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.
Natural resources rents and economic performance: Post-COVID-19 era for G7 countries

Tolassa Temesgen Hordofa\textsuperscript{a}, Song Liying\textsuperscript{a}, Nafeesa Mughal\textsuperscript{a}, Asma Arif\textsuperscript{b}, Hieu Minh Vu\textsuperscript{c,*,}\textsuperscript{,} Prabjot Kaur\textsuperscript{d}

\textsuperscript{a} School of Economics and Finance, Xī’ an Jiaotong University, Xī’ an, Shaanxi, China
\textsuperscript{b} Department of Economics, University of Wah, Wah Cantt, 47040, Pakistan
\textsuperscript{c} Faculty of Business Administration, Van Lang University, Viet Nam
\textsuperscript{d} Department of Mathematics, birla institute of technology Mesra, Ranchi, Jharkhand, India

\textbf{ARTICLE INFO}

Keywords:
Natural resources commodity prices
COVID-19
Economic performance

\textbf{ABSTRACT}

COVID-19 affected the economies of both developed and developing countries through multiple channels. However, the impact of this pandemic was also not so different for the developed world too. This study aims to evaluate the effect of the natural resources’ rents such as oil, natural gas and energy rents on the economic performance of G7 economies from 1990 to 2020. This study uses updated panel data methods to identify the effect of COVID-19 by using novel diagnostic and unit root methods. The study found that during the COVID-19 and post pandemic, economic performance has been declined. This study found that natural resources rent, including oil and gas, help to improve the economic performance. Further, structural break for the year 2019 caused by COVID-19 also slowed down the economic performance of G7 economies. This study suggests more stabilization policies towards natural resources commodity prices and encouragement of active role from the G7 countries. This study further provides relevant policy implications in the concluding section for the selected group of countries.

1. Introduction

Since the beginning of the 21st century, the world has faced many challenges that involve global financial crises of 2007–08, and the contagious disease of Covid-19 pandemic, among others. Where the former disturbed each and every economic, social, and environmental activities. Also, the natural resource commodities demand has been reported fluctuating with many downs and ups. The pandemic has expanded throughout the world’s economy, first in the industrialized nations and now reaching developing economies. It is undeniable that emerging economies are at a disadvantage throughout this procedure, not only because their health conditions and health services are not as advanced as those in industrialized countries but also because their macroeconomic conditions are not strong enough to resist such a long-term socioeconomic crisis (Demircan Çakar et al., 2021). Those nations are poorer and allocating resources to the health sector is difficult for them. Compared to emerging economies, the developed world has also been hit hard by the pandemic’s severe impacts. As a result of the global economy’s long-term lockdown and slowdown, all industrialized nations had a negative rate of economic growth in the following years (Demircan Çakar et al., 2021). However, the Covid-19 affects economic growth, adversely affects the financial market, and enhances inflation in the European Union (EU) economies (Erdogan et al., 2020a, 2020b).

This global economic and financial uncertainty significantly contributes to natural resource volatility, which could be crucial to micro and macroeconomic growth: household expenditures, corporate revenue, and even the national economy (Lin and Bai, 2021). For all the developing and developed countries, energy remains the essential factor of production, such as labor and capital. Also, energy use is among the basic factors determining economic growth and development (Adegboyega et al., 2021). The relationship between natural resources volatility and economic growth is important because it may cause a change in the macroeconomic policies and the level of welfare in a country. For instance, an increase in the natural resource commodity prices, the oil and gas prices in specific, could reduce the output in many ways (Yıldırım and Oztürk, 2014). Firstly, these oil and gas price shocks lead to lower aggregate demand, as the increase in the oil and gas price leads to redistribution of the income among the net oil importing and exporting nations.
economies. Secondly, the rise in oil and gas prices may reduce capital and labor productivity due to the allocated budget constraints of the firm. Thus, higher oil and gas prices lead to minimizing energy consumption. Moreover, this minimal energy consumption level precursors enhancement in unemployment due to real wage reduction (Federer, 1996). Hence, a real wages reduction contributes to unemployment and decreases the country’s real gross domestic product (GDP).

On the other hand, a decrease in oil prices declines production costs, further enhancing economic activities and promoting economic growth (Varayyan et al., 2014). This decline would significantly raise the stock market prices due to higher returns in the future (Filis, 2010). However, the current decline in oil, natural gas and other natural resources is primarily due to the outbreak of the Covid-19 pandemic. The recent pandemic and the subsequent global economic lockdowns have disturbed the supply chains and declined the aggregate demand globally (Vidya and Prabheesh, 2020). It is reported that a sharp reduction in the consumption of oil because of the lockdown environment drastically declined the prices of crude oil in the global market, specifically from US $ 61 in January to US $ 12 in April 2020 (Prabheesh et al., 2020).

Volatility has been observed in oil, natural gas and other natural resources, including gold, minerals, etc., due to the Covid-19 disruption. In this regard, how the Covid-19 affect the natural resources commodity price volatility, which influences economic growth in the most advanced economies.

This study aims to empirically investigate the long-run association between the volatility in natural resources commodity prices, including the oil rents, natural gas rents, total natural resources rents, and energy-related inflation, with the economic performance of the G7 economies. This investigation holds importance because no specific study found empirically examining the said variables, particularly for the G7 economies, while considering the Covid-19 pandemic. However, the current study analyzed the impact of volatility in the natural resources’ commodity prices in the pandemic period while identifying the specific structural breaks and introducing the dummy variable after the Covid-19 emergence.

Although there is extensive literature that covers natural resource and economic growth in the pre-Covid-19 pandemic period. However, this study is novel and contributes to the existing literature by threefold. Firstly, the extensive literature did not empirically investigate natural resources and economic performance in the pre and post-Covid-19 pandemic periods. Therefore, this study provides empirical evidence especially from the developed countries’ perspective. Secondly, this study specifically analyzes the mediating role of Covid-19 pandemic, which the earlier studies ignored. Thirdly, this study utilized the most updated dataset, providing policy insights favorable for overcoming this panic of economic and natural resources’ rents uncertainty. Moreover, this study holds more importance because it is one of the pioneering studies that provide empirical estimates and policy implications in the Covid-19 era while using the cross-sectionally augmented autoregressive distributive lags (CS-ARDL) model, augmented mean group (AMG) and common correlated effect mean group (CCEMG) estimators. Also, it is believed that the outcome of the current study will benefit future researchers, students, policy-makers, institutions, and academics concerning the natural resources commodity price volatility and economic performance from the G7 economies’ perspectives.

The rest of the study is organized as following. Section-2 provides an extensive review of the literature that uncovers the linkage between natural resources commodity prices and economic performance. Section-3 reveals the methodology and model specification. Section-4 discusses the obtained empirical results their interpretation. Lastly, Section-5 provides the conclusion and the policy implications based on the empirical findings.

2. Literature review

Most studies consider and discuss oil prices concerning natural resources volatility and economic performance, which holds importance in energy usage and economic growth. The literature extensively provides the influence of oil prices on the economic growth of different countries and regions. Such studies include Tahar et al. (2021), Lin and Bai (2021), Monye Michael and Omogbiya Shulammitie (2020), Guan et al. (2021), Adegboyega et al. (2021), Khan et al. (2021). These studies provide contradictory findings depends upon the nature and responsiveness of the countries or regions to oil price shocks.

One of the most recent studies concerning commodity prices and economic performance in commodity-dependent economies has been provided by Tahar et al. (2021) via employing a panel auto regressive distributed lag (ARDL) model to unveil the short-run and long-run symmetric effects. The empirical estimates show that the recent commodities boom effect between 2004 and 2014 varies from previous phenomena. This illustrates the learning effect from the earlier experiences. Besides, the non-linear ARDL estimates reveal that asymmetric effects exist for the commodity price shocks. In addition, the study provides evidence that positive changes exert greater influence on per capita income in the long run. At the same time, the negative shock affects only economic growth in the short run. At the same time, Lin and Bai (2021) studied oil prices and uncertainty in the economic policy for oil-importing and exporting economies. Employing the vector autoregressive framework, the study reveals that economic policy uncertainty fluctuates in response to oil price shocks, whereas the oil prices respond negatively to uncertain economic policies. Besides, the empirical findings suggest that the oil price shocks have a smaller fluctuation to economic policy uncertainty in the oil-importing economies than the oil-exporting economies. Similarly, in case of the Nigerian economy, Monye Michael and Omogbiya Shulammitie (2020) found a negative and significant association between oil prices and economic growth while analyzing the primary data with a sample of 320 respondents.

In addition, Guan et al. (2021) studied the natural resources commodity prices volatility and economic growth nexus for the top gold and oil-producing countries over the 2000–2020 period. Using the PMG and ARDL estimating approaches, the results asserted that the volatility of resources prices is harmful to economic growth in the long-run, in all the resource-dependent economies. However, in the short-run, the natural resources commodity prices volatility impact is inconsistent on economic growth. In continuation to the prior literature, Adegboyega et al. (2021) investigated oil prices, non-renewable energy, and economic performance for the case of Nigeria throughout 1980–2013. The study used ordinary least square (OLD) methodology and the unit root and cointegration tests and provided evidence concerning cointegration among economic growth, non-renewable energy consumption, and oil prices. However, in the short-run, natural gas and coal consumption do not influence real economic growth. Concerning the impact of natural resources commodity prices, i.e., oil prices, on the stock market development, Khan et al. (2021) investigated Pakistan’s time series data between 1985 and 2017. The study used a dynamic simulated ARDL estimator and revealed that oil prices, foreign direct investment (FDI), and remittances inflow positively contribute to stock market development, while exchange rate adversely affects the development of the stock market.

Concerning natural resources abundance, economic growth, and financial development, Erdogan et al. (2020c) investigated Next-11 economies between 1996 and 2016. The study concludes that financial deepening played a crucial role in mediating the positive influence of natural resources on economic growth. On the contrary, Veenen et al. (2021) reveal that economic growth negatively influences economic growth in Pakistan. However, unlike the empirical findings of Erdogan et al. (2020c), this study concludes that financial development does not play any significant role in transforming the negative impact of natural resources on economic growth. Using the second generation panel data methodology, Shabbaz et al. (2019a) unveil that natural resources significantly and positively affect economic growth in resource-abundant economies. However, resource dependence

T.T. Hordofa et al. Resources Policy 75 (2022) 102441
adversely affects economic growth of these regions over the period from 1980 to 2015. Besides, another study by Shahbaz et al. (2019b) investigated the US economy and provided contrary results. The estimated results conclude the validation of the resource curse hypothesis. However, oil prices and capitalization promote economic growth in the region. In addition, extensive literature provides contradictory results regarding the positive or negative influence of natural resources on economic growth. However, studies have also confirmed the influence of natural resources on environmental quality. Such studies include Umar et al. (2020), Ulucak and Danish Ozcan (2020), and Erdogan et al. (2021), which empirically demonstrates that both natural resources abundance and dependence significantly promote environmental degradation by enhancing carbon level and carbon footprints. Still, there is a contradiction in the empirical findings regarding the environmental effect of natural resources. In this regard, Danish Ulucak and Khan, 2020 analyzed BRICS economies over the period 1992–2016 and concluded that natural resources are playing a positive role in environmental sustainability.

One recent study by Shahbaz et al. (2021) investigated the long-run co-variability between economic policy uncertainty and oil prices in both developed and developing economies. The study analyzes monthly data covering the period from 1998M1–2018M12 and provides mixed results in different economies. That is, the long-run positive and negative associations between oil prices and economic policies are found among different countries from the selected group of countries. For the case of an oil exporting economy, i.e., Saudi Arabia, Cevik et al. (2021) examined oil prices, volatility spillovers and stock market return on the weekly data throughout 2001–2018. Using APARCH process, the study uncovers the bidirectional causal association among stock market performance and oil performance. Besides, a substantial spillover effect has been observed running from crude oil price volatility to stock market return. Besides the prior studies that signify the natural resource commodity prices and economic performance linkage, Rubaszek (2021) identified the forecasting of crude oil prices via dynamic stochastic general equilibrium (DSGE) and vector autoregression models. The results unveil that the oil sector DSGE model provides more efficient results at real oil price estimations than vector autoregression and random walk by following two principles as the author provided in the study.

Concerning natural resources abundance and human capital (HC) development role in economic growth, Rahim et al. (2021) examined next-eleven economies covering the period from 1990 to 2019 via employing augmented mean group estimator. The findings provide evidence of the presence of resource curse hypothesis in the selected group of countries. Besides, the study unveils that HC development, and the interaction of natural resources and HC helps promote economic growth significantly. The economic growth is not only limited to production and consumption, but also includes financial sectors development. In this regard, Jianqiang et al. (2020) examined the exacerbating impact of energy prices on resource curse for the G-7 economies between 1990 and 2017. The study used Common Correlated Effect Mean Group (CCEMG) methods along with the SC-ARDL and AMG approaches for robustness. The estimated results reveal those natural resources abundance promote financial development. However, the rise in energy prices negatively affect financial development expansion. Similarly, Hussain et al. (2020) re-examined the role of energy prices and political institutions in resource curse hypothesis in the BRICS economies throughout 1992–2016. The results are obtained through CS-ARDL and CCEMG estimators, which confirms the earlier findings of Jianqiang et al. (2020) that energy negatively affects while political institutions positively influence financial development.

Additionally, Algamdi et al. (2021) investigated the association among Covid-19 death cases and oil prices volatility for Saudi Arabia, covering the daily data from January 22 to June 14, 2020. The study used ARDL modelling and revealed that the Covid-19 deaths ratio negatively and significantly affects oil prices. However, the spillover effect from the situation reported in the USA reveals that the death ratio from Covid-19 positively influences oil prices.

Since the literature provided by the scholars is extensive, no such study was found that empirically investigates the linkage of the natural resources’ rents and economic performance specifically in the G7 economies. Besides, the said linkage also remained unexplored in the era of Covid-19. Also, no such study has been found that considered the natural gas rents, oil rents, total natural resource rents and the energy related inflation combinedly. Therefore, an empirical investigation has been required to fill this gap.

3. Methodology and model specification

3.1. Data and model specification

Based on the literature as previously mentioned, the current study considered gross domestic product (GDP) to measure economic performance and growth. As per Khan et al. (2020), GDP is the measure of the economy’s health, which considers various factors such as government expenditures, consumption, investment, and net exports. The variable GDP is taken as a constant 2010 US dollars unit. However, unlike other studies, the current study considers three variables that denote the natural resources commodity price in the Covid-19 pandemic. The natural resources commodity prices as the earlier studies only considered oil prices. Still, the three variables such as natural gas rents (NGR), total natural resource rents (TNR), and oil rents (ORR) are taken as the exogenous variables that thoroughly covers the natural resources commodity prices (Ma et al., 2021). All of these variables are taken as the percentage of GDP. The TNR covers the coal rents, mineral rents, and forest rents among other (Khan et al., 2020). Besides, the energy-related inflation, that is consumer price index of energy (CPIE), is also considered the exogenous variable to thoroughly examine the influence of natural resources commodity price on economic performance. Hence, the model could be constructed as following:

3.1.1. Model-1

\[ GDP_{it} = f(NGR_{it}, TNR_{it}, ORR_{it}, CPIE_{it}) \]

The Model-1 above reveals that economic performance is the function of natural gas rents, total natural resources rents, oil rents and energy related consumer price index. The variables GDP, NGR, TNR and ORR are obtained from the world development indicators (World Bank, 2021). However, the data for CPIE is obtained from the Organization of Economic Cooperation and Development (OECD, 2021). The data obtained from these sources cover the 31 years’ time span from 1990 to 2020 for the group of seven (G7) most developed economies, including Canada, France, Germany, Italy, Japan, the UK, and the US. The reason for selecting the G7 economies is that it is the most advanced and industrialized countries across the globe. Since developed nations are playing the leading role in global policy-making, investigating natural resources rents and economic performance, particularly in the Covid-19 pandemic period in these developed countries, could provide a pioneering policy implication. Such policies which could help recovering economic growth and mediating natural resources towards economic growth and performance would be expanded to the developing and emerging countries. Therefore, it is important to investigate the most industrialized economies in this global pandemic period.

The above general model could be transformed to a regression model as following Eq. (1).

\[ GDP_{it} = \beta_1 + \beta_2NGR_{it} + \beta_3TNR_{it} + \beta_4ORR_{it} + \beta_5CPIE_{it} + \epsilon_{it} \]

The above Eq. (1) reveals that GDP is the dependent variable, while NGR, TNR and CPIE are the exogenous variables. Where represents the intercept of the model and \( \beta_2, \beta_3, \beta_4, \) and \( \beta_5 \) provides the coefficient value for NGR, TNR, ORR and CPIE, respectively. Besides, the ‘\( \epsilon \)’ and
“\( t \)” in the subscript indicate the cross-section and time series, while “\( e \)” represents the error term of the model. Additionally, current study aims to investigate the natural resources commodity price volatility specifically in the Covid-19 pandemic period; therefore we include the dummy variable that indicates the volatility or behavior of the natural resources’ commodity prices, particularly in the period. Hence, the above Eq. (1) could be written by including the dummy variable as following Eq. (2):

\[
GD_{i,t} = \beta_1 + \beta_{2N}GR_{i,t} + \beta_{3T}TN_{i,t} + \beta_{4O}RR_{i,t} + \beta_{5}CPI_{i,t} + \beta_{6}D_{2019,t} + \epsilon_{it}
\]

(2)

where \( D_{2019} \) reveals the dummy variable for Covid-19 and afterward. The \( \beta_k \) is the slope coefficient for \( D_{2019} \).

The adoption of data for the selected 31 years reveals the most updated dataset available. However, prior to 1990, there is issue of the data availability. Besides, the adopted dataset covers both the pre and post-Covid-19 pandemic periods, which is according to the aims and objective of the study.

### 3.2. Estimation strategy

After specifying the regression model as given Eq. (1) and (2), the current study uses various panel estimation approaches based on data characteristics. As this study adopted G7 economies over the prementioned time period, which is a panel dataset, therefore the estimation techniques would purely depend upon the panel data approaches. Based on the data specifications, we will first check the slope coefficient heterogeneity and cross-section dependence, which are the major issues in panel data. Afterward, the unit root will be tested and if the data is of mixed order, then a specific estimation approach is preferred in this case, such as the CS-ARDL, which provides both short-run and long-run results with the speed of adjustment towards equilibrium. Furthermore, to validate the long-run findings of CS-ARDL, this study used the long-run estimators including AMG and CCEMG. If the results of the CS-ARDL are confirmed, then it is important to test for the causal association between the dependent variable and independent variables. Specifically, these approaches are discussed below.

#### 3.2.1. Slope coefficient homogeneity and cross-section dependence test

Our empirical analysis begins with the assessment of slope coefficient homogeneity (SCH) and the cross-section dependence test. Since the industrial revolution and international trade, globalization opens the doors for free trade, which increase the partial or total dependence of one country on other countries for numerous economic, financial, political, and environmental reasons. However, dependence of one country on other countries results in similarity in some respects, while differentiate in some other features. However, these countries, if possessing the homogenous characteristics may provide biased results while empirically analyzing them. In this regard, the current study assessed the slopes heterogeneity of the selected panel economies, i.e., G7, to avoid biased estimates. Hence, we employed the Pesaran and Yamagata (2008) SCH test across the G7 economies. The said test generally provides both the SCH and adjusted slopes coefficient homogeneity (ASCH) estimates. Moreover, the Pesaran and Yamagata (2008) SCH test claims that the slopes are homogenous across the panel as null hypothesis. However, this hypothesis could be accepted if the estimated outcomes are insignificant and could be rejected otherwise. Both the SCH and ASCH tests could be presented in the final form as following in Eq. (3) and (4), respectively:

\[
\hat{\Delta}_{SCH} = \sqrt{N} \left( 1 \over K \right) \left( N^{-1}S - K \right)
\]

(3)

\[
\hat{\Delta}_{ASCH} = \sqrt{N} \left( 1 \over 2K(T - 1) \right) \left( N^{-1}S - 2K \right)
\]

(4)

where the \( \hat{\Delta}_{SCH} \) and \( \hat{\Delta}_{ASCH} \) designate slope coefficient heterogeneity and the adjusted slope coefficient heterogeneity, respectively.

There are factors that increase the dependence of one country on other countries such as financial concerns, political matters, and economic policies, among others. However, these dependence factors may provide misleading and inconsistent results specifically in the panel data analysis (Campello et al., 2019). The issue of cross-section dependence is more common in the panel data. In this concern, we used the cross-section dependence (CD) test proposed by Pesaran (2004) to assess the cross-section dependence across the G7 economies. The null hypothesis of the Pesaran (2004) CD test is that the cross-sections are independent across the panel. Specifically, the said test assumed that there is no cross-section dependence among the countries under consideration. The equation form of the Pesaran (2004) CD test is provided as following Eq. (5):

\[
CD_{t} = \sqrt{N} \left( 1 \over N(N-1) \right) \sum_{t=1}^{N} \sum_{t=1}^{N} \sum_{i=1}^{N} T_{i}^t \epsilon_{i} \epsilon_{j}
\]

(5)

#### 3.2.2. Stationary test

Once the slope heterogeneity and cross-section dependency of the panel is tested, we test the stationarity or presence of the unit root in the data. Dealing with the data having both the time series and cross-sections must be stationary across the time, otherwise it may provide inconsistent results. In this regard, we used the second generation panel unit root test, i.e., Pesaran (2007) unit root test. Unlike Maddala and Wu (1999) and Levin et al. (2002), the Pesaran (2007) unit root test tackles the slope heterogeneity problem and also consider the cross-section dependence issue between the units (Khan et al., 2020a). Hence, dealing the issue of cross-section dependence and slopes heterogeneity the Pesaran (2007) approach invalidate the utilization of first generation unit root tests (Jalili, 2014).

#### 3.2.3. Cross-sectionally augmented ARDL model

After examining the stationarity of data via Pesaran (2007) unit root test, the estimated results provide mixed order of integration, i.e., the GDP is stationary at I(1), while other independent variables such as NGR, TNR, ORR and CPI are stationary at I(0). This mixed order allows current study to the cross-sectionally augmented autoregressive distributed lags (CS-ARDL) model, which is efficient in tackling mixed order data and provides both short-run and long-run estimates. The CS-ARDL approached is first proposed by Chudik and Pesaran (2015). Whether the data series is stationary at I(0), I(1), or both, and whether it is cointegrated or not, the CS-ARDL provides robust estimates (Okumus et al., 2021). Since this approach belongs to the CCE family, where the lag dependent term and lagged cross-section terms are taken into account. The CS-ARDL model is based on enhancing each cross-section of ARDL assessment using cross-sectional means which are proxies for unobserved common factors and their lags (Chudik et al. (2017). Additionally, this approach tackles the weak exogeneity issue, which is common while taking the lag dependent term in the model (Okumus et al., 2021). CS-ARDL can be obtained via the following regression:

\[
y_{t} = \theta_{1} + \sum_{i=1}^{n_{1}} \beta_{i1}y_{t-1} + \sum_{i=1}^{n_{2}} \beta_{i}x_{t-1} + \sum_{i=1}^{n_{3}} \phi_{i}z_{t-1} + \epsilon_{t}
\]

(6)

where in the above Eq. (6), \( y_{t-1} \) reveals the lagged cross-section means (\( \bar{y}_{t-1} \)), while the long-run mean group parameters could be computed as:

\[
\bar{\beta}_{i1} = \frac{1}{N} \sum_{i=1}^{N} \beta_{i1}
\]

\[
\bar{\phi}_{i} = \frac{1}{N} \sum_{i=1}^{N} \phi_{i}
\]
obtained via using the following Eq. (7):
\[
\hat{\theta}_{CS-ARDL,i} = \frac{\sum_{t=0}^{T/2} a_{ij}}{1 - \sum_{t=0}^{T/2} a_{ij}}, \quad \hat{\theta}_{MG} = N^{-1} \sum_{i=1}^{N} \hat{\theta}_{i}
\]

From the above equation, \(\hat{\theta}_{i}\) indicates individual estimation of each single cross-section. In addition, the CS-ARDL’s error correction term, which reveals the speed of adjustment in the model could be obtained by using the following model:

\[
\Delta y_{it} = \omega_t [y_{i,t-1} - \hat{\varphi}_{i}x_{i,t-1}] - \theta_t + \sum_{j=1}^{n} \beta_j \Delta y_{i,t-j} + \sum_{j=1}^{n} \beta_j \Delta x_{i,t-j} + \sum_{j=1}^{n} \varphi_j \Delta z_{i,t-j} + \epsilon_{it}
\]  

(8)

where in the above Eq. (8), \(\omega_t\) denotes the speed of adjustment (error correction). As per Chudik and Pesaran (2013), the CCE mean group approach is efficient in due to augmentation of lags, which enhance the power in terms of size and bias. However, there is a negative bias when the time period is less than 50 (T < 50). Therefore, to tackle biasedness of the sample, the authors proposed a split-panel jackknife approach provided by Dhaene and Jochmans (2015). However, this approach could be presented in equation form as following:

\[
\tilde{\Pi}_{MG} = 2\hat{\Pi}_{MG} - \frac{1}{2} \left( \hat{\Pi}_{MG} + \hat{\Pi}_{MG} \right)
\]

(9)

where \(\hat{\Pi}_{MG}\) represents the first half (t = 1, 2, ..., (T/2)) of CCEMG in time dimension and \(\hat{\Pi}_{MG}\) represents the second half (t = (T/2) + 1, (T/2) + 2, ..., T) of CCEMG, respectively. Moreover, this study considered the time-span of 31 years (i.e., T < 50). Thus, the bias corrected estimations of CS-ARDL will be presented in the study.

3.2.4. Long-run estimations and panel causality test

After empirically analyzing the short and long-run influence of natural resources rents on economic growth, this study further investigates the long-run coefficients to validate the findings of CS-ARDL. Scholars provide evidence that using the traditional approaches in the presence of cross-section dependence and slope heterogeneity issues may lead to biased and inconsistent estimation results (Coban and Topcu, 2015; Yao et al., 2019). In this regard, in the presence of slope heterogeneity and cross-section dependence, we employed the Augmented Mean Group (AMG) proposed by Eberhardt and Teal (2010) and Common Correlated Effect Mean Group (CCEMG) proposed by Pesaran (2006). Additionally, both the AMG and CCEMG efficiently perform the estimations even in the presence of non-stationarity and unobserved common factors (Khan et al., 2020a). The CCEMG considers the time-variant unobserved common factors with the heterogenous slope parameters and tackles the identification issue. Besides, it also equates both independent and dependent variables for each cross-section to eradicate the cross-section dependence’s caused spillover effect, not by just including the trends or time dummies (Liddle, 2018). This approach provides strong estimates to both the strong and weak factors for infinite and limited numbers with the global shocks, such as financial crises, oil price shocks, and/or local spillover effect (Chudik et al., 2011). Moreover, the AMG estimator is an alternative CCEMG approach, including year dummies, tackles the unobserved common factors, and deliberately considers it a common dynamic process (Eberhardt and Teal, 2010). Also, the AMG estimator considers the slope heterogeneity and cross-section dependence along with the structural breaks.

After testing the long-run coefficients via AMG and CCEMG, we also checked for the causal linkage between the selected variables. Hence, the current study employed the Dumitrescu and Hurlin (2012) Granger panel heterogeneous causality test. The said test provides efficient estimates when the time-series and cross-sections are not balanced, i.e., (T≠N). Moreover, the Dumitrescu and Hurlin (2012) Granger panel causality test also considers the panel data issues, including cross-section dependence and slope heterogeneity (Banday and Aneja, 2020).

4. Empirical results and discussion

We begin our analysis by providing the descriptive statistics in Table-1. This includes the mean values, median and minimum values for each variable under consideration. Specifically, the mean value for GDP is 4.39E\(^{-12}\), whereas the median value is reported as less than the mean value, accounted for 2.67E\(^{-12}\). This indicates that across the time, the economy reports growth as moving from 1990 towards 2020. Besides, the minimum value is reported as 9.91E\(^{-12}\) and the maximum value is accounted as 1.83E\(^{-11}\), this indicates that the G7 economies follow the growth trend in the 31 years span. Regarding the NGR, the mean value is reported greater than the median value. That is, the mean value is accounted for 0.162859 as a percentage of GDP and the median value is reported as 0.023744 as a percent of GDP. This leads to concludes that natural gas consumption is reported as increasing in the selected time span. Besides, the maximum and minimum values of the NGR is reported as 2.183876 and 0.00 percent of the GDP, which indicates that across the selected 31 years, the natural gas contribution to the GDP in the shape of rents increases.

Concerning the TNR, the mean value is greater than the median value of 0.627850 and 0.135007 percentage of the GDP. However, the maximum and the minimum values are reported as 5.007270 and 0.010885 as a GDP percentage, respectively. This means that similar to GDP and NGR, the TNR also follows the growing trend. In addition, the ORR carries the mean value of 0.309695 and 0.041031 as a percentage of the GDP. Also, the maximum and minimum values are reported as 2.618798 and 0.000512 as a percentage of GDP, respectively. The ORR values also indicate that the data follows the same trend as the GDP, NGR, and the TNR in the selected time span. Moreover, the energy related inflation, i.e., CPIE, indicates the opposite trend relative to the earlier variables. Specifically, the mean value of CPIE is found minimum than the median, accounted for 2.394624 and 2.401302. This means that the CPIE varies across time and is confronted with many fluctuations. Their maximum and the minimum values also show the volatility in the CPIE. The range of the CPIE indicates that the energy related inflation goes from the minimum value of –18.397210 to the maximum of 17.13092, which could also influence the economic activities. The main reason behind the fluctuation is structural breaks in the form of global shocks, including the oil price shocks, global financial crises and the recent contagious Covid-19 pandemic.

After discussing the descriptive statistics, the current study analyzed the slope homogeneity and the cross-section dependence. In this regard, the estimated results of the Pesaran and Yamagata (2008) SCH test and the Pesaran (2004) CD test are provided in Table-2. Concerning the Pesaran and Yamagata (2008) SCH test, the estimated results indicate that the SCH and ASPCH values are significant at 1%, 5%, and 10% levels. Therefore, the null hypothesis of the slopes coefficient being homogeneous could be rejected and the alternative could be accepted, which concludes that the slope coefficients are heterogeneous.

As globalization and international trade emerge, the barriers across the borders have vanished, promoting trade openness. Because of these reasons, the dependency of one country increases on other countries for supply and demands and different goods to achieve financial stability, economic growth, and others. The estimated results of the Pesaran

| Table-1 Descriptive statistics. |
|-------------------------------|
| **GDP** | **NGR** | **TNR** | **ORR** | **CPIE** |
| Mean  | 4.39E\(^{-12}\) | 0.162859 | 0.627850 | 0.023744 | 2.394624 |
| Median | 2.67E\(^{-12}\) | 0.023744 | 0.135007 | 0.041031 | 2.401302 |
| Maximum | 1.83E\(^{-11}\) | 2.183876 | 5.007270 | 2.618798 | 17.13092 |
| Minimum | 9.91E\(^{-11}\) | 0.000000 | 0.010885 | 0.00512 | –18.397210 |
in the G7 economies by 0.683 and 0.613% and 1% and 10% level of
the other hand, if there is a one percent increase in the TNR, CPIE and D-
performance by 0.362 and 0.011% at 1% and 5% levels, respectively. On
percent increase in the NGR and ORR significantly increases economic
performance in the G7 region. Specifically, a one
while TNR, CPIE, and the dummy for Covid-19 pandemic (D-2019)
reveal that the NGR, and ORR positively affect economic performance,
provided in the same table. Concerning the short-run estimates, results
estimating approach provides both the short-run and long-run results, as
both I(0) and I(1). This allows current study to employ the CS-ARDL

(2004) CD test delivers significant outcomes for all the variables at 1%,
5%, and 10%, levels. Thus, the null hypothesis of the under-discussion
test could be rejected, which reveals no cross-section dependence.
However, it is concluded that the panel data for the variable GDP, NGR,
TNR, ORR, and CPIE are cross-sectionally dependent.

After the SCH and CD testing, we provide the empirical results of the
stationarity test analyzed by employing the Pesaran (2007) test in
Table-3. The data has been tested on both the level ([I(0)]) data and the
first differenced ([I(1)]) data. Concerning I(0), all the exogenous variables
are found significant, revealing that the NGR and CPIE are significant at
1% level, and TNR and ORR are significant at 5% level. Hence, the
exogenous variables are found stationary at I(0). However, the GDP is
found significant at I(1) at 1% level. Thus, the GDP is also found sta-
tionary at I(1). As all the variables are found stationary at I(0) and I(1),
this allows us to estimate the cointegration association between the
variables under consideration.

As priorly mentioned, the stationarity test provides mixed order at
both I(0) and I(1). This allows current study to employ the CS-ARDL
approach and the estimated outcomes are provided in Table-4. This
estimating approach provides both the short-run and long-run results, as
provided in the same table. Concerning the short-run estimates, results
reveal that the NGR, and ORR positively affect economic performance,
while TNR, CPIE, and the dummy for Covid-19 pandemic (D-2019)
decline economic performance in the G7 region. Specifically, a one
percent increase in the NGR and ORR significantly increases economic
performance by 0.362 and 0.011% at 1% and 5% levels, respectively. On
the other hand, if there is a one percent increase in the TNR, CPIE and D-
2019 economic performance will significantly reduce by 0.142, 0.078,
and 0.130% respectively. Thus, the null hypothesis of the under-discussion
Model-1, NGR and ORR are found to influence economic performance positively. However, the TNR
and CPIE are found to affect economic performance adversely. Specif-
ically, a one percent increase in the NGR, the economic performance is
increased by 0.659 and 0.529% via AMG and CCEMG estimators,
respectively. Similarly, a one percent increase in the ORR increases the
economic performance by 0.0395 and 0.0595%, respectively. This in-
dicates that the natural gas rents and the oil rents are playing an important role in economic growth. Current findings are consistent to the
earlier findings of Khan et al. (2021). Concerning the TNR and CPIE,
both the AMG and CCEMG estimators provide similar impact of these
variables on economic performance. Specifically, a one percent increase in the TNR decreases economic growth by 0.485 and 0.286%, respec-
tively. Similarly, an increase of one percent in the energy related infla-
tion decreases economic performance by 0.142 and 0.150%, respectively.
All the results of the exogenous variables are found significant at 1%, 5% and 10% levels. The economic activities are industrial
sector mainly depends upon the energy prices. As revealed by the law of
demand, an increase in the prices of the commodity reduces its demand.
Thus, if the energy-related inflation increases, the industrial and
manufacturing sectors reduced the energy demand, which reduced
economic activities and adversely affected the country’s economic
growth.

After including the dummy variable, the Model-2, current study
employed both the AMG and CCEMG estimators, which reflect approx-
imately the same impact with a slight change in the coefficients’
magnitude, here, the impact of the NGR and ORR are found positive, while the influence of the TNR and CPIE are found negative. Although
the impact remains the same, still a minimal change in the magnitude
values have been observed. However, the results are found significant at
1%, 5%, and 10% level. Besides, the dummy variable for the Covid-19
(D-2019) indicates negative influence of the natural resources’
commodity prices on economic performance. The results of both AMG
and CCEMG provide a similar impact of Covid-19 on economic performance.
Specifically, a one percent increase in the Covid-19 accidents (including

| Table-2 | Diagnostic tests. |
|---------|------------------|
| **Slope Coefficients Test** | **Values** |
| **Statistics** | **Values** |
| Adjusted | 10.055*** |
| TNR | 10.949*** |
| CPIE | 16.752*** |
| GDP | NGR |
| NGR | 7.946*** |
| CPIE | 20.659*** |

Note: Significance of 1%, 5% and 10% is denoted by ***, ** and *.

| Table-3 | Stationarity check. |
|---------|------------------|
| **Variables** | **Trend and Constant** |
| **Level** | **First Difference** |
| GDP | 2.182 | 4.142*** |
| NGR | 3.078*** | 3.078*** |
| TNR | 2.851*** | 2.851*** |
| ORR | 3.303** | 3.303** |
| CPIE | 4.258*** | 4.258*** |

Note: Significance of 1%, 5% and 10% is denoted by ***, ** and *.

| Table-4 | CS-ARDL. |
|---------|---------|
| **Variables** | **Short – Run Coefficients** | **Long – Run Coefficients** |
| NGR | 0.362*** | 0.682*** |
| TNR | −0.143*** | −0.324* |
| ORR | 0.0112** | 0.0613* |
| CPIE | −0.078* | −0.103*** |
| D-2019 | −0.098** | −0.130*** |
| ECM(-1) | −0.892*** | −0.892*** |

Note: Significance of 1%, 5% and 10% is denoted by ***, ** and *.
cases, deaths, lockdowns, etc.), the natural resources commodity prices significantly reduce economic performance by 0.196 and 0.188%, respectively. The D-2019 findings are found significant at 1% level. This indicates that the Covid-19 pandemic is hazardous to human health and economic growth by converting the natural resources commodity prices affect into negative. Besides, the volatility in the natural resources commodity prices is negatively affecting economic growth.

Moreover, current study also examined the panel causal linkage between the variables under-consideration. The long-run estimates of the AMG and CCEMG identify each exogenous variable’s specific impact on the dependent variable. However, these tests do not provide any causal association that exists among the variables under study. In this regard, the estimated results of the Dumitrescu and Hurlin (2012) Granger panel causality heterogeneous test are provided in Table-6. The estimated results reveal that all the variables are found in bidirectional causal relationship. The p-value suggests that the values are significant at 1%, 5%, and 10% levels. Thus, it is important to note that any policy targeting NGR, TNR, ORR, and CPIE would significantly influence the economic performance in the G7 economies. Besides, the policies concerning economic growth also influence the volatility in the natural resources commodity prices. Therefore, the natural resources commodity prices hold importance concerning any policy change as it directly influences economic performance of the G7 economies.

5. Conclusion and policy implications

Since the G7 are the most advanced economies globally, any policy change in these economies greatly influences the countries’ policies in the rest of the world. As the Covid-19 pandemic outbreak affects each country across the globe. Hence, it is impossible to express that the advanced economies, specifically the G7, would not be affected. Besides, the locked-down environment in each country reduces economic activities and industrial manufacturing. This significantly reduces the demand for oil, natural gas, and other natural resources across the globe. Hence, reducing energy demand in the Covid-19 period would cause fluctuations in the natural resources’ rents. This volatility in the natural resources’ rents could also influence economic performance of the countries. In this regard, the current study investigates the volatility of natural resources and economic performance in both the pre and post-Covid-19 pandemic periods. In this concern, the current study investigates the panel data covering the period from 1990 to 2020 for the G7 economies. As both the cross-sectional and time-series data in consideration, therefore current study utilized panel data approaches, including the Pesaran and Yamagata (2008) SCH test, the Pesaran (2004) CD test, and the Pesaran (2007) panel unit root test. These tests confirm that the sloped coefficients are heterogeneous and cross-sectionally dependent. Moreover, the panel unit root test reveals that the data is of mixed order, i.e., the GDP is stationary at I(1), while TNR, NGR, ORR, and CPIE are found stationary at I(0). This mixed order of integration leads to the adoption of a suitable and efficient estimator.

Based on the mixed integration order of the data, this study utilized the CS-ARDL approach, which provides robust estimates while analyzing mixed order of data. The empirical findings of the said approach reveal that the NGR and ORR significantly and positively affect economic performance of the G7 region. While TNR, CPIE and D-2019 significantly reduce economic performance in the region in both the short-run and the long-run. Additionally, the ECM reveals that the model is approaching equilibrium at a speed of 89.2% each year. Moreover, this study also tested for the validity of long-run estimates. In this regard, the current study used appropriate long-run panel estimators such as the AMG and CCEMG. The findings of these approaches reveal that the natural gas and oil rents significantly contribute to economic performance, while the total natural resource rents and energy related inflation adversely affect economic performance of the G7 economies. Besides, a dummy variable for the Covid-19 pandemic unveils that volatility in the natural resources’ rents negatively and significantly affects economic performance of the G7 economies. The AMG and CCEMG estimates validate the findings of CS-ARDL in the long-run. All the results are found highly statistically significant. Moreover, the Dumitrescu and Hurlin (2012) Granger panel causality test illustrates a bidirectional causal association between the study variables. Specifically, the NGR, TNR, ORR, and CPIE granger causes GDP, while these variables’ feedback effect has also been observed. This further indicates that any policy change in the independent variable(s) would significantly cause changes in the dependent variable and vice versa.

Based on the empirical findings, the G7 economies, current study provides few practical policy implications that require instant attention for implementation to accommodate the economic growth and natural resources’ rents volatility in this Covid-19 pandemic period. Firstly, as the total natural resources negatively influence economic performance, the dependency on oil, natural gas, and other natural resources could be reduced by enhancing innovative and environmentally friendly technologies, contributing to economic growth and satisfying consumers’ needs. The empirical findings suggest that the energy related inflation

### Table-5
Long-run estimations.

| Variables | Coefficients$^{***}$ [Std.Error] | Coefficients$^{***}$ [Std.Error] | Coefficients$^{**}$ [Std.Error] | Coefficients$^{*}$ [Std.Error] |
|-----------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| NGR       | 0.659*** [0.1721]               | 0.529*** [0.1920]               | 0.663*** [0.1923]               | 0.351** [0.177]                |
| TNR       | -0.485*** [0.1531]             | -0.286*** [0.0672]             | -0.482*** [0.1045]             | -0.303*** [0.066]              |
| ORR       | 0.0395*** [0.0062]             | 0.0595*** [0.0056]             | 0.0404*** [0.0052]             | 0.141*** [0.0372]              |
| CPIE      | -0.142*** [0.0221]             | -0.150*** [0.0241]             | -0.192*** [0.00241]            | -0.104*** [0.0221]             |
| D-2019    | -12.40*** [0.1235]             | 11.412*** [0.1524]             | 12.403*** [0.1239]             | 11.462*** [0.2361]             |

Note: Significance of 1%, 5% and 10% is denoted by $^{***}$, $^{**}$ and $^{*}$.

Dumitrescu-Hurlin causality check.

| $H_0$ | WaldStats | $z_{stats}$ | $P_{vals}$ |
|-------|-----------|-------------|------------|
| NGR - GDP | 5.920 | 4.817 | 0.000 |
| GDP - NGR | 4.770 | 2.866 | 0.004 |
| TNR - GDP | 6.130 | 4.370 | 0.000 |
| GDP - TNR | 5.845 | 4.055 | 0.000 |
| ORR - GDP | 4.560 | 2.633 | 0.008 |
| GDP - ORR | 5.011 | 4.188 | 0.000 |
| CPIE - GDP | 3.753 | 1.739 | 0.082 |
| GDP - CPIE | 4.810 | 4.410 | 0.000 |

Note: Significance of 1%, 5% and 10% is denoted by $^{***}$, $^{**}$ and $^{*}$. 
could adversely affect economic performance: thus, it is essential to lower the prices for better economic performance and manage volatility to maintain higher economic performance. Additionally, natural resources hedging could be beneficial in tackling volatility in the natural resources and their prices. Therefore, policies must be revised that could consider natural resources hedging in both the short-term and long-term. Also, the price ceiling and price freezing policies could help maintain the positive contribution of natural resources rents to economic performance. Besides, as empirically revealed that the Covid-19 pandemic moderates the negative effect of natural resources rents on economic performance, immediate precautionary measures should be adopted to tackle the issue. Moreover, the research and development investment could be improved, which would help transmit the natural resources’ dependency towards efficient energy sources. This would lead both the environment and economy towards sustainable development.

Credit author statement

Tolassa Temesgen Hordofa: Supervision, Project administration, Funding acquisition. Song Liying: Formal Analysis, Conceptualisation. Miss Nafeesa Mujtaba: Conceptualisation, Data Curation. Miss Asma Arif: Methodology, Software, Formal Analysis. Mr. Hieu Minh Vu: Writing final draft, data curation. Miss Prabjot Kaur: Methodology, Software, Proof reading.

References

Adegbuyega, O.S., Abee, O.O., Mathew, A.A., 2021. Non-renewable energy, oil prices and economic performance in Nigeria. Int. Eur. Ext. Enabler Sci. Eng. Manag. 9, 27–50.

Algamb, A., Brita, S.K.M., Musa, A., Chergui, K., 2021. COVID-19 deaths case impact on oil prices: probable scenarios on Saudi Arabia economy. Frontiers in Public Health 9, 6. https://doi.org/10.3389/fpubh.2021.620875.

Banday, U.J., Anjra, B., 2020. Renewable and non-renewable energy consumption, economic growth and carbon emission in BRICS: evidence from bootstrap panel causality. Int. J. Energy Sect. Manag. 14, 248–260. https://doi.org/10.1108/IJESM-02-2019-0007.

Campello, M., Galvao, A.F., Juhl, T., 2019. Testing for slope heterogeneity bias in panel data models. J. Bus. Econ. Stat. 37, 749–760. https://doi.org/10.1080/07350015.2017.1421545.

Cevik, E.I., Dibooglu, S., Abdallah, A.A., Al-Eisa, E.A., 2021. Oil prices, stock market returns, and volatility spillovers: evidence from Saudi Arabia. Int. Econ. J. Econol. Pol. 18, 157–175. https://doi.org/10.1007/s10620-004-0084-0.

Chudik, A., Mohaddes, K., Pesaran, M.H., Raisi, M., 2017. Is there a debt-threshold dependency towards efficient energy sources. This would compare between resource abundance and resource dependence in resource countries. Resour. Environ. Sustain. 4, 100018. https://doi.org/10.1016/j.resourpol.2020.101689.

Chudik, A., Pesaran, M.H., 2013. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. A simple panel unit root test in the presence of cross-section dependence. J. Econom. 142, 50–76. https://doi.org/10.1016/j.jeconom.2013.04.007.

Chudik, A., Pesaran, M.H., 2014. Testing slope homogeneity in large panels. J. Bus. Econom. Stat. 32, 260–283. https://doi.org/10.1198/jbes.2013.12068.

Chudik, A., Pesaran, M.H., 2015. Common correlated effects estimation of heterogeneous data models. J. Bus. Econom. Stat. 37, 749–760. https://doi.org/10.1080/07350015.2015.1078350.

Chudik, A., Pesaran, M.H., Yamagata, T., 2008. Testing slope homogeneity in large panels. J. Econom. 108, 1–24. https://doi.org/10.1016/j.jeconom.2007.03.002.

Chudik, A., Zhong, X., 2018. Consumption-based accounting and the trade-carbon emissions nexus. Energy Econ. 69, 71–78. https://doi.org/10.1016/j.eneco.2017.11.004.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. Testing slope homogeneity in large panels. J. Econom. 108, 1–24. https://doi.org/10.1016/j.jeconom.2007.03.002.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.

Chudik, A., Pesaran, M.H., 2015. Large panel data models with cross-sectional multifactor error structure. Econometrica 74, 967–993. https://doi.org/10.1145/1368-0262.2006.00692.x.
abundant countries. Resour. Pol. 60, 47–55. https://doi.org/10.1016/j.resourpol.2018.12.002.

Shahbaz, M., Sharif, A., Belaid, F., Vo, X.V., 2021. Long-run co-variability between oil prices and economic policy uncertainty. Int. J. Finance Econ. https://doi.org/10.1002/ijfe.2478.

Tahar, M.B., Slimane, S.B., Houfi, M.A., 2021. Commodity prices and economic growth in commodity-dependent countries: new evidence from nonlinear and asymmetric analysis. Resour. Pol. 72, 102043. https://doi.org/10.1016/j.resourpol.2021.102043.

Ulucak, R., Danish Ozcan, B., 2020. Relationship between energy consumption and environmental sustainability in OECD countries: the role of natural resources rents. Resour. Pol. 69, 101803. https://doi.org/10.1016/j.resourpol.2020.101803.

Umar, M., Ji, X., Kirikkaleli, D., Shahbaz, M., Zhou, X., 2020. Environmental cost of natural resources utilization and economic growth: can China shift some burden through globalization for sustainable development? Sustain. Dev. 28, 1678–1688. https://doi.org/10.1002/sd.2116.

Vidyne, C.T., Prabheesh, K.P., 2020. Implications of COVID-19 Pandemic on the Global Trade Networks. Emerging Markets Finance and Trade. https://doi.org/10.1080/1540496X.2020.1785426.

World Bank, 2021. World Development Indicators. Retrieved from. https://databank.worldbank.org/source/world-development-indicators#advancedDownloadOptions.

Yasmeen, H., Tan, Q., Zameer, H., Vo, X.V., Shahbaz, M., 2021. Discovering the relationship between natural resources, energy consumption, gross capital formation with economic growth: can lower financial openness change the curse into blessing. Resour. Pol. 71, 102013. https://doi.org/10.1016/j.resourpol.2021.102013.

Yıldırım, E., Öztürk, Z., 2014. Oil price and industrial production in G7 countries: evidence from the asymmetric and non-asymmetric causality tests. Procedia-Social and Behavioral Sciences 143, 1020–1024. https://doi.org/10.1016/j.sbspro.2014.07.547.