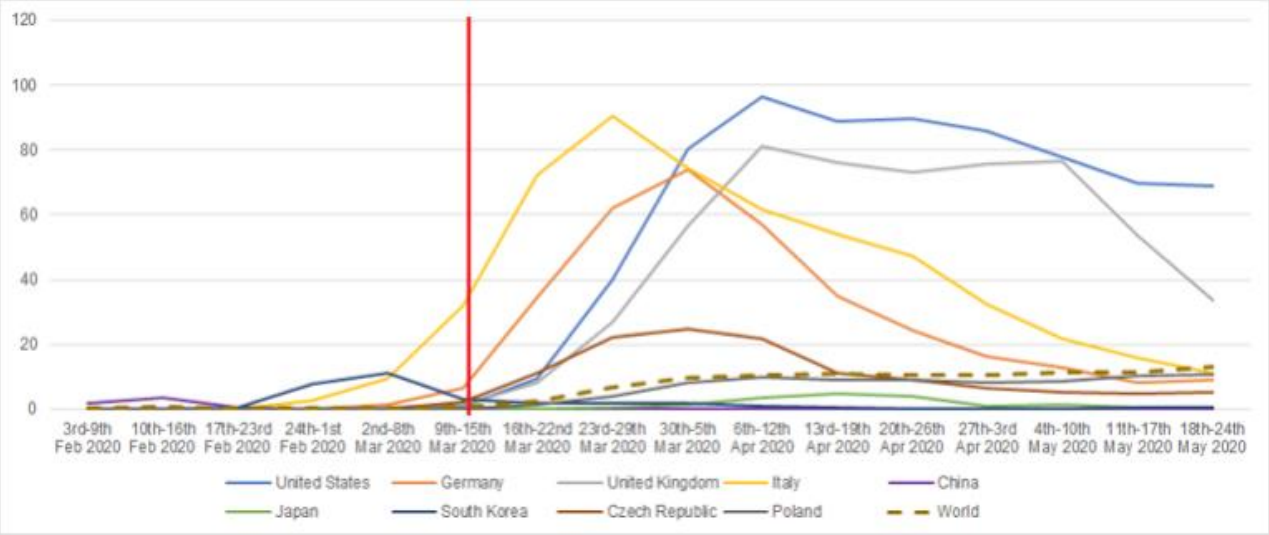
The structure of the paper is as follows: The first chapter summarizes the timeline the disease followed as it spread worldwide. The second chapter explains the methodology of our research. The third chapter deals with price changes and the volatility of stock indices in selected countries, including a look at policy developments and state reactions. The relationship between the number of infected and the development of a country's stock index is assessed in the fourth chapter using correlation analysis.

1 The onset of the COVID-19 global pandemic in 2020

The outbreak of the coronavirus pandemic is difficult to pinpoint. The first major restrictive measure against coronavirus was imposed in China on the 20th of December 2019 (CGTN, 2020), when Winner Medical Group decided to cancel its executive meeting in Hubei. Subsequently, on the 30th of December 2019, the Wuhan Municipal Health Commission issued the first public announcement regarding the coronavirus situation (Caixin, 2020). Deliberate secrecy about information related to the spread of the disease may have been a key factor that contributed to the faster spread of the coronavirus from the Wuhan area.

On the 30th of January 2020, the World Health Organization (WHO) declared a Public Health Emergency of International Concern (WHO, 2020a) and on the 11th of March 2020 (WHO, 2020b), the WHO declared the spread of coronavirus to be a global pandemic.

Figure 1 The average number of newly infected per million inhabitants



Source: John Hopkins University (2020), CIA (2020), own calculations

Figure 1 shows the development of the number of persons newly infected with COVID-19 per million inhabitants in selected countries of the world. The red line indicates the declaration of a global pandemic by the World Health Organization on the 11th of March 2020. Charting the number of patients using a relative scale shows that, when taking the size of its population into account, China did not record particularly high numbers of infections. Of the countries studied, the coronavirus pandemic hit the United States (with a maximum of 96 infected per million inhabitants), Italy (90), the United Kingdom (80) and Germany (74) the hardest. The respective numbers of people infected in these countries were significantly higher than the global average.

2 Data and Methodology

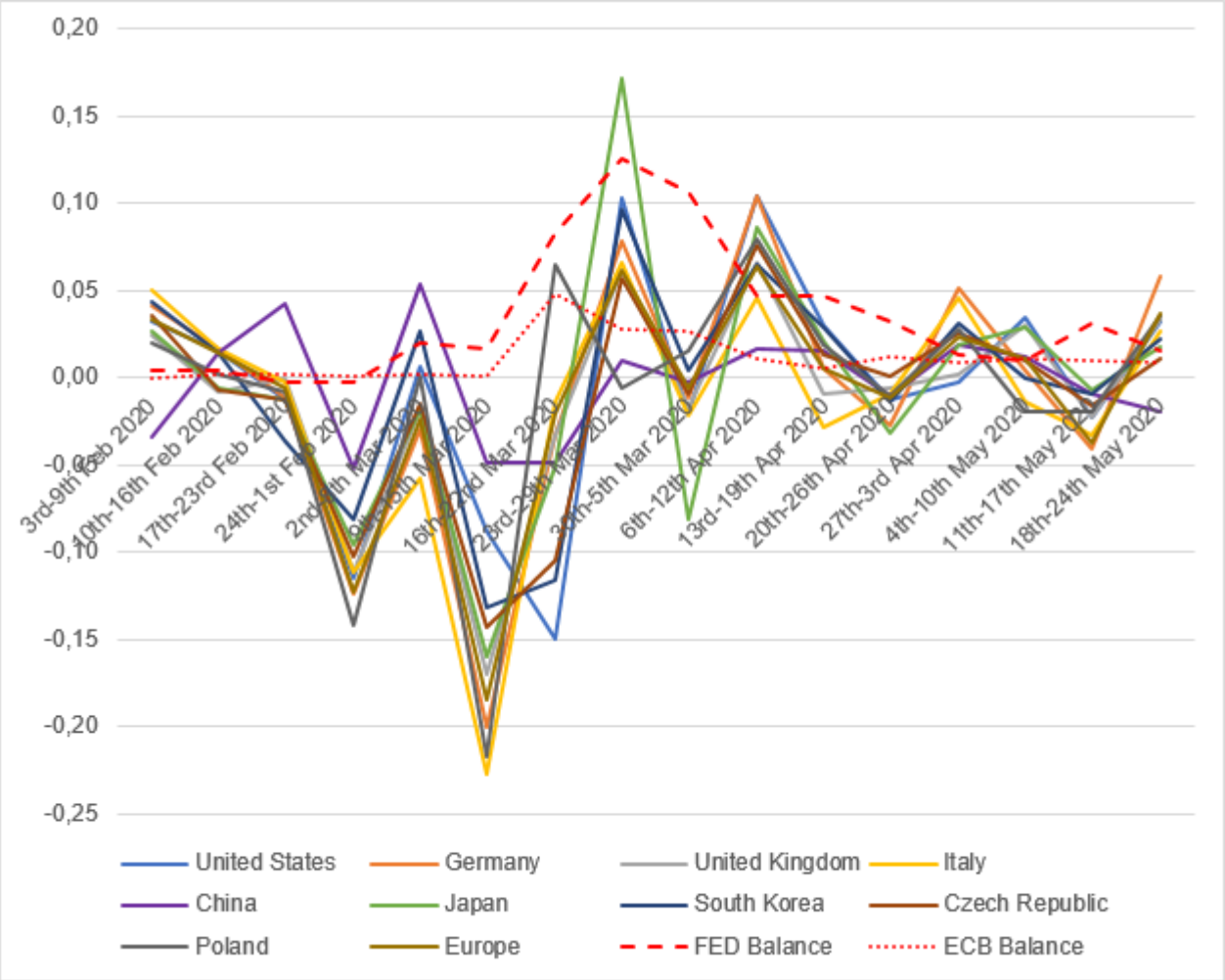
Statistics about the number of people infected were obtained from the COVID-19 Data Repository operated by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Information about stock market prices was sourced from the web portal investing.com. Stock index volatility was calculated as the weekly standard deviation of prices when including information for 5 (working) days. In addition to volatility, which illustrates market risk, systemic risk was examined through volatility correlations of individual stock indices. Table 2 shows how correlations between the volatility development of a given stock index and the number of infected per million inhabitants in each country changed before and after the introduction of central bank interventions. Index "Stoxx Europe 600" is used as representative of "Europe", "S&P 500" of USA, "DAX Historical" of Germany, "FTSE100" of United Kingdom, "FTSE Italia" of Italy, "KOSPI" of South Korea, "Nikkei225" of Japan, "PX Historical" of Czech Republic, "Shanghai composite" of China and "WIG" of Poland.

3 Stock market reactions to the global pandemic of COVID-19

In their paper, Sevcik et al. (2020) distinguish the characteristics of the 2008-2009 global crisis and the current coronavirus pandemic. During the global crisis of 2008-2009, it was primarily the financial sector that failed. This time, the whole economy is affected across almost all sectors, except for those strategic sectors relevant for tackling the coronavirus pandemic. *„Now, however, the whole real economy is affected, from industrial production, transport, services (especially*

tourism and hospitality) and foreign trade to agriculture. Significant shocks are also affecting stocks and bond markets as well as other financial market sectors." Sevcik et al. (2020, p. 160). The causes of the 2008-2009 global financial crisis can be attributed to the failure of authorities, both the executive (national governments) and central banks, as well as other regulators. Credit rating agencies and audit firms also played a significant negative role. In the case of the coronavirus pandemic crisis, government or monetary authorities were (probably) not the trigger, but, much as with the global financial crisis, their role increased due to the need to react and address events.

Figure 2 Week-on-week change in price of stock indexes

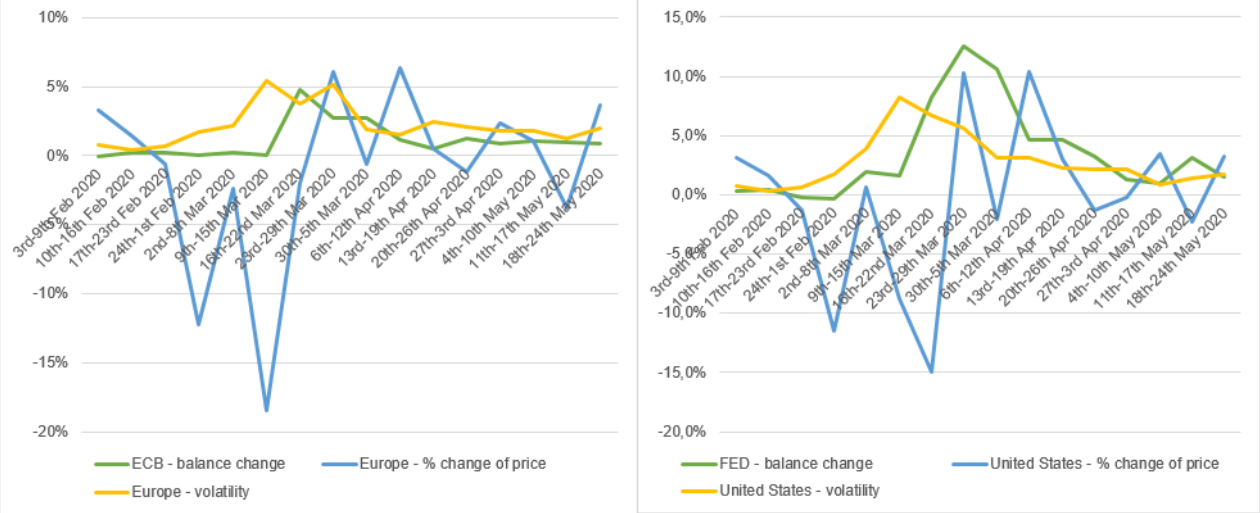


Source: ECB (2020), FED (2020a), Investing.com (2020), own calculations

How has the coronavirus pandemic influenced the stock markets so far? Figure 2 shows the week-on-week changes in stock index prices. It reveals that most of the countries surveyed recorded their first major drop during the week beginning with the 24th of February 2020. After a temporary stabilization, stock index prices fell increasingly rapidly during the week starting with the 9th of March 2020. Figure 2 also charts the course of the FED and ECB balance (red lines). The FED and ECB began their expansive monetary policy in response to the largest drop of stock index prices shown

in the week beginning with the 9th of March 2020. The stock market responded with an immediate increase of stock index prices. A more detailed view is offered in the Figure 3.

Figure 3 Development of the ECB and FED balance sheet total, including price and volatility development of the S&P 500 and EU600 indices



Source: ECB (2020), FED (2020a), Investing.com (2020), own calculations

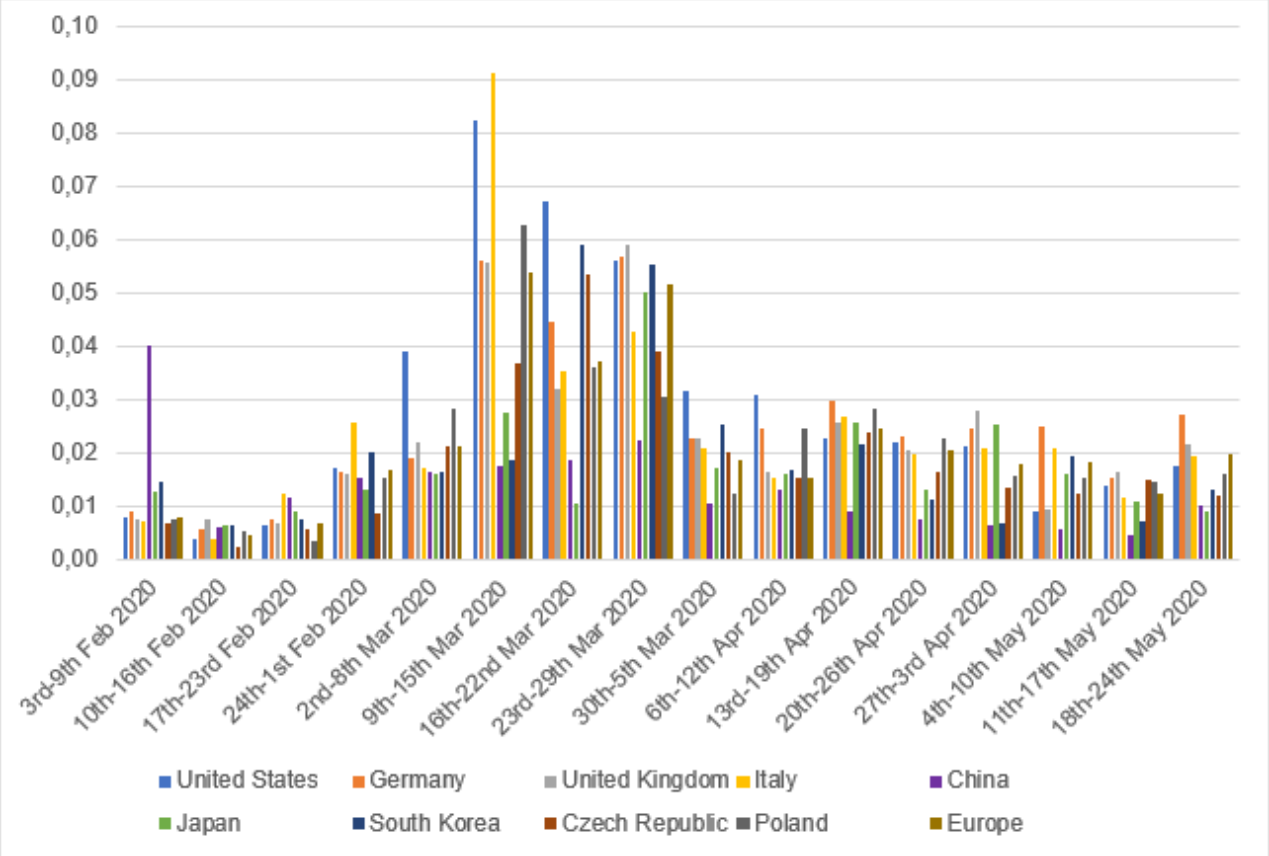
The Federal Reserve announced its plan to reduce interest rates to near-zero and to provide support for households and businesses in the form of 700 billion USD worth of securities purchases on the 15th of March 2020 (FED, 2020b). The stock index prices did not rise significantly until mid-March 2020, when the FED's balance sheet grew by more than 20% in just two weeks. The volatility of US stock index prices decreased immediately in the week following the launch of this expansive monetary policy. The ECB's reaction was less vigorous - its balance sheet increased by about 10% throughout March 2020. From the beginning of February 2020 to the 24th of May 2020, the overall increase in the FED's balance sheet was 69% cumulatively, compared to the 19% cumulative growth of the ECB's balance sheet.

Stock index prices were not only influenced by monetary policy, the role of fiscal policy was also evident. On the 14th of March 2020, an 8.3 billion USD rescue package was approved in the US, and on the 27th of March (Vox, 2020), Donald Trump signed the Coronavirus Aid, Relief, and Economic Security Act, which included 2.3 trillion USD in spending, or about 11% of GDP (Deutsche Welle, 2020). Figure 3 shows us that the financial market responded immediately in the following week, when the volatility of stock index prices started to drop. Since the EU does not have a common fiscal policy, it could not launch an expansive fiscal policy in response to the global COVID-19 pandemic.

Fluctuations aside, the examined stock markets recorded a growth trend in connection with the above mentioned expansionary monetary and fiscal policy. The synchronization of the course of all three indicators is obvious in the data shown in Figure 3. The data provided therefore allows us to confirm Hypothesis 1, "The volatility of all examined stock indices first increased significantly in synchronization, only to subsequently decrease with the announcement of state fiscal and monetary stimuli".

According to the Granger causality test (see Appendix), increased volatility in the major indices of the United States and Europe elicited a response from the central banks. Granger's causality test confirmed the possible causality of an increase in the central bank's balance sheet to an increase in stock prices (0.01 level of significance).

Figure 4 Weekly volatility of stock indices measured by standard deviation



Source: Investing.com (2020), own calculations

Figure 4 presents the results of our calculation of the weekly volatility of stock index prices in the selected countries. It shows that China was the only country to show high volatility at the beginning of the period under review, which can be explained by the earlier spread of the disease there. The risk (volatility) in other markets gradually increased with values exceeding 0,05 throughout March 2020. Interestingly, volatility in the US was above average compared to the rest of the sample. Since April 2020, volatility has returned to values of between 0,01–0,03. However, the volatility of the stock markets has remained higher than before the coronavirus pandemic in Germany, Italy, the United Kingdom, and the United States. This corresponds to the findings presented in Figure 1, which shows that these four countries have been the ones most affected by the coronavirus pandemic in relative terms.

4 Correlation analysis

Correlation matrices for the period before and after the WHO's declaration of a coronavirus pandemic on the 11th of March 2020 are presented below.

Table 1 Correlation matrices

4/23/2019–3/10/2020										
	China	Czech Republic	Europe	Germany	Italy	Japan	South Korea	Poland	United States	United Kingdom
China	1.00	0.42	0.36	0.37	0.36	0.25	0.46	0.26	0.37	0.34
Czech Republi	0.42	1.00	0.69	0.58	0.57	0.42	0.61	0.74	0.71	0.71
Europe	0.36	0.69	1.00	0.94	0.87	0.52	0.72	0.72	0.88	0.93
Germany	0.37	0.58	0.94	1.00	0.88	0.57	0.70	0.67	0.84	0.86
Italy	0.36	0.57	0.87	0.88	1.00	0.54	0.67	0.68	0.81	0.82
Japan	0.25	0.42	0.52	0.57	0.54	1.00	0.65	0.57	0.60	0.53
South Korea	0.46	0.61	0.72	0.70	0.67	0.65	1.00	0.57	0.71	0.72
Poland	0.26	0.74	0.72	0.67	0.68	0.57	0.57	1.00	0.78	0.70
United States	0.37	0.71	0.88	0.84	0.81	0.60	0.71	0.78	1.00	0.85
United Kingdo	0.34	0.71	0.93	0.86	0.82	0.53	0.72	0.70	0.85	1.00

3/11/2020–5/22/2020										
	China	Czech Republic	Europe	Germany	Italy	Japan	South Korea	Poland	United States	United Kingdom
China	1.00	0.71	0.72	0.71	0.50	0.56	0.75	0.52	0.68	0.71
Czech Republi	0.71	1.00	0.87	0.87	0.67	0.44	0.63	0.69	0.83	0.79
Europe	0.72	0.87	1.00	0.98	0.86	0.52	0.51	0.81	0.89	0.95
Germany	0.71	0.87	0.98	1.00	0.83	0.53	0.54	0.77	0.84	0.93
Italy	0.50	0.67	0.86	0.83	1.00	0.28	0.10	0.90	0.87	0.80
Japan	0.56	0.44	0.52	0.53	0.28	1.00	0.62	0.14	0.41	0.64
South Korea	0.75	0.63	0.51	0.54	0.10	0.62	1.00	0.15	0.37	0.49
Poland	0.52	0.69	0.81	0.77	0.90	0.14	0.15	1.00	0.85	0.73
United States	0.68	0.83	0.89	0.84	0.87	0.41	0.37	0.85	1.00	0.84
United Kingdo	0.71	0.79	0.95	0.93	0.80	0.64	0.49	0.73	0.84	1.00

Source: Investing.com (2020), own calculations

The correlation matrix shows that since the pandemic declaration by the WHO, the whole world has partaken of the high volatility initially seen in China's stock market. In other words, the correlation between the development of different stock index prices strengthened. Like Zhang et al. (2020), we can confirm the difference between developments in Asian countries and in the rest of the world. This difference deepened after the declaration of the global coronavirus pandemic. That is especially evident in the example of South Korea, whose correlation with Italy decreased by 0.57 points. This can be explained by previous experience with similar viral diseases and a better ability to cope with the situation in South Korea, which led to lower volatility there. The differences between correlations during the two periods examined are shown in the Appendix.

Table 2 Correlation of stock index volatility development and the number of infected per million inhabitants in a given country

	2/03/2020 – 3/15/2020	**3/16/2020 – 5/18/2020**
United States	0.94	-0.80
Germany	0.98	0.41

United Kingdom	0.99	-0.57
Italy	0.96	0.69
China	-0.03	-0.10
Japan	0.88	0.00
South Korea	0.63	0.82
Czech Republic	0.92	0.31
Poland	0.94	-0.72

Source: John Hopkins University (2020), Investing.com (2020), own calculations

Table 2 examines correlation coefficients between the relative number of people infected and stock volatility for the period before and the period after the introduction of strong fiscal and monetary stimuli in the US and the EU. Apart from China, the stock markets of all countries responded to the growing number of newly infected cases with a strong increase in volatility during the first period. In many cases, the correlation coefficient came close to 1, corresponding to an almost perfect positive relationship. The correlation coefficient for South Korea at 0.63 suggests a looser relationship between the number of infected and volatility.

The second period, characterized by expansionary monetary and fiscal policies, began in mid-March 2020, which is also the time when the correlation between the number of new infections and volatility ceases to apply in most countries. In the United States, the United Kingdom and Poland, it actually reverses completely - while the number infected continues to rise, volatility decreases. In other countries (Germany, Italy, the Czech Republic) the correlation is weaker, in Japan it is nonexistent at zero. Perceived stock market risk is no longer affected by the number of people newly infected but other factors are important - especially economic policy.

For the first period under review, we can therefore confirm an amended Hypothesis 2, “The volatility of a country's stock index correlates with information released about the number of newly infected worldwide”. After monetary and fiscal intervention, the correlation significantly weakens.

Conclusions

This paper provides an overall analysis of stock market behavior in response to the global coronavirus pandemic outbreak. The main findings, based on the author’s own estimations, are as follows: Stock markets responded to the coronavirus pandemic immediately, starting in China in January 2020. Hypothesis 1, “The volatility of all examined stock indices first increased significantly in synchronization, only to subsequently decrease with the announcement of state fiscal and monetary stimuli” has been confirmed by our analysis which focused mainly on US economic policy, since the US stock market has a significant influence on other stock markets all around the world. Hypothesis 2, “The volatility of a country's stock index correlates with information released on a given day about the daily number of newly infected within that country and with the number of infected worldwide” was partially confirmed. We demonstrated that the global coronavirus pandemic led to tighter correlations among the stock market indexes in the countries selected. These correlations were then weakened by monetary and fiscal stimuli, which conduced to decrease the volatility of stock index prices.

One reason why the markets calmed down may also be the finding that the coronavirus pandemic is not as serious a disease as was initially expected. Klaus et al. (2020, p. 59) specifically point out

that, in April 2020, data on coronavirus deaths began to be cleared of persons who had died of another cause while also infected with coronavirus. The coronavirus pandemic has affected countries regardless of their size or population, which is shown in the evolution of individual indices. While the coronavirus pandemic has been tackled at the national level, it has gained momentum due to globalization. In this context, Klaus et al. (2020) warn against the encouragement of "artificial hostilities" towards foreign countries. It was China that played its part during the months that the pandemic broke out in European countries.

Whether a second wave of the coronavirus pandemic arrives or not, asset markets can be expected to fall for a second time once companies with short-term savings that allowed them to operate for several more months begin to collapse.

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Appendix

Table 3 The difference between stock index correlations before and after the WHO's official declaration of a global pandemic

	China	Czech Republic	Europe	Germany	Italy	Japan	South Korea	Poland	United States	United Kingdom
China	0.00	0.29	0.36	0.35	0.15	0.31	0.29	0.26	0.31	0.37
Czech Republic	0.29	0.00	0.17	0.29	0.10	0.03	0.02	-0.05	0.12	0.08
Europe	0.36	0.17	0.00	0.03	-0.01	0.00	-0.21	0.10	0.01	0.02
Germany	0.35	0.29	0.03	0.00	-0.05	-0.04	-0.16	0.10	0.00	0.07
Italy	0.15	0.10	-0.01	-0.05	0.00	-0.25	-0.57	0.23	0.06	-0.02
Japan	0.31	0.03	0.00	-0.04	-0.25	0.00	-0.02	-0.42	-0.19	0.11
South Korea	0.29	0.02	-0.21	-0.16	-0.57	-0.02	0.00	-0.42	-0.34	-0.23
Poland	0.26	-0.05	0.10	0.10	0.23	-0.42	-0.42	0.00	0.07	0.03
United States	0.31	0.12	0.01	0.00	0.06	-0.19	-0.34	0.07	0.00	-0.01
United Kingdom	0.37	0.08	0.02	0.07	-0.02	0.11	-0.23	0.03	-0.01	0.00

Source: Investing.com (2020), own calculations

Figure 3 Pairwise Granger Causality test

Sample: 2/03/2020 5/18/2020
Lags: 2

Null Hypothesis:	Obs.	F-Statistic	Prob.
FED does not Granger Cause SP500_price	14	2.51040	0.1360
SP500_price does not Granger Cause FED		2.43358	0.1429
FED does not Granger Cause SP500_ volatility	14	0.65529	0.5424
SP500_volatility does not Granger Cause FED		19.3695	0.0005
ECB does not Granger Cause EU600_ volatility	14	2.31016	0.1550
EU600_ volatility does not Granger Cause ECB		22.9861	0.0003
ECB does not Granger Cause EU600_price	14	8.16355	0.0095
EU600_price does not Granger Cause ECB		4.72528	0.0395

Source: ECB (2020), FED (2020a), own estimations,