Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Global evidence of the COVID-19 shock on real equity prices and real exchange rates: A counterfactual analysis with a threshold-augmented GVAR model

Afees A. Salisu, Taofeek O. Ayinde, Rangan Gupta, Mark E. Wohar

Centre for Econometric & Allied Research, University of Ibadan, Ibadan, Nigeria
Department of Economics, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa
Department of Economics, Fountain University, Osogbo, Nigeria

ARTICLE INFO

Keywords:
Threshold-GVAR
Financial markets
COVID-19

ABSTRACT

In this study, we offer a global perspective on the impacts of the COVID-19 pandemic on financial markets using a multi-country Threshold-Augmented Global Vector Autoregressive Model of Chudik et al. (2020). We document a negative impact of the pandemic on real equity prices across countries (except the United States) and country groupings with the highest negative impact recorded in 2020Q2. The biggest losers are the emerging economies while the biggest gainers are the United States whose real stock prices remain positive and the Euro Area that achieved real exchange rate appreciation when the financial markets were mostly vulnerable. Our results support the effectiveness of the quantitative easing policy regime in the Euro Area during the COVID-19 pandemic and also suggest hedging role for the US stocks among other suggested safe assets.

1. Introduction

This study contributes to the existing knowledge with a multi-country analysis of the impacts of COVID-19 pandemic shock on the global financial markets such as the global equity and foreign exchange markets. The addition to knowledge transcends the existing sectoral, countrywide, or regional analysis where the pandemic has been shown to affect financial assets chiefly by raising financial market risks, volatility, and uncertainty.1 The major conclusion from these studies is that the global financial markets experienced significant dip and that the negative effects of the pandemic vary among markets in developing, emerging and advanced economies. The striking finding of Belaid et al. (2021) indicates that the COVID-19 pandemic increased crisis spillovers between advanced and emerging stock markets with further evidence that the European stock markets are the primary transmitter of shock to other regional stock markets. On the foreign exchange market,2 findings from Wei et al. (2020) suggest increased uncertainty risks in the global forex

* Corresponding author at: College of Business Administration, University of Nebraska at Omaha, 6708 Pine Street, Omaha, NE 68182, USA. E-mail addresses: rangan.gupta@up.ac.za (R. Gupta), mwohar@unomaha.edu (M.E. Wohar).

1 See Duttillo et al. (2020), Harjoto et al. (2020), Ji et al. (2020), Narayan (2020a&b), Narayan et al. (2020a&b), Salisu et al. (2020,2021a), Seven and Yilmaz (2020), Stepahanos et al. (2020), Zhang et al. (2020), Haldar & Sethi (2021), Milcheva (2021), Ozkan (2021), Scherf et al. (2021), Ozkan (2021), Kinateder et al. (2021), among others.

2 Studies such as Urbschat & Watzka (2020), Devpura (2021), Feng et al. (2021) and Tanin et al (2021) also show that the COVID-19 pandemic contributed to the instability of the exchange rates and increased uncertainty of international investment environment.
markets in the aftermath of the pandemic with particular rise in spillover of shocks among the Renminbi and the regional Belt and Road (“B&R”) currencies.

We however differ from the extant literature on the impact analysis of the COVID-19 pandemic in two ways. First, we consider a multi-country study where we highlight the impacts of the pandemic for both real equity prices and real exchange rates from a global perspective covering both the emerging and developed economies including the Euro Area, Advanced Economies, Emerging Economies, and Asia Pacific Economies. This attempt offers a broader perspective that allows for meaningful comparisons of financial markets’ responses to the pandemic across the globe and thus investors, particularly intentional portfolio investors, gain better insights into how vulnerable financial markets have been amidst the pandemic and identify where safe investments can be made during this period.

The second contribution lies in the predictability analysis of the counterfactual outcomes of real stock returns and exchange rate over the 2020Q1–2021Q4 pandemic period in relation to the pre 2019Q4 levels. The counterfactual analysis is relevant for this study as it is considered ideal to explore the impact of the introduction of a policy like the adoption of quantitative easing in the United Kingdom in 2009 (see Pesaran and Smith, 2016) or an emergency event like the COVID-19 pandemic (see Feng and Li, 2021). Also, this study is more amenable to counterfactual analysis rather than the use of techniques involving historical data given the stylized fact in the literature showing that financial market uncertainty rose to levels previously unmatched during past financial crises episodes including the Global Financial Crisis (GFC) (Baker et al., 2020). This study is however an improvement on Feng & Li (2021) who also adopt counterfactual analysis and find that the negative impact of COVID-19 on the Chinese stocks exceeds that of the Severe Acute Respiratory Syndrome (SARS) (another variant of corona virus). We situate the study within the Threshold-Augmented Global Vector Autoregressive (TGVAR) framework of Chudik et al. (2020), which is an improvement on the standard multi-country model of Chudik and Pesaran (2016) and Chudik et al. (2016). The former is specifically developed for COVID-19-related counterfactual analysis and we provide its technical details in the immediate section. In the end, the contribution allows us to assess the effectiveness of policy responses put in place by countries to combat the pandemic. We follow this section with the methodology in Section 2. Section 3 discusses the findings and Section 4 presents the conclusion.

2. Methodology

2.1. Model specification issues

We employ the global vector autoregression model with threshold effects (TGVAR) proposed in Chudik et al. (2020) for the counterfactual analysis of the cross-country impacts of the COVID-19 pandemic on financial markets. We begin our specification with the standard GVAR model in Eq. (1):

\[ z_t = \alpha_i + \Phi_i z_{t-1} + B_i z_{t-1}^* + A_0 g_t + A_1 g_{t-1} + u_t; \]

\[ i = 0, 1, 2, \ldots, n; t = 1, 2, \ldots, T \]

where \( z_t \) is the vector of domestic variables with dimension \( k_t \) across the \( n \) countries, that is, \( z_t = (\Delta y_{it}, \Delta r_{it}, \Delta e_{it}, \Delta e_{gpt})' \) with the corresponding variables defined as the log of real gross domestic product (\( y_{it} \)), nominal long-term interest rate (\( r_{it} \)), log of real equity prices (\( e_{it} \)), and log of real exchange rates (\( e_{gpt} \)). \( \Delta \) represents first differences in the variables, while the United States is the reference country and it is indexed as \( i = 0 \). Also note that \( z_{it}^* \) is the vector of weakly exogenous foreign variables constructed as trade-weighted counterparts of the domestic variables: \( z_{it}^* = (\Delta y_{it}^*, \Delta r_{it}^*, \Delta e_{it}^*, \Delta e_{gpt}^*)' \) such that \( z_{it}^* = \sum_{j=1}^{n} w_{ij} z_{it}, w_{ij} [w_{ii} = 0, \sum_{i=0}^{n} w_{ij} = 1] \) is the weighting matrix obtained from the IMF Direction of Trade flows data; \( g_t \), which are not country-specific, are the global variables that capture observed external factors.

In order to capture the intent of this study, we augment the model with the unobserved global factors, \( \tilde{z}_t = (\Delta y_{it}^*, \Delta r_{it}^*, \Delta e_{it}^*, \Delta e_{gpt}^*)' \) and threshold effects, \( h_t = \{ (1) \} \), which represent structural shifts due to the COVID-19 pandemic:

\[ \tilde{z}_t = \alpha_i + \Phi_i \tilde{z}_{t-1} + B_i \tilde{z}_{t-1}^* + A_0 f_t + A_1 f_{t-1} + \lambda h_{t-1}(\gamma_t) + u_t \]  

(2)

where \( \tilde{z}_t \) is the unobserved vector of global factors which are obtained by weighting the observables \( z_t = (\Delta y_{it}, \Delta r_{it}, \Delta e_{it}, \Delta e_{gpt})' \) with the GDP purchasing power parity weights \( (\tilde{w}_t) \) across the countries of the domestic variables \( \tilde{z}_t = \sum_{i=0}^{n} \tilde{w}_i z_{it} \); \( \lambda h_{t-1}(\gamma_t) \) indicates the threshold effect where \( h_{t-1}(\gamma_t) = I((0, 1) \gamma_t - > \gamma) = I(\gamma_t > 1) \); \( \gamma_t \) is the global stock market volatility is the threshold variable.

In the specification of Eq. (2), between 1979Q2 and 2019Q4, the reduced form shock (\( u_t \)) can be decomposed as in Eq. (3) while shock between 2020Q1 and 2020Q4 split in Eq. (4) as follows:

---

3 This framework is rooted in the conventional global vector autoregression (GVAR) approach of Pesaran et al. (2004), Chudik & Pesaran (2016), Chudik et al. (2016), Mohaddes & Raisi (2020), and others. The conventional GVAR toolbox (see Smith & Galesi, 2014) fits together several country specific VAR models containing domestic, foreign and weakly exogenous global factors.

4 The observable global factors are international crude oil prices (expressed in log returns) (\( \Delta oil \)) and the measure of global stock markets volatility(\( \gamma_t \)).
more the real global equity prices and real exchange rates may have been influenced by the pandemic. These disruptions to world output and trade would not only impact stock markets negatively (see Narayan et al., 2020b) but also affect some drivers of real exchange rate disequilibrium (international investment position, exchange rate volatility and capital flows) (see Narayan, 2020; Narayan et al., 2020a). Hence, we find out by how much the real global equity prices and real exchange rates may have been influenced by the pandemic.

We report generalized impulse response functions (GIRFs) for different panels: World, advanced economies (Euro Area & Advanced Asia-Pacific Countries) and emerging economies (Emerging Economies & Emerging Asia less China to remove the effect of outlier) (see Fig. 1a). We also produce impulse responses for the individual countries (see Table 2 and the appendix). As expected, the pandemic has negative effects on the global equity markets throughout the forecast horizon and the decline in global real equity prices became most severe in the second period (h = 2) equivalent to 2020q2. In the advanced economies, the biggest negative impacts of the pandemic

\[ u_t = \Psi e_t + \eta_t \]
\[ u_{T+q} = \sigma_{T+q} + \Psi e_{T+q} + \eta_{T+q} \]

where \( e_t \) is the global shock, \( \eta_t \) represents the idiosyncratic shock, \( \sigma_{T+q} \) is the COVID-19 pandemic shock over the period of 2020Q1 to 2020Q4.

2.2. Data

The full description of the data is contained in the Mohaddes and Raissi (2020) paper which presents the GVAR updated database. The global model comprises thirty-three (33) countries nicely connected by trade linkages (see Table 1 for the list of countries). In this study, we focus on the real equity prices and real exchange rate among the four domestic variables in the TGVAR model. The log of real equity price (eq_a) is computed as LN(Equity_{it}/CPI_{it}) where LN denotes natural logarithm and Equity_{it} is the nominal equity price deflated by consumer price index(CPI_{it}). The real exchange rate (ep_a) is computed as the multiplication of bilateral nominal exchange rate (EXRA) and the ratio of foreign consumer prices and domestic consumer prices, that is, ep_a = LN[EXRA_{it} * (CPI_{it} / CPI_{d})] and the US dollar is the reference currency.\(^5\) In whole, the estimation covers the pre-pandemic (1979Q2 to 2019Q4) and the pandemic (2020Q1–2021Q4) periods where 2020Q1 data involves the growth forecast revisions of IMF in order to identify the COVID-19 shock for the counterfactual analysis (see Chudik et al., 2020).

3. Results and discussion

As previously noted, we conduct counterfactual analyses in line with the threshold global VAR framework of Chudik et al. (2020)\(^6\) to isolate the impacts of the COVID-19 shock on real equity prices and real exchange rates. Theoretically, we would expect negative effects of the pandemic on the global equity markets given the negative impacts of the pandemic on global output (see Caggiano et al., 2020) and similar negative implication on the global trade (see Feng et al., 2021). For instance, Caggiano et al. (2020) show a 14% cumulative drop in global output due to the pandemic. Similarly, Feng et al. (2021) document an 18.5% decline in global trade for 2020Q2 based on year-on-year comparison with 20219Q2. These disruptions to world output and trade would not only impact stock markets negatively (see Narayan et al., 2020b) but also affect some drivers of real exchange rate disequilibrium (international investment position, exchange rate volatility and capital flows) (see Narayan, 2020; Narayan et al., 2020a). Hence, we find out by how much the real global equity prices and real exchange rates may have been influenced by the pandemic.

We report generalized impulse response functions (GIRFs) for different panels: World, advanced economies (Euro Area & Advanced Asia-Pacific Countries) and emerging economies (Emerging Economies & Emerging Asia less China to remove the effect of outlier) (see Fig. 1a). We also produce impulse responses for the individual countries (see Table 2 and the appendix). As expected, the pandemic has negative effects on the global equity markets throughout the forecast horizon and the decline in global real equity prices became most severe in the second period (h = 2) equivalent to 2020q2. In the advanced economies, the biggest negative impacts of the pandemic

\(^5\) The nominal exchange rates represent the prices of the (advanced & emerging) currencies in relation to the US dollar (USD). A decline (increase) in the bilateral exchange rate represents appreciation (depreciation) of the domestic currency in question relative to the USD. On the other hand, the real exchange rate measures the values of basket of goods in the advanced & emerging countries in relation to the US. By implication, if for instance, the real exchange rates are higher (lower) in emerging economies, it implies that basket of goods is costlier (cheaper) in the countries relative to the US. This divergence in the real exchange rates (between the countries and the US) would cause the overvalued (undervalued) emerging countries’ currencies to depreciate (appreciate) to restore the real exchange rates disequilibria.

\(^6\) The results of the threshold effects are available in Chudik et al. (2020).
also came in 2020Q2 where the real equity prices of the Euro Area declined by 70% and the Advanced Asia Pacific by 120%. The movers of the COVID-19 pandemic shock among the advanced economies appear to be Norway whose real equity price fell by 178.5%, Austria, Finland, and Spain in the Euro Area with decline of 133.7%, 117.9% and 97.7% respectively. The Asia Pacific are the hardest hit among the advanced economies with Korea & Japan (−189.9% & −101.2% respectively) being the biggest shakers in the region. Comparatively, the emerging stock markets are the worst hit compared with the advanced. The biggest pandemic shock impacts in emerging economies were recorded in Argentina (−175.2%), and Emerging Asia (India, −162.2% and Thailand, −142.3% in 2020Q2).

We attribute the lesser negative impact of the pandemic on advanced economies to the effectiveness of the adoption of both unconventional monetary policy and fiscal policy implemented in these economies relative to their emerging counterparts (see Chudik et al., 2021; Padhan and Prabheesh, 2021). In all, we highlight some hedging role for the US stocks – the only market whose prices...
Credit conditions, and exchange rate appreciation (Urbschat and Watzka 2020). Interestingly, the deployment of the unconventional monetary policy appears to pay off given that all the countries in the Euro Area experienced real exchange rate appreciation at the lowest ebb of financial markets in 2020Q2 (see also Chudik et al., 2021; Padhan and Prabheesh, 2021). Nonetheless, the estimated model which does not take cognizance of the unconventional monetary and fiscal policies fully adopted in the advanced economies appears to predict that the stock markets may not fully recover from the pandemic shock whereas, the real exchange rate disequilibrium between the Euro and the US dollar would be corrected to pre-2019Q4 levels (see Figs. 2a & b).

4. Conclusion

This study investigates the impact of the COVID-19 pandemic, occasioned by the spike in global financial market volatility, on the real equity prices and real exchange rates using the TGVAR framework of Chudik et al. (2020). The large country and large regional...
cases considered comprise the Euro Area, advanced economies, emerging economies excluding China, emerging Asia without China and the Asia-Pacific economies. We produce generalized impulse responses from the TGVAR model to trace the impact of the pandemic and assess the possibility or otherwise for the relevant variables to revert to their pre-2019Q4 (i.e. pre-COVID) equilibria.

We show that the pandemic has widespread negative impacts on the global real equity prices across the different country groupings. A striking discovery from the analysis is that the greatest negative impact of the pandemic is reported on global output, global trade, and global stock markets in 2020Q2. The advanced Asia-Pacific countries are the worst hit among advanced economies with 110% decline in 2020Q2 while the overall losers are the emerging countries with emerging economies (less China) suffering by 140% and emerging Asia (less China) declining by 150%. We attribute the lesser negative impacts of the pandemic on the advanced countries to the deployment of unconventional monetary policy and fiscal policies. Our results specifically highlight the effectiveness of these policies in the Euro Area (particularly due to the European Central Bank’s unconventional monetary policy) where all the eight

![Counterfactual analysis of the Impact of COVID-19 on real exchange rates (percent deviation from baseline).](image-url)
countries achieved real exchange rate appreciation (and the ability to revert to pre-pandemic levels) despite the financial markets being at the lowest ebb in 2020Q2. An updated multi-country impact analysis of the COVID-19 shock covering different waves, would further enrich the outcome of this study and in particular offer greater insights into how individual countries have sustained their...
Fig. 2b. Dynamics of Real Exchange Rates Following the COVID-19 Shock (in logs; 2019Q4=1).
response to the pandemic.

Author Statement

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address which is accessible by the Corresponding Author and which has been configured to accept email from biomaterials@elsevier.com.

CRediT authorship contribution statement

Afees A. Salisu: Conceptualization, Methodology, Software, Formal analysis, Writing – original draft, Writing – review & editing. Taofeek O. Ayinde: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. Rangan Gupta: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. Mark E. Wohar: Validation, Writing – original draft, Writing – review & editing.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.frl.2021.102519.

References

Baker, S.R., Bloom, N.A., Davis, S.J., Terry, S.J., 2020. COVID-Induced Economic Uncertainty. NBER Working Paper No. 26983.
Belaid, F., Ben Amar, A., Goutte, S., Guesmi, K., 2021. Emerging and advanced economies markets behaviour during the COVID-19 crisis era. Int. J. Finance Econ. 1–19.
Caggiano, G., Castelnuvo, E., Kima, R., 2020. The global effects of COVID-19-induced uncertainty. Econ. Lett. 194, 109392.
Chudik, A., Pesaran, M.H., 2016. Theory and practice of GVAR modeling. J. Econ. Surv. 30 (1), 165–197.
Chudik, A., Grossman, V., Pesaran, M.H., 2016. A multi-country approach to forecasting output growth using PMIs. J. Econom. 192 (2), 349–365.
Chudik, A., Mehdi, R., Mohaddes, K., Pesaran, M.H., Rebucci, A., 2020. A Counterfactual Economic Analysis of COVID-19 Using a Threshold Augmented Multi-Country Model. CEPR Discussion Papers 15312, C.E.P.R. Discussion Papers.
Chudik, A., Mohaddes, K., Raisi, M., 2021. COVID-19 fiscal support and its effectiveness. Econ. Lett. 205, 109939.
Devpura, N., 2021. Effect of COVID-19 on the relationship between Euro/USD exchange rate and oil price. MethodsX 8, 101262. https://doi.org/10.1016/j.ame.2021.101262.
Duttilo, P., Gattone, S.A., Di Battista, T., 2020. Volatility modelling: an overview of equity markets in the euro area during COVID-19 pandemic. Mathematics 9, 1212. https://doi.org/10.3390/math9111212.
Feng, G., Feng, H., Gong, Q., Chang, C., 2021. What is the exchange rate volatility response to COVID-19 and government interventions? Econ. Anal. Policy 69, 705–719.
Feng, Y., Li, X., 2021. Causal estimation of COVID-19 and SARS on China’s stock market: evidence from a time series counterfactual prediction. Econ. Res. https://doi.org/10.1080/1331677X.2021.1910533.
Harjoto, M.A., Rossi, F., Lee, R., Sergi, B.S., 2020. How do equity market reacts to COVID? Evidence from emerging and developed countries. J. Econ. Bus. https://doi.org/10.1016/j.jeconbus.2020.105966.
Ji, Q., Zhang, D., Zhao, Y., 2020. Searching for safe-haven assets during the COVID-19 pandemic. Int. Rev. Finance. Anal. 71, 101526.
Kinasteder, H., Campbell, R., Choudhury, T., 2021. Safe haven in GFC versus COVID-19: 100 turbulent days in the financial markets. Finance Res. Lett., 101951
Micheva, S., 2021. Volatility and the cross-section of real estate equity returns during COVID19. J. Real Estate Finance Econ. https://doi.org/10.1007/s11146-021-09840-6.
Mohaddes, K., Raisi, M., 2020. Compilation, Revision and Updating of the Global VAR (GVAR) Database, 1979Q2-2019Q4. University of Cambridge: Judge Business School (mimeo).
Narayan, P.K., 2020c. Has COVID-19 changed exchange rate resistance to shocks? Asian Econ. Lett. 1 (1) https://doi.org/10.46557/001c.17389.
Narayan, P.K., 2020a. Did bubble activity intensify during COVID-19? Asian Econ. Lett. 1 (2) https://doi.org/10.46557/001c.17654.
Narayan, P.K., 2020b. How has COVID-19 changed exchange rate resistance to shocks? Asian Econ. Lett. 1 (1) https://doi.org/10.46557/001c.17389.
Narayan, P.K., Phan, D.H.B., Liu, G., 2020a. COVID-19 lockdowns, stimulus packages, travel bans, and stock returns. Finance Res. Lett. 38, 101732 https://doi.org/10.1016/j.frl.2020.101732.
Narayan, P.K., Phan, D.H.B., Liu, G., 2020b. COVID-19 lockdowns, stimulus packages, travel bans, and stock returns. Finance Res. Lett. 38, 101732 https://doi.org/10.1016/j.frl.2020.101732.
Ozkcan, O., 2021. Impact of COVID-19 on stock market efficiency: evidence from developed countries. Res. Int. Bus. Finance 58, 101445.
Padhan, R., Prabheesh, K.P., 2021. The economics of COVID-19 pandemic: a survey. Econ. Anal. Policy 70, 220–237.
Pesaran, M.H., Smith, R.P., 2016. Counterfactual analysis in macroeconometrics: an empirical investigation into the effects of quantitative easing. Res. Econ. https://doi.org/10.1016/j.res.2016.01.004.

Pesaran, M.H., Schuermann, T., Weiner, S.M., 2004. Modeling regional interdependencies using a global error-correcting macroeconometric model. J. Bus. Econ. Stat. 22 (2), 129–162.

Salisu, A.A., Ebuh, G.U., Usman, N., 2020. Revisiting oil-stock nexus during COVID-19 pandemic: some preliminary results. Int. Rev. Econ. Finance 69, 280–294.

Salisu, A.A., Ogbonna, A.E., Oloko, T.F., Adediran, I.A., 2021a. A new index for measuring uncertainty due to the COVID-19 pandemic. Sustainability 13, 3212. https://doi.org/10.3390/su13063212.

Salisu, A.A., Raheem, I.D., Vo, X.V., 2021b. Assessing the safe haven property of the gold market during COVID-19 pandemic. Int. Rev. Financ. Anal. 74, 101666.

Scherf, M., Matschke, X., Bieger, M.O., 2021. Stock market reactions to COVID-19 lockdown: a global analysis. Finance Res. Lett., 102245

Seven, U., Yilmaz, F, 2020. World equity markets and COVID-19: immediate response and recovery prospects. Res. Int. Bus. Finance. https://doi.org/10.1016/j.ribaf.2020.101349.

Smith, L.V., Galesi, A., 2014. GVAR Toolbox 2.0. Available at. https://sites.google.com/site/gvarmodelling/gvar-toolbox.

Stephanos, P., Athanassios, F., Dimitris, K., Dimitrios, D, 2020. Direct and Indirect Effects of COVID-19 Pandemic on Implied Stock Market Volatility: Evidence from Panel Data Analysis. University Library of Munich, Germany. MPRA Paper 100020.

Tanin, T.I., Sarker, A., Brooks, R., 2021. Do currency exchange rates impact gold prices? New evidence from the ongoing COVID-19 period. Int. Rev. Financ. Anal. 77, 101868.

Urbichat, F., Watzka, S., 2020. Quantitative easing in the Euro Area—an event study approach. Q. Rev. Econ. Finance 77, 14–36.

Wei, Z., Luo, Y., Huang, Z., Guo, K., 2020. Spillover effects of RMB exchange rate among B&R countries: before and during COVID-19 event. Finance Res. Lett. 37, 101782.

Yilmazkuday, H., 2021. COVID-19 and Monetary policy with zero bounds: a cross-country investigation. Finance Res. Lett. https://doi.org/10.1016/j.frl.2021.102103.

Zhang, D., Hu, M., Ji, Q, 2020. Financial markets under the global pandemic of COVID-19. Finance Res. Lett. 36, 101528.