Investigating the nexus between European major and sectoral stock indices, gold and oil during the COVID-19 pandemic

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Abstract

This paper investigates the dynamic conditional linkages between the Eurostoxx50, and the Eurostoxx600 and its sub-indices with COVID-19 deaths, gold, and crude oil. The Dynamic Conditional Correlations (DCC) methodology is employed and the period examined spans from 22 January 2020 until 10 July 2020. Econometric outcomes reveal that the European stock indices are modestly-to-strongly linked with gold in a positive direction and this prevents them from abrupt falls during the pandemic. Nevertheless, weak positive linkages of indices with oil are detected. Sectors of major importance such as the energy sector, financial services, banks, automobiles and parts, and basic resources are mostly influenced by gold and oil. Notably, the impact of COVID-19 deaths on major European markets is rather indirect. These findings inform interested investors in order to ameliorate their risk–return tradeoff during the pandemic bear market.

Keywords COVID-19 · Eurostoxx · Eurostoxx sectors · Gold · Oil · Dynamic correlations

JEL Classification G1 · F3

Introduction

The outbreak of the COVID-19 pandemic has led to a large number of restraining measures that have brought about serious societal impacts, but have also affected worldwide economies. Thereby, it has been inevitable that this phenomenon would cause a heated debate about the economic consequences of this coronavirus disease. The series of lockdowns and social distancing measures have impeded firms

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SN Business & Economics
A **SPRINGER NATURE** journal

from functioning as usual. The rapidly proliferating numbers of patients and deaths caused by COVID-19 have led to abrupt decreases in market values of major financial assets with gold being the most prominent exception.

During times of crisis, academic research focuses on investigating the behaviour of financial markets and their impacts on the overall economy and the profitability of economic agents (Choudhry et al. 2015; Haitsma et al. 2016; Papadamou et al. 2018, 2019, 2020, 2021; Beneki et al. 2019; Kyriazis et al. 2019; Kyriazis 2020a). The nexus of turbulent economic conditions with financial assets has also been under scrutiny (Kyriazis 2020b). Moreover, it is examined whether financial assets of major importance present diversifying, hedging or safe-haven linkages among them (Fatum and Yamamoto 2016; Conlon and McGee 2020) and on the ways that the synthesis of investor portfolios could alter to prevent economic agents from suffering losses. Baur and McDermott (2010) define diversifiers as positively but not perfectly correlated with each other, hedgers as negatively correlated and safe havens as hedgers during extreme economic conditions.

In this paper, we extend the rapidly emerging literature on COVID-19 consequences in the financial sector by exploring the dynamic nexus between major European stock indices and sectoral sub-indices with basic commodities and COVID-19 deaths. To do so, dynamic conditional correlations are estimated from the period since the first day that official death data were announced (22 January 2020) up to the present (10 July 2020). The contribution of this study is threefold. First, this is the first academic paper that employs the specific methodology to investigate the relation of major European financial assets with commodities by employing this specific methodology. Second, to the best of our knowledge, no emphasis has been put to the number of deaths in academic studies so far as most researchers look into relations during the COVID-19 period and not focus on the impacts that the number of disease incidents has caused. Third, in this paper, focus is made on how the COVID-19 has affected investor sentiment across alternative financial sectors and how the diversifying or hedging capabilities between major assets has altered.

The remainder of this study is structured as follows. The section "Literature review" provides the literature review concerning COVID-19 effects on financial markets. The section "Data and methodology" presents the data employed and the methodology applied for the purposes of estimations. Furthermore, the section "Econometric outcomes" lays out and analyzes the empirical outcomes and the economic implications. Finally, the section "Conclusions" concludes and suggests avenues for further research.

Literature review

A proliferating bulk of academic work has been investigating topics related to our study. The first strand of relevant literature has focused on Dynamic Conditional Correlations methodologies to study linkages among financial assets. Ciner et al. (2013) investigate whether time variation in conditional correlations between stocks, bonds, gold, oil, and exchange rates in the US and the UK display hedging properties against each other. They reveal that gold acts as a safe-haven against currency

values in both countries. Moreover, bonds serve as useful hedgers against stocks. From their own perspective, Kean and Teng (2013) employ a DCC-MGARCH specification and investigate the correlations between the US, Japan, China, and India and their integration into the Malaysian stock market. The highest levels of financial integration are traced between Malaysia and China. Moreover, it is argued that diversification benefits emerge for investors in Malaysia by investing in China and Japan.

For the purposes of their estimations, Barunik et al. (2016) adopt a wavelet approach and perform a time–frequency analysis of dynamic correlations between major assets spanning from 1987 to 2012. It is argued that after the 2008 Global Financial Crisis, higher correlations between pairs of gold, oil, and stocks appear and render homogeneous. They also support that these three assets could make part of a portfolio behaving as diversifiers only for short time horizons. Moreover, Kryzanowski et al. (2017) detect a spillover impact of Quantitative Easing (QE) on international financial markets by employing DCC-GARCH methodologies. It is noted that these correlations between bond markets, stock markets, and currency forwards alter by QE rounds across advanced and developing regions. In a similar vein, Aslanidis et al. (2019) investigate conditional cross-correlations among cryptocurrencies and traditional financial assets. They argue that correlations among digital currencies are positive but time-varying. Especially high volatility is detected regarding correlations with Monero. Moreover, the dynamic linkages between cryptocurrencies and traditional assets are found to be very weak.

The second strand of academic work related to this paper focuses interest on the Eurostoxx indices. To be more precise, Islami and Kurz-Kim (2014) construct a single composite financial stress indicator (FSI) to predict developments in the real economy in the euro area. This indicator is compared to the Eurostoxx 50 volatility index during the banking crisis and the sovereign debt crisis to provide accurate results. Moreover, Xidonas and Mavrotas (2014) employ an innovative algorithm of Eurostoxx 50 and verify that a sufficient number of efficient or Pareto optimizing portfolios emerge that can improve efficiency in investment portfolios. Furthermore, Li et al. (2018) look into the network topology of equity fluctuations by modeling the interdependencies of the Eurostoxx companies. It is revealed that during turbulent periods, the topology of the minimum spanning tree employed renders more star-like and compact in detecting systemic risk.

The third and more recent strand of relevant literature has centered interest on the impacts of COVID-19 on stock markets and other traditional or modern assets. Cepoi (2020) employs panel quantile regression methodologies and examines the linkages between COVID-19-related news and stock market returns concerning the US, the UK, Germany, France, Spain, and Italy. It is supported that the stock markets display asymmetric dependencies with information about the disease, such as fake news, media coverage, or contagion. Thereby, communication should be ameliorated to confront the coronavirus-induced crisis. Somewhat similarly, Erdem (2020) adopts panel data regressions including 75 countries to find whether freedom in countries is linked to stock market volatility when news about COVID-19 are announced. It is argued that the COVID-19 leads to falls in stock market returns, but increases in their volatilities. Announcements about the number of cases are found

to be three times more influential than announcements about the number of deaths, while freedom is not strongly influential. When it comes to Salisu and Vo (2020), they use data about the 20 most hardly hit countries by the COVID-19 to find the importance of health news on stock returns. It is supported that health news constituted a good predictor of stock returns during the coronavirus period. Moreover, financial news is found to be important for the efficiency of the health-news model. Salisu et al. (2020) adopt panel-VAR and panel logit methodologies for examining how oil and stocks respond to COVID-19 shocks. They provide evidence that the COVID-19 has led to own and cross shocks being more influential to oil and stock markets.

From another point of view, Mazur et al. (2020) investigate the reason why the US stock market values fell abruptly during March 2020. Surprisingly, they argue that health care, food, natural gas, and software stocks performed very well during that period. Nevertheless, other sectors such as petroleum, real estate, and entertainment and hospitality stock values decreased dramatically. It is also noted that loser stocks presented asymmetric fluctuations that were negatively correlated with stock returns. In a somewhat different vein, Sharif et al. (2020) employ the coherence wavelet methodology and wavelet-based Granger causality and studies the impacts of COVID-19 and oil price shocks. It is revealed that COVID-19 exerts stronger effects on geopolitical risk than on economic uncertainty in the US as well as exhibits powerful short-term impacts of the disease on the US stock markets. Moreover, Al-Awadhi et al. (2020) look into the impacts of infectious diseases on stock markets by employing panel data analysis. It is supported that both COVID-19 cases and deaths lead to lower market values concerning the Hang Seng index as well as the Shanghai Stock Exchange Composite index in a powerful manner. By investigating impacts of COVID-19 on modern financial investments, Goodell and Goutte (2020) employ the wavelet methodology of Grinsted et al. (2004) to trace co-movements between COVID-19 deaths and Bitcoin. They reveal that these deaths result into higher Bitcoin market values. This finding is found to be more powerful since 5 April 2020.

Data and methodology

Our study data encompass the period from 22 January 2020 to 10 July 2020. Therefore, the entire period of deaths due to COVID-19 in a worldwide level is under scrutiny. All the series used are downloaded in daily frequencies. Data about European stock indices and sub-indices as well as concerning gold and oil have been downloaded from Datastream. The wide range of highly representative sectoral stock indices provide an overall perspective of effects that COVID-19 deaths and traditional assets cause on the stock markets of each sector during the pandemic.

More specifically, the indices investigated are: the Eurostoxx 50 (STOXX Europe 50),[1] the Eurostoxx 600 (STOXX Europe 600),[2] the STOXX Europe 600 Health Care (SXDP), the STOXX Europe 600 Industrial Goods & Services (SXNP), the STOXX Europe 600 Banks (SX7P), the STOXX Europe 600 Personal & Household Goods (SXQP), the STOXX Europe 600 Food & Beverage (SX3P), STOXX Europe 600 Technology (SX8P), the STOXX Europe 600 Insurance (SXIP), and the STOXX Europe 600 Oil & Gas (SXEP). Moreover, the indices: STOXX Europe 600 Utilities (SX6P), STOXX Europe 600 Chemicals (SX4P), STOXX Europe 600 Retail (SXRP), STOXX Europe 600 Telecommunications (SXKP), STOXX Europe 600 Construction & Materials (SXOP), STOXX Europe 600 Financial Services (SXFP), STOXX Europe 600 Real Estate (SX86P), STOXX Europe 600 Automobiles & Parts (SXAP), STOXX Europe 600 Basic Resources (SXPP), STOXX Europe 600 Media (SXMP), and STOXX Europe 600 Travel & Leisure (SXTP). Notably, the gold as well as the WTI Oil quotes is expressed in dollars. These are vastly employed in financial research. As regards the COVID-19 deaths, data about this series have been extracted from the www.worldometers.info webpage. To conduct estimations, series have been transformed into logarithmic differences.

Figure 1 displays how the main variables investigated behave as time passes. It can be observed that the stock indices have been highly volatile especially during March 2020 when the outburst of the pandemic became more widespread. Gold and oil have also been highly volatile during March and April 2020. For the purposes of comparison, CRIX index—the mostly representative of cryptocurrency indices—has been included in this representation. This also presents high levels of volatility during the same months and an intense bear market can be seen that abides by the overall pessimism in international markets. Nevertheless, estimations have revealed a non-significant effect of CRIX on Eurostoxx indices, so the relevant estimations have been omitted in this study.

Furthermore, Table 1 presents the descriptive statistics of the Eurostoxx 50 and the Eurostoxx 600 indices, the 19 sub-sectors of Eurostoxx 600, the COVID-19 deaths, gold, and oil. It can be seen that while COVID-19 deaths and gold prices have been increasing, the great majority of indices (with only the Technology sector being the exception) as well as WTI_Oil have been displaying bear markets on average. One can easily observe that the Banks, Insurance, Oil & Gas, Automobiles & Parts as well as

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[1] It should be noted that STOXX Europe 50 index provides a blue-chip representation of supersector leaders in Europe covering almost 50% of the free-float market capitalization of the European stock market. The index covers 50 stocks from 18 European countries: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom (source: www.wikipedia.com).

[2] This has a fixed number of 600 components representing large, mid, and small capitalization companies among 17 European countries, covering approximately 90% of the free-float market capitalization of the European stock market (not limited to the Eurozone). The countries that make up the index are the United Kingdom (comprising around 27% of the index), France, Germany, and Switzerland (accounting for around 15% of the index each) [1], as well as Austria, Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, and Sweden. (source: www.wikipedia.com).
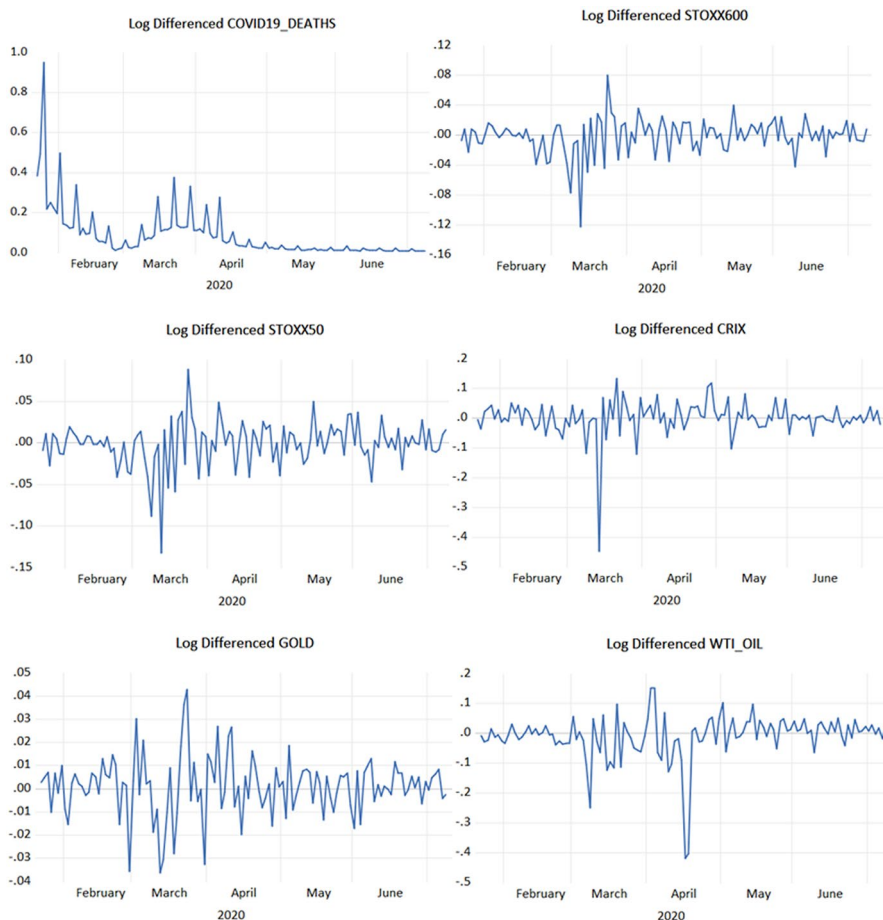
Fig. 1 Graphical representations of main variables

the Travel & Leisure sectors have exhibited the largest volatility among the indices investigated.

The methodology employed for the purposes of our estimations is the Dynamic Conditional Correlations (DCC) approach based on Engle (2002). This methodology enables the examination of the linkages among financial assets in a dynamic rather than a static manner and let us examine how interrelations are formed as time passes. More specifically, Engle (2002) suggested that time-varying conditional correlations $\left(q_{ij,t}\right)$ concerning two return series should be estimated by a GARCH (1,1) process:

$$q_{ij,t} = \overline{\rho_{ij}} + \alpha_{\mathrm{dcc}}\left(\varepsilon_{i,t-1}\varepsilon_{j,t-1} - \overline{\rho_{ij}}\right) + \beta_{\mathrm{dcc}}\left(q_{ij,t} - \overline{\rho_{ij}}\right), \qquad (1)$$

where $\overline{\rho_{ij}}$ stands for the unconditional correlation between $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$. The correlation estimator is given as $\rho_{ij,t} = \frac{q_{ij,t}}{q_{i,t}q_{i,t}}$. Such methodologies have been previously

Table 1 Summary statistics of variables under scrutiny

	Mean	Std. dev	Min	Max
Indices				
Eurostoxx 50	− 0.00098	0.02686	− 0.13241	0.08834
Eurostoxx600	− 0.00119	0.02353	− 0.12191	0.0807
Health care	− 0.00019	0.01807	− 0.0929	0.04779
Industrial goods & services	− 0.00134	0.02842	− 0.12626	0.09478
Banks	− 0.00306	0.03456	− 0.15488	0.0943
Personal & household goods	− 0.00077	0.02049	− 0.09767	0.061
Food & beverage	− 0.0012	0.01908	− 0.09196	0.05318
Technology	0.00036	0.0253	− 0.11441	0.09159
Insurance	− 0.00205	0.03298	− 0.16378	0.14036
Oil & gas	− 0.00339	0.03827	− 0.18431	0.1465
Utilities	− 0.00053	0.02443	− 0.15359	0.0593
Chemicals	− 0.00009	0.02364	− 0.09873	0.07014
Retail	-0.00058	0.02061	− 0.10681	0.07119
Telecommunications	− 0.00143	0.02311	− 0.12179	0.09639
Construction & materials	− 0.00116	0.03064	− 0.14634	0.08934
Financial services	− 0.00089	0.02814	− 0.13591	0.11863
Real estate	− 0.002	0.02522	− 0.12389	0.08439
Automobiles & parts	− 0.00179	0.03736	− 0.17302	0.14326
Basic resources	− 0.00123	0.03418	− 0.15546	0.1473
Media	− 0.00209	0.02427	− 0.11853	0.07496
Travel & leisure	− 0.00359	0.03812	− 0.14093	0.11303
Determinants				
COVID-19 deaths	0.08672	0.12661	0.00942	0.94987
Gold	0.00119	0.01267	− 0.03609	0.04297
WTI_Oil	− 0.0093	0.07545	− 0.41765	0.15286

employed by studies about major financial assets, such as in Kean and Teng (2013) and Kryzanowski et al. (2017).

Econometric outcomes

Econometric estimations have been conducted examining whether COVID-19 deaths, gold, or oil are determinants of market values concerning the Eurostoxx 50 and the Eurostoxx 600 indices and sectoral sub-indices. Table 2 lays out the empirical outcomes based on the DCC methodology. Findings provide evidence that more deaths that are caused by COVID-19 result into lower market values of every index under scrutiny. This is in accordance to rationality, as negative external factors lead to negative effects on financial markets. Furthermore, it can

Table 2 Econometric estimations about effects of COVID-19 deaths and commodities on European stock indices

	COVID-19 deaths	Gold	WTI_Oil	Arch constant
Eurostoxx 50	− 0.01154	0.56037***	0.0826***	0.00062***
Eurostoxx600	− 0.01155	0.45314***	0.08111***	0.00048***
Health care	− 0.0022	0.32609**	0.03932*	0.0003***
Industrial goods & services	− 0.01669	0.51403***	0.08672***	0.00071***
Banks	− 0.02272	0.43921*	0.119***	0.00107***
Personal & household goods	− 0.01113	0.36786***	0.05594**	0.00037***
Food & beverage	− 0.00733	0.22617*	0.06084***	0.00033***
Technology	− 0.00689	0.60516***	0.08602***	0.00053***
Insurance	− 0.01841	0.59706***	0.09163**	0.00097***
Oil & gas	− 0.01527	0.73314***	0.17891***	0.00119***
Utilities	− 0.0061	0.49734***	0.07944***	0.00052***
Chemicals	− 0.00376	0.4021**	0.08084***	0.00049***
Retail	− 0.00962	0.39469***	0.04234*	0.00038***
Telecommunications	− 0.00892	0.492***	0.0848***	0.00045***
Construction & materials	− 0.0151	0.60044***	0.09665***	0.00082***
Financial services	− 0.0128	0.62769***	0.10267***	0.00066***
Real estate	− 0.01958	0.55335***	0.07914***	0.00054***
Automobiles & parts	− 0.02164	0.60383**	0.11536***	0.00124***
Basic resources	− 0.02051	0.5769**	0.12714***	0.001***
Media	− 0.01128	0.37131*	0.08074***	0.00052***
Travel & leisure	− 0.02911	0.46461*	0.07253	0.00137***

be easily seen that these negative impacts are very weak. Moreover, these estimations are not statistically significant.

Apart from that, emphasis should be put in that gold is found to be positively correlated with each one of these European indices at least at a weak-to-modest level. Notably, gold is positively and tightly connected with a large portion of the indices examined. To be more precise, it is strongly connected with the Eurostoxx 50 index (0.56037), the STOXX Europe 600 Oil & Gas index (0.73314), the STOXX Europe 600 Financial Services index (0.62769), the STOXX Europe 600 Technology index (0.60516), the Europe 600 Automobiles & Parts index (0.60383), the STOXX Europe 600 Construction & Materials index (0.60044), the STOXX Europe 600 Insurance index (0.59706), the STOXX Europe 600 Basic Resources index (0.5769), the STOXX Europe 600 Real Estate index (0.55335), and the STOXX Europe 600 Industrial Goods & Services (0.51403). Moreover, a modest connection is detected between gold prices and the Eurostoxx 600 (0.45314) index, the STOXX Europe 600 Utilities index (0.497339), the STOXX Europe 600 Telecommunications index (0.49201), the STOXX Europe 600 Travel & Leisure (0.46461), the STOXX Europe 600 Banks (0.43921), and the STOXX Europe 600 Chemicals index (0.4021). It should also be noticed that some indices

are weakly connected with gold. More specifically, the STOXX Europe 600 Retail index (0.39469), the STOXX Europe 600 Media index (0.37131), the STOXX Europe 600 Personal & Household Goods (0.36786), and the STOXX Europe 600 Food & Beverage index (0.22617). It should be noted that the great majority of results are statistically significant at least at a 90% confidence level.

When it comes to results about the influence of oil on European stock indices and sectoral sub-indices, weak positive effects are revealed. The strongest linkages are detected between oil market values and the STOXX Europe 600 Oil & Gas index (0.17891), the STOXX Europe 600 Basic Resources index (0.12714), the STOXX Europe 600 Banks index (0.119), the STOXX Europe 600 Automobiles & Parts index (0.11536), and the STOXX Europe 600 Financial Services index (0.10267). It should be noted that the Eurostoxx 50 displays weak connection (0.0826028) with oil and so does the Eurostoxx 600 index (0.08111). Moreover, weak nexus of oil is traced with the STOXX Europe 600 Construction & Materials index (0.09665), the STOXX Europe 600 Insurance index (0.09163), the STOXX Europe 600 Industrial Goods & Services index (0.08672), the STOXX Europe 600 Technology index (0.08602), the STOXX Europe 600 Telecommunications index (0.0848), the STOXX Europe 600 Chemicals index (0.08084), the STOXX Europe 600 Media index (0.08074), the STOXX Europe 600 Utilities index (0.07944), the STOXX Europe 600 Real Estate index (0.07914), the STOXX Europe 600 Travel & Leisure index (0.07253), the STOXX Europe 600 Food & Beverage index (0.06084), and the STOXX Europe 600 Personal & Household Goods index (0.05594). Remarkably, very weak connection is found between oil market quotes and the STOXX Europe 600 Retail (0.04234) and STOXX Europe 600 Health Care (0.03932) indices. In resemblance to results about gold effects, the vast majority of estimation outcomes are statistically significant at least at a 90% confidence level.

An important number of economic findings emerge from the econometric estimations undertaken. It should be stressed that the number of deaths that are caused by COVID-19 influences the market values of Eurostoxx 50, Eurostoxx 600, and the Eurostoxx 600 sectoral sub-indices in a negative manner. This is highly reasonable as negative external shocks use to be harmful towards financial markets. Nevertheless, it is surprising that this impact is very weak and not statistically significant. Thereby, it can be concluded that the COVID-19 outburst has not affected the Eurostoxx indices in a direct manner but rather indirectly, by leading the overall financial markets to a bearish movement. Moreover, it is highly remarkable that the gold market and the crude oil market have affected the Eurostoxx indices in a positive direction, but their influence was not equal. Gold—which is usually characterized as a safe-haven asset in a worldwide level—has presented a bullish market during this pandemic and is significantly more influential towards the European indices investigated. On the other hand, oil has displayed a bear tendency and is significantly less influential towards European stock indices.

Thereby, the most prestigious safe-haven asset has been the driver of European stock indices and has prevented a significant fall in their market values. Even though the Eurostoxx indices have suffered losses in market values, their diversifying character against gold has prevented them from large losses. Moreover, their positive but very weak connection with crude oil has prevented from a large fall in their market

values. This leads us to conclude that major commodities have been influential towards European stock markets, but a special emphasis should be attributed to gold and to the finding that the financial assets (Eurostoxx indices) investigated are complementary rather than substitutes to gold. This gives credence to gold market being the most important determinant of financial markets during crises.

Special emphasis should be put in that the energy sector (oil and gas), financial services, banks, automobiles and parts, as well basic resources have been the European stock sectors most affected by gold and oil prices. This provides credence to supporters of the major economic sectors being more malleable to external shocks that lead to crises. Additionally, it is proven that gold which is the form of liquidity and the commodity of major importance has been the giver of significant effects towards major European sectors. Nevertheless, it should be underlined that gold works as a safe-haven against risk, but rather acts as a diversifier than a hedger in a portfolio consisting of European major indices and sub-indices.[3]

Conclusions

This paper investigates the dynamic nexus of Eurostoxx 50, Eurostoxx 600, and the Eurostoxx 600 sectoral sub-indices with the number of deaths by COVID-19 and the market values of gold and crude oil. The innovative methodology of Dynamic Conditional Correlations (DCC) is employed to study the period spanning from 22 January 2020 (the starting date of recorded COVID-19 deaths) until 10 July 2020.

Econometric outcomes provide evidence that the number of COVID-19 deaths exerts a weak and negative impact on European stock indices and sectoral sub-indices, but estimations are not statistically significant. Furthermore, gold prices are influential towards the Eurostoxx indices in a positive, modest-to-strong and statistically significant manner. As regards crude oil, a positive nexus and statistically significant connection is also detected but in a remarkably weaker level compared to gold linkages with indices. The sectors most influenced by gold and oil are the major economic sectors, such as: the energy sector (oil and gas), financial services, banks, automobiles and parts, and basic resources. Empirical outcomes reveal that gold serves efficiently as a safe-haven against risk, even though it mostly acts as a diversifier against European stock indices, not as a hedge against them. Notably, the number of COVID-19 deaths influences major European financial markets in an indirect—by increasing the safe-haven status of gold—rather than a direct manner.

This study has undertaken the strenuous task of casting light into the interdependencies between major European financial assets and major commodities during the COVID-19 pandemic. This has provided investors with in-depth knowledge of the nexus between the coronavirus disease and European stock markets, and has informed about how safe-haven assets influence specific major economic sectors. Thereby, this study provides a compass for investing during turbulent periods.

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[3] Estimations conducted about the impacts of COVID-19 infections in a worldwide level on the same European stock markets have led to similar results.

Avenues for further research should include the empirical examination of non-European sectoral indices and their linkages with alternative safe-haven assets.

Declarations

Conflict of interest The author declares that he has no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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