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Volatility in natural resources, economic performance, and public administration quality: Evidence from COVID-19

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ABSTRACT

The recent Covid-19 pandemic outbreak caused a global economic recession and promoted uncertainty in the natural resources. Also, this uncertainty is linked with the demand and supply of natural resources such as oil and natural gas, which is a substantial factor of industrial and economic activities. Declining natural resource demands substantially drop such activities that adversely affect economic performance. This attracts the attention of policy-makers and governors to efficiently tackle the issue. This study investigates the association of natural resources volatility, global economic performance, and public administration in earlier and Covid-19 pandemic peak periods. The study covers the period from 1990 to 2020 for the global data. The empirical findings of the cointegration test suggested that the variables are cointegrated. This study utilizes three long-run estimators, i.e., fully modified ordinary least square (FMOLS), dynamic OLS (DOLS), and Canonical Cointegrating Regression (CCR). The empirical findings suggest that natural resources volatility (TNR) negatively and significantly affect global economic performance. While natural gas rents, oil rents, and public administration quality (QPA) promote global economic performance. Besides, the results also indicate that the interaction of QPA and TNR enhances economic performance. This study demonstrates that volatility in natural resources is detrimental to global economic performance. However, improved public administrative quality could play a significant role in transforming the negative influence of natural resources volatility into a positive effect. The findings are robust as validated by Robust regression. This study provides some practical policy insights for the governors and policy-makers to tackle the mentioned issues.

1. Introduction

Since the beginning of the 21st century, the world has faced many events, which have caused changes in economic performance and natural resources volatility. Besides the earlier crisis like the Gulf war, oil price hikes, and global financial crisis, the recent challenge of the Covid-19 pandemic is no less than the previous. Besides, this shock is considered long-lasting and persistent (Gao et al., 2021; Su et al., 2021; Wang et al., 2021). As per (Gao et al., 2021), the world has been facing two severe shocks in recent times: firstly, the Covid-19 pandemic outbreak and secondly, the dropping down of natural resource oil prices. These two shocks have created a global economic recession, which causes a reduction in industrial and production activities and leads to economic slow-down. The slow-down in economic and industrial activities causes uncertainty regarding natural resources and their prices. Additionally, this uncertainty is limited to the Covid-19 pandemic, and other factors such as Russia and Saudi Arabia trade war and negative oil price news further fuel volatility in natural resources (Bourghelle et al., 2021; Su et al., 2020b; Zhang et al., 2021). In recent times, scholars and policy-makers have been struggling to identify the problems connected to natural resources volatility and slow-down of global economic performance. In this regard, the current study is intended to contribute to this burning issue and provide innovative policy insights relevant to the said problem.

Social instability occurred across several regions in 2019, indicating a massive disparity between popular expectations and economic and
social reality. Then, in early 2020, the oil price on the worldwide market dropped. This was the start of the Covid-19 epidemic. Sudden drops in commodity prices, drastic tightening of financial circumstances, and big natural disasters are all common occurrences in the Caribbean and Latin America (World Bank, 2020). The region’s present external environment is comparable to that of the past, implying that prior experience will be extremely critical. The Covid-19 pandemic, on the other hand, adds a new dimension, as the steps required to manage the pandemic ultimately result in a severe supply shock. The ways in which bad external shocks influence domestic economies differ from region to region. Demand from the G7 economies and China will drop considerably, although to varying degrees, affecting commodities exporters in South America as well as manufacturers and service exporters in the Caribbean and Central America (World Bank, 2020). Oil price declines will be harmful to countries whose net exports and budget resources are heavily reliant on oil, but they will be beneficial to net oil-importing countries. Flights have been widely canceled to avoid the spread of the virus, which has reduced air travel to a trickle. The subsequent tourist decline will have a significant impact on countries worldwide (Qin and Su, 2021).

Although, it is mentioned that a crisis or global event substantially enhances volatility in natural resources and their prices. Still, scholars have a contradiction regarding natural resources and economic growth nexus (Umar et al., 2020a, 2021b). Numerous studies are available which demonstrate that natural resources are negatively associated with economic growth, and countries with natural resources abundance tend to grow slower than the natural resource-scarce economies (Li et al., 2021; Naseer et al., 2020; Rahim et al., 2021; Su et al., 2020a, 2021b; Yang et al., 2021). The said phenomenon is termed as resource curse hypothesis. While on the other hand, studies like (Hayat and Tahir, 2021), (Chien et al., 2021), and (Atil et al., 2020) provide empirical evidence that natural resources are blessings for both economic and financial development. However, studies have provided different remedial measures to transform the negative influence of natural resources into positive ones (Su et al., 2021a). Specifically (Rahim et al., 2021), reveal that advancement in human capital could transform the negative impact of natural resources into a positive one, contributing to economic growth. Similarly (Epo and Faha, 2020), demonstrate that natural resources enhance economic growth but depend upon the institutional quality of a country or region. The higher the institutional quality, the natural resources will act as blessings for the region.

Institutional or public administration differences are the primary cause of regional growth disparities. The development of natural resources will have two main effects: one would be the “output effect,” in which the actions resulted in a tangible output, and the other is the “institutional effect,” in which the action has indirect or a direct impact on institutions (Qiang and Jiaan, 2020). Natural resources were not previously seen to be the key to economic progress, but they have now become an issue in a region or country. In this regard, it is worthy to consider the influence of public administration quality in global economic performance as it could regulate these natural resources and control volatility by effective measures and policies.

The primary objective of this research study is to empirically investigate the nexus of natural resources volatility and global economic performance. Although many studies have empirically studied this association, the problem exists by ignoring this nexus in the Covid-19 pandemic. However, the current study considers the Covid-19 pandemic period, which could have substantial economic importance. Secondly, this study will analyze the influence of natural gas rents and oil rents on global economic performance. Both of these variables are counted as the primary energy sources, where oil is the most tradable natural resource globally. Therefore, the contribution of these variables to the industrial sector, which is the backbone of economic development, could not be ignored. Lastly, the current study aims to analyze the role of public administration quality in global economic performance while interacting with the volatility of natural resources. However, many indicators harm economic performance. Still, empirical evidence showed that institutional and public administration quality could stimulate the positive role of these indicators. Therefore, it is crucial to analyze the interactive role of public administration quality and natural resources volatility on global economic performance. Based on these objectives, this study is novel and contributes to the existing literature by three-fold. This study is among the pioneering studies that empirically investigates natural resource volatility and global economic performance in the Covid-19 pandemic. Nonetheless, extensive literature is provided regarding natural resources volatility and economic growth. However, the existing studies ignored this global event (i.e., Covid-19 pandemic), which could have substantial importance globally. Secondly, this study adopted the role of public administration quality in economic performance. Many studies have provided evidence regarding the influential role of institutional quality in economic growth and natural resources (Epo and Faha, 2020; Ji et al., 2020; Maruta and He, 2020). However, to the best of our knowledge, no existing study adopted the influential role of public administration quality with natural resources on global economic performance, which this study adopted. Lastly, this study contributes to the existing literature by providing practical policy insights that could benefit governors, policy-makers, and researchers.

The rest of the paper is categorized as follows: Section-2 provides relevant literature review regarding each variable; Section-3 represents data, model specification, and the methodology used for empirical estimations; Section-4 presents empirical results and their discussion; Section-5 provides concluding remarks and policy implications.

2. Literature review

After the emergence of globalization, most economic and non-economic activities have a spillover effect on other indicators. Specifically, when a natural or non-natural event occurs, it has a significant spillover effect on both economic performance and natural resources. In this regard, literature extensively provided evidence that the occurrence of an event, crisis, or shock causes volatility in natural resources and their prices. An earlier study by (Prasad et al., 2007) empirically investigated the occurrence of an event(s) and its influence on the natural resource oil prices. It revealed that a crisis or shock exhibits asymmetric and persistent influence on the oil price volatility. However, volatility in one natural resource does not remain limited but also influences other natural resources (Radchenko, 2005). Identified that an increase in the oil price volatility significantly reduces the degree of asymmetry in gasoline prices (Bakar et al., 2016). Investigated the persistence of volatility in natural resources, i.e., oil and gold, in both the pre and post-global financial crisis (GFC) (2007-08) periods. The study unveils that volatility in oil is greater than volatility in gold in both pre and post-GFC periods. However, in the per GFC period, there is a bidirectional causal association exists between gold and oil, while in the post-GFC period, the unidirectional causal association is observed running from gold to oil.

Besides volatility in earlier global events, recent studies have provided evidence regarding the influence of the Covid-19 pandemic on natural resources volatility. In this regard, the recent study (Ma et al., 2021) investigated volatility in natural resources commodity prices and economic performance in the pre and post Covid-19 pandemic periods. The study used novel wavelet specifications and concluded that natural resources commodity price volatility is higher in China’s Covid-19 pandemic peak period. Also, a unidirectional causal association is reported from natural resources to economic growth in the medium-run. Concerning a global perspective (Sun and Wang, 2021), also employed the same approach and unveils that natural resources commodity prices are volatile before and after the emergence of the Covid-19 pandemic. On the contrary, this study argued that no causal association exists between natural resources commodity prices and economic performance.

In addition, the studies of (Albulescu, 2020; Bourghelle et al., 2021; Jiang et al., 2021; Narayan, 2020; Zhang et al., 2021) empirically
analyzed the spillover effect of Covid-19 on natural resources (oil prices in specific) volatility. These studies have confirmed that the spread in Covid-19 has a significant and positive influence on natural resources volatility and oil stock volatility. Also, the demand and supply of natural resources, irrespective of the Covid-19 pandemic, play a positive and significant role in enhancing natural resources price. Volatility is determined by both demand and supply shocks in a region. Specifically (Yang, 2020), revealed that a 4% reduction in OPEC oil production significantly increases oil prices in the oil-importing countries, which could greatly contribute to volatility in natural resource prices in the oil-importing economies. Regarding the spread of the Covid-19 pandemic (Devpura and Narayan, 2020), conclude that the covid-19 active cases, its death ratio, and news regarding negative oil prices significantly promote natural resource price volatility. However, all these studies identified an important connection of various events, crises, and natural resources volatility. However, these studies have ignored a crucial aspect of the economic performance of the countries and regions.

Concerning the nexus between natural resources price volatility and economic performance, both the recent and earlier studies are available that empirically demonstrate the influence of natural resources price volatility on the economic performance of the country or region. A recent study (Hayat and Tahir, 2021) investigated resource-rich economies throughout 1970–2016. Using the autoregressive distributed lags (ARDL) approach, the study demonstrates that natural resources are playing an important and positive role in the economic growth of the selected region, validating resource blessings. However, the economic growth of such regions is negatively and significantly influenced by volatility in natural resources volatility (Guan et al., 2021), investigated oil and gold-dependent economies throughout 2000–2020 by using pooled mean group (PMG) and ARDL approaches. The findings reveal that volatility in both the selected natural resources prices adversely affects economic growth in oil and gold-dependent economies, particularly in the long run. However, the influence of natural resources on economic growth is reported inconsistent. Concerning crude oil price volatility and economic growth nexus (Chien et al., 2021), investigated Pakistan over the period 2980–2018 and confirmed the findings of earlier studies that natural resources price volatility negatively affects economic growth. However, the study only confirms the positive impact of natural resource volatility on the transport and communication sectors. Besides, various indicators could determine economic performance, considering financial development (Attil et al., 2020). investigated natural resources and financial development in the same country throughout 1972–2017. This study also validates natural resources as a blessing for financial development. Unlike the study of (Hayat and Tahir, 2021) and (Guan et al., 2021), this study provides contradictory results by revealing that natural resources volatility plays a positive and significant role in the country’s financial development. These studies, although, greatly contribute to the existing literature. Still, they ignored the influence of natural resources in a pandemic outbreak, which created a global economic recession.

On the contrary to earlier mentioned studies that demonstrate natural resources are blessings. Extensive literature provides evidence that natural resources abundance is a curse and plays a destructive role in the economic development of the country and region. In this regard (Rahim et al., 2021), validate the natural resource curse in the Next-11 countries. However, the interaction of human capital could stimulate natural resources and play a positive and significant role in promoting economic growth in the region. On the other hand (Ampofo et al., 2020), top mineral-rich economies and conclude mixed findings, i.e., natural resource curse and natural resource blessing for different countries. However, the study relates that curse and blessing to economic policies such as trade liberalization. Additionally (Cheng et al., 2020), validate the natural resource curse in China. However, the study further reveals that green economic growth could be achieved by transforming dependency on natural resources and promoting human capital and investment in technology and innovation. Moreover (Qiang and Jian, 2020), found that the resource curse is effect severe in China’s resource-abundant provinces. However, higher institutional quality could transform the resource curse into resource blessings in China.

Public administration and institutional quality are also considered substantial factors for economic growth. The quality of institutions and public administration plays an important role in every economic and environmental policymaking. However, literature is extensively provided on the economic impact of institutional quality (Maruta and He, 2020), investigated 74 developing economies between 1980 and 2016 and concluded that foreign education aid is more effective in the aids receiving economies. However, the institutional quality stimulates its positive influence, leading to enhanced economic growth (Epo and Paha, 2020), revealed that natural resource and economic growth nexus vary for countries, depending on the country’s institutional quality. In addition (Ji et al., 2014), investigated China over the period 1990–2008 and revealed the positive influence of natural resource abundance on economic growth. Still, the study demonstrates that the positive effect is non-linear and depends upon the quality of institution in the region. Although an extensive literature has been provided regarding natural resource and oil price volatility, institutional quality, and their association with the economic performance of different regions. However, natural gas is also considered a factor of natural resources, which could dominate economic performance as it is among the primary energy sources. Many studies have identified the influence of natural gas rents on economic performance. In this regard (Canh et al., 2020), investigated 90 developing and developed nations over the period 2002–2017 and found a significant influence of economic complexity on mineral rents, natural gas rents, and coal rents. Additionally, the recent studies of (Galadima and Aminu, 2020) and (Etokakpan et al., 2020) provide evidence that consumption of natural gas positively and significantly plays a mediating role in the economic growth of Nigeria and Malaysia, respectively.

In addition to the prior, extensive literature is available that relates economic growth and natural resources with environmental quality and environmental sustainability. For instance (Alvarado et al., 2021), highlights that natural resources and economic complexity have an asymmetric influence on ecological footprint. Most of the influential studies, institutions, authors have demonstrated the influence of economic growth, financial development, and energy consumption on the environment as an environmental Kuznets curve (Ahmad et al., 2019; Koondhar et al., 2021; Shahbaz et al., 2015; Sharma et al., 2021; Shen et al., 2021; Sinha and Shahbaz, 2018). Studies also demonstrate that renewable energy, energy efficiency, trade openness, financial development, and technological innovation could lead to better environmental quality (Dogan and Seker, 2016; Zhao et al., 2021). Specifically, the level of carbon dioxide (CO$_2$) emissions have been dropped due to enhancement in these variables. In this sense (Abedoyin and Zakari, 2020), demonstrate that economic growth, industrial investment, and low CO$_2$ emissions are essential measures for energy efficiency. On the contrary (Sharma et al., 2021), reveals that renewable energy production, financial development, research and development, energy intensity, temperature, natural resources depletion, and development of stock market significantly and adversely affect environmental quality by enhancing CO$_2$ emission level (Umar et al., 2021a).

A recent study (Islam et al., 2021) investigated the influence of globalization, energy consumption, and foreign direct investment (FDI) on environmental quality through the ARDL approach. Empirical findings of the study asserted that economic growth, urbanization, energy consumption, and trade enhance environmental degradation while institutional quality, FDI, innovation, and globalization promote environmental sustainability. In the same vein (Shahbaz et al., 2020), examined the largest available dataset from 1870 to 2017 and validated the EKC hypothesis. However, the authors claimed that investment in research and development tends to reduce the negative impact of CO$_2$ emissions. Particularly in the long run, if
there is a positive shock in CO₂ emissions, a reduction in economic growth is evidenced, and vice versa (Rehman et al., 2021). Also (Oryani et al., 2021; Rehman et al., 2021), demonstrate that transportation is the primary factor of economic growth and environmental degradation that promote CO₂ emissions. On the other hand (Oryani et al., 2021), argued that renewable electricity could reduce CO₂ emissions. Regarding the influence of natural resources prices on clean energy stocks (Bibi et al., 2021), reveals that oil prices, gold prices, and coal prices exhibit a positive and significant influence on clean energy stocks. Nonetheless, earlier studies mentioned that natural resources such as oil, coal, and natural resources significantly promote CO₂ emissions (Muhammad et al., 2021). However, exports of natural resources, fuel, ore, and metal significantly promote environmental sustainability (Muhammad et al., 2021). Besides the positive impact of natural resources and financial development on ecological footprint (Zia et al., 2021), reveals that human capital could be used as a remedial measure to transform the negative influence of these factors on environmental quality. Regarding food production (Dagar et al., 2021), illustrates that due to technical inefficiency, the land and labor ratio applied by farmers leads to loss of productivity and income, whereas sustainable agriculture production enhances food production that meets its demand.

Although the literature has been extensively studied concerning natural resources price volatility, public administration and institutional quality, and economic growth. However, these studies ignored volatility in natural resources and economic performance in the Covid-19. Also, the literature on public administration regarding economic performance and growth is scant. Therefore, the current study aims to fill this gap based on the objective of the study as provided in Section-1.

3. Methodology

3.1. Data and model specification

Based on the objective of the study and the literature as provided in Section-2, this study used a total of five variables. The dependent variable is global economic performance, represented by the gross domestic product. It is well reported that GDP considers consumption, investment, and expenditures. Therefore, it is the measure of the health of an economy or region. However, the remaining four are the exogenous variables, which include total natural resource rents (TNR), natural gas rents (NGR), oil rents (OR), and public administration quality (QPA), respectively. Here, the volatility of the natural resource is represented by the TNR. In addition, this study aims to analyze natural resources volatility and global economic performance in earlier and Covid-19 pandemic peak periods. Therefore, the data gathered is from a global perspective, which covers the period from 1990 to 2020. Data for all the selected variables are obtained from two sources. The variables considered in this study have some specifications. The GDP at purchaser’s prices equals the total gross value contributed by all resident producers in the economy, plus any product taxes, minus any incentives not included in the product value. It is computed without considering the depreciation of manufactured assets or natural resource depletion and deterioration. The values are in 2010 US dollars. Official exchange rates from 2010 converted GDP numbers from local currencies to dollars. An alternate conversion factor is employed in a few nations where the official exchange rate does not match the rate effectively applied to actual foreign exchange transactions. The TNR is the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. NGR is the difference between the value of natural gas production at regional pricing and overall production costs. Additionally, the OR indicates the gap between the value of crude oil output at regional prices and overall production costs. Finally, the QPA is measured by the degree to which civilian central government staff is organized to create and execute government policies and deliver services efficiently. The variable’s specification and data sources are provided in Table 1.

Concerning the study’s objectives, we have constructed two general models. Where in the Model-1, the global economic performance is the function of TNR, NGR, OR, and QPA, as follows:

Model-1

\[ GDP_t = f(TNR_t, NGR_t, OR_t, QPA_t) \]

However, the Model-2 includes an interaction term of TNR and QPA, which is presented as follows:

Model-2

\[ GDP_t = f(TNR_t, NGR_t, OR_t, QPA_t, \text{interaction}) \]

| Table 1 | Variables’ specification and data sources. |
|-----------------|---------------------------------------------|
| Variable   | Unit          | Data source                                      |
| GDP        | Constant 2010 US$ | https://databank.worldbank.org/source/wo rld-development-indicators#advancedDownloa dOptions |
| TNR        | % Of GDP     | https://databank.worldbank.org/source/wo rld-development-indicators#advancedDownloa dOptions |
| NGR        | % Of GDP     | https://databank.worldbank.org/source/wo rld-development-indicators#advancedDownloa dOptions |
| OR         | % Of GDP     | https://databank.worldbank.org/source/wo rld-development-indicators#advancedDownloa dOptions |
| QPA        | Rating (1 – low to 6 – high) | http://www.worldbank.org/ida |
GDP = f(TNR, NGR, OR, QPA, TNR * QPA)

These two generally constructed models could be transformed into regression models as follows:

\[ GDP = \beta_0 + \beta_1 TNR + \beta_2 NGR + \beta_3 OR + \beta_4 QPA + \varepsilon_i \]  (1)

\[ GDP = \beta_0 + \beta_1 TNR + \beta_2 NGR + \beta_3 OR + \beta_4 QPA + \beta_5 TNR * QPA + \varepsilon_i \]  (2)

where in the above Eq. (1) and Eq. (2), GDP is the global economic performance, TNR is the volatility of the natural resource, NGR indicates natural gas rents, OR represents oil rents, QPA denotes the public administrative quality, and TNR * QPA indicates the interaction term of TNR and QPA. Besides, \( \beta_i \) represents intercept and the rest of the beta’s denoted slope of TNR, NGR, OR, QPA, and TNR * QPA, respectively. Moreover, Besides, \( t \) in the subscript indicates the time-series of each variable and \( \varepsilon_i \) is the error term of the regression.

3.2. Estimation strategy

Once the econometric models are obtained, this study further utilized various econometric approaches to acquire empirical estimates. As mentioned earlier, this study utilized global data for the variables under consideration. Therefore, it could be treated as time-series variables. Such time series approaches employed in this study are the variables’ normality test and descriptive statistics. Computing descriptive statistics is essential in economic research as it summarizes the data under study. After this study uses time-series variables, which could have the issue of a unit root. Therefore, we employed the Augmented Dickey-Fuller test proposed by (Dickey and Fuller, 1979) and the Dickey-Fuller Generalized Least Square unit root test proposed by (Elliott et al., 1992). Since these tests are more powerful than the simple Dickey-Fuller, the latter also de-trends data series locally to effectively determine the series’ predictable parameters. The results reveal that all the variables are stationary at first difference. Therefore, this study used Bayer-Hanck combined cointegration test, which validates the long-run relationship between the study variables. The primary reason for adopting the Bayer-Hanck combined cointegration test is that it provides efficient estimates, whereas the separate tests provide ambiguous estimates (Umar et al., 2020b; 2021a). The cointegration among variables allows us to use efficient long-run estimators. Therefore, we employed Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Square (DOLS), and Canonical Cointegrating Regression (CCR). These estimators are more efficient than the traditional ordinary least square approaches as FMOLS is parametric and DOLS is non-parametric, while considering the leads and lags, which the traditional approaches lack (Sun et al., 2021; Tao et al., 2022). Also, these estimators are efficient in this case as the data neglects the issue of mixed order of integration, which would lead to the adoption of the autoregressive distributed lags model. Moreover, this study also employed the robust regression estimator in order to verify the empirical estimates of earlier mentioned long-run regression approaches and obtain robust results.

3.2.1. Normality test and descriptive statistics

We begin the empirical estimation section by computing the descriptive statistics, which summarize the variables’ data under consideration. Specifically, the descriptive statistics provide mean and median values, maximum and minimum (range) values, the standard deviation value, and the skewness and Kurtosis of each variable’s data. In addition, this study tested the normality of data for each variable. Therefore, we utilized the normality test premiered by (Jarque and Bera, 1980). Both the skewness and excess Kurtosis has been considered in the said test. These two factors (skewness and excess Kurtosis) have been taken as equal to zero. Thus, if these conditions are satisfied, the null hypothesis of (Jarque and Bera, 1980) normality test assumed the data is normal. However, if probability values exceed the significance level of 1%, 5%, and/or 10%, the null hypothesis could be rejected, and it will conclude that the data is not normally distributed. Generally, the estimates for the Jarque-Bera normality test could be calculated via the following equation:

\[ JB = \frac{N}{6} \left( S^2 + \frac{K - 3}{4} \right) \]  (3)

3.2.2. Stationarity test

Once the descriptive statistics and normality are each under consideration variable is checked, this study further analyzes the unit root or checked for stationarity of the time-series variable(s). Therefore, the current study utilized two-unit root testing approaches: (i) Augmented Dickey-Fuller (ADF) and (ii) Dickey-Fuller Generalized Least Square (DF-GLS). Firstly, the ADF unit root test adopted in this study is proposed by (Dickey and Fuller, 1979). It is an efficient unit root test as it allows for the issue of serial correlation. Additionally, the ADF test is more powerful than the traditional Dickey-Fuller (DF) test by computing a model more complex than the latter. The ADF unit root takes place by using the following equation:

\[ y_t = \gamma + \phi t + \mu y_{t-1} + \varepsilon_t \]  (4)

However, the priorly mentioned equation could be estimated via ordinary least square (OLS), which is presented as Eq. (5) below:

\[ Ay_t = (\mu - 1)y_{t-1} + \gamma t + \theta t + \varepsilon_t \]  (5)

Moreover, the ADF unit root test could be obtained in two versions, one is with the intercept, and the other is with the trend. Furthermore, the said unit root test holds the null hypothesis as the presence of unit root in the data. However, the null hypothesis could be rejected if the statistics found are greater in absolute form than the critical values.

Secondly, the DF-GLS approach adopted in this study is proposed by (Elliott et al., 1992). This test is a modified version of the ADF unit root test (Cheung et al., 2009). This testing technique outperforms other existing unit root tests in terms of power. It de-trends (de-means) data series locally to effectively determine the series’ predictable parameters, then uses the modified data to run a standard ADF unit root test. For series that are close to the non-stationary domain, this method can help eliminate the means and linear trends. The DF-GLS estimations could be achieved through the following equation:

\[ \bar{y}_t = y_t - \frac{c}{N} \bar{y}_{t-1} \]  (6)

where the above Eq. (6) could be achieved from a simple time series model, presented as follows:

\[ y_t = d_t + \mu_t \]  (7)

While \( \mu_t \) could be estimated as follows:

\[ \mu_t = \rho \mu_{t-1} + \varepsilon_t \]  (8)

where \( d_t \) represents the deterministic portion and \( \mu_t \) indicates the stochastic portion of \( y_t \). However, in the above Eq. (8), \( \rho = 1 - \frac{c}{N} \).

3.2.3. Bayer-Hanck combined cointegration test

Once the data’s stationarity results are analyzed, all the variables are found stationary at 1 (1). This further allows us to analyze the cointegration association between the variables under consideration. In this regard, the current study utilized the Bayer-Hanck combined cointegration test. However, there are many other cointegration approaches, such as (Engle and Granger, 1987), (Johansen, 1991), (Banerjee et al., 1998), and (Boswijk, 1994) cointegration test. However, the Bayer-Hanck combined cointegration test is efficient as this approach allows and considers all these mentioned cointegration approaches combined. Besides (Shahbaz et al., 2018), mentioned that if these earlier mentioned cointegration tests are employed separately, the
estimated outcomes might be ambiguous and unreliable because of their explanatory power properties. Hence, this study utilized the (Bayer and Hanck, 2009) proposed combined cointegration approach to overcome the said issues. In addition, the said cointegration test combined the (Engle and Granger, 1987), (Johansen, 1991), (Banerjee et al., 1998), and (Boswijk, 1994) cointegration tests and delivers reliable and conclusive results based on the Fishers F-statistics (Shahbaz et al., 2018). Furthermore, the adopted cointegration approach is only allowed for a unique (I (1)) integration order. This test assumes no cointegration association between the considered variables concerning the null hypothesis. However, if the statistics are found significant, the null hypothesis could be rejected. Based on Fisher’s formulation, the Bayer-Hanck cointegration equation is presented as following Eq. (9) and Eq. (10):

$$EG - J = -2[\ln(P_{EG}) + \ln(P_f)]$$

$$EG - J - Ba - Bo = -2[\ln(P_{EG}) + \ln(P_f) + \ln(P_{Bo}) + \ln(P_{Bo})]$$

In the above mentioned Eq. (9) and Eq. (10), the $P_{EG}$ represents the probability values for (Engle and Granger, 1987), $P_f$ for Johansen (1991), $P_{Bo}$ for (Banerjee et al., 1998), and $P_{Bo}$ is the probability value for the (Boswijk, 1994) cointegration test. Fisher’s formulation statistics reveal that whether or not the cointegration relationship exists among the considered variables.

3.2.4. Long-run estimation techniques

Once the cointegration association between the variables under consideration has been confirmed, this allows us to analyze the specific influence of each exogenous variable (TNR, NGR, OR, QPA, and QPA∗ TNR) on the global economic performance. Therefore, this study followed the study of (Khan, 2019), the following three long-run estimators have been adopted. That is, fully modified ordinary least square (FMOLS), dynamic ordinary least square (DOLS), and Canonical Cointegrating Regression (CCR). Concerning FMOLS and DOLS, where the former is proposed by (Pedroni, 2001). Both of these estimators are adopting different approaches, that is, non-parametric and parametric approaches by DOLS and FMOLS, respectively. Moreover, both these estimators allow for serial correlation and endogeneity issues, thus providing reliable long-run estimations. In addition, the DOLS also allows for dealing with the non-stationarity issue of the time series. The FMOLS and the DOLS estimates could be achieved through the following Eq. (11) and Eq. (12), respectively.

$$\hat{\delta} = \left[ \frac{\alpha}{\beta} \right] = \frac{1}{\sum_{i=1}^{T} Z_i} \sum_{t=1}^{T} Z_i Y_i - T \begin{bmatrix} \hat{\alpha} \\ \hat{\beta} \end{bmatrix}$$

where $Z_i = (X_i, D_i)$. However, the long-run covariance matrix plays a substantial role in analyzing the FMOLS estimator.

$$y_i = X_i \beta + D_i \gamma_i + \sum_{j=q}^{r} \delta X_i, \sigma + v_i$$

Here, the DOLS approach holds the expansion of cointegration regression by accounting for both leads and lags $\Delta X_i$ due to the orthogonal error term cointegration equation. Further, the DOLS approach simulates the addition of $q$ lags and $r$ leads of the differences regressors, where the long-run association could be detected between the two error terms, i.e., $e_i$ and $e_{u_i}$.

In addition to the prior long-run estimating approaches, the CCR is a pure regression-based estimating approach. However, the CCR approach allows for fixing the linear regression part and thus playing a substantial role (Park and Zhao, 2010). Therefore, the exact leads and lags identification are the crucial issues of CCR. Moreover, the CCR estimates could be achieved based on the following equation:

$$\hat{y}_i = \hat{\phi}_{pq} \hat{z}_{pq} + \hat{\mu}_{pq}$$

where in the prior equation, $y_i$ and $z_{pq}$ indicates the stationary transformation of $y_i$ and $z_{pq}$, respectively. Once the long-run coefficient estimates are achieved, this study further utilized the Robust regression technique to validate and confirm the estimated outcomes of FMOLS, DOLS, and CCR. Robust regression is a statistical method of regression analysis used throughout robust statistics to get beyond some drawbacks of traditional parametric and non-parametric procedures. The purpose of regression analysis is to assess the relationship between one or more independent variables and a dependent one. Ordinary least squares (OLS), for instance, have useful properties while their basic assumptions are fulfilled but can give misleading estimates if they are not; hence, the OLS is regarded as not robust to assumptions violations. On the other hand, the Robust regression approach is designed to be unaffected by assumptions violations in the underlying data generation process. Furthermore, robust regression is an alternative to OLS regression when data is affected by outliers or influential observations, and it could also be used to determine influential observations. Furthermore, robust regression is an iterative method for identifying outliers and decreasing their impact on parameter estimates. In robust regression, the amount of weighting given to each observation is controlled by a particular curve known as an influence function.

Once the results are obtained via the discussed approaches, they will benefit policy-makers, governors, investors, and future researchers in various dimensions. Specifically, uncertainty in the global natural resources market due to recent pandemic outbreaks causes a fear among governors and policy-makers to take sensible steps. Hence, the empirical findings and the findings-based policy implications help provide remedial measures tackling uncertainty in natural resources and are beneficial for the recovery of global economic performance. Besides, the investors who postpone their investments due to uncertain situations will be less reluctant to invest in the natural resources market and industrial sectors. Moreover, these findings are critical for resuming economic and industrial activities that will bring back the economy on track. Due to this, unemployment will be reduced, and the economic performance will be improved in most regions across the globe.

4. Results and discussion

4.1. Results

In recent times, volatility in natural resources has been a burning issue that has attracted the attention of scholars and policy-makers. Nonetheless, the issue of volatility in natural resources prices, particularly in oil prices, has existed since the last few decades (Pradak et al., 2007; Radchenko, 2005). However, after the emergence of the Covid-19 pandemic, natural resource volatility and economic performance rise more frequently. Since the outbreak of the Covid-19 pandemic, two issues regarding natural resources arise simultaneously: firstly, the global economic recession that adversely affects industrial and economic activities across the globe. Secondly, decline in oil prices in an international market. Besides, the conflict between Russia and Saudi Arabia further fuels the uncertainty in natural resources prices (Bourjeghle et al., 2021). Since the recent uncertain situation needs urgent policy insights to recover global economic performance and tackle volatility in natural resources. Therefore, recent studies have made attempts, such as (Sun and Wang, 2021) and (Khan, 2019). However, the problem still exists as these studies only identified the causal nexus of volatility in natural resources commodity prices and economic performance. Therefore, the current study holds three objectives: firstly, empirically examining the association of natural resources volatility and global economic performance; secondly, investigating the impact of oil rents and natural gas rents on global economic performance; lastly, the role of public administration quality on global economic performance. Besides, this study also tested for the interactive role of natural resources volatility and public administration quality on global economic performance.
performance. Since the objective are already mentioned in Section-1, which are novel and relevant to the current scenario of uncertainty. Therefore, this study is novel and contributes to the existing literature by providing new insights regarding the prevailing issue. Specifically, this study plays a pioneering role by examining the natural resources volatility and global economic performance while using an extended dataset covering the Covid-19 pandemic peak period. Additionally, the current study contributes to the existing literature by providing empirical estimates on the nexus of oil rents and natural gas rents with the global economic performance. Moreover, public administration indeed plays a substantial role in environmental quality improvement. However, its influence is yet unexplored on global economic performance. Therefore, this study provides an empirical analysis of public administration quality and global economic performance. Furthermore, the interactive term of public administrative quality and natural resources is also additional to the present literature.

Before initiating the empirical estimations, we have computed the descriptive statistics and normality of the variable’s data. Regarding the descriptive statistics, the mean, median, range, standard deviation, skewness, and Kurtosis of the time-series data has been calculated, and the estimated outcomes are provided in Table 2. Specifically, the mean and median values of GDP, which represents global economic performance, in this case, are accounted for 59.8 and 59.4 US trillion dollars. While the global GDP is observed minimum in the initial times of the time-series under-taken, i.e., 37.9 trillion dollars in 1990, and reached to the maximum of 85.0 trillion dollars in 2019. The greater difference in the range values indicates a higher deviation from the mean value. Therefore, the standard deviation value is accounted for 15.4 US trillion dollars. Every country across the globe aims to stimulate its economic growth by utilizing various natural and industrial sources. However, the global economic growth is observed to be affected severely in two periods, where the GDP growth falls, i.e., the 2009 global financial crisis and the 2020 Covid-19 pandemic. Concerning global TNR, the mean and median values are accounted for 2.381 and 2.047 percentage of GDP, respectively. While the range values are observed as increasing over time. The minimum global TNR value is accounted for 0.909, while it reached the maximum of 0.497% of the global GDP. This indicates that the contribution of natural resources rent in the countries’ economic growth is increasing. As noted earlier that the difference in range values is quite large, therefore the estimated figures revealed that the standard deviation in the TNR is 1.076 as a percentage of GDP. Moreover, the skewness and Kurtosis of QPA hold a considerable distance from their tabulated values. Moreover, the probability values of GDP, TNR, NGR, and ORR are found insignificant for the (Jarque and Bera, 1980) normality test, which is insufficient for rejecting the null hypothesis. Thus, it is concluded that these variables are normally distributed. On the contrary, the (Jarque and Bera, 1980) probability value is found significant, which rejects the null hypothesis of data being normal and concludes that the QPA is not normally distributed in the selected time span.

Once the descriptive statistics and normality test results are obtained, which helps to summarize the data under consideration, we begin our empirical estimations. The current study tested for the non-stationarity or presence of unit root in the data across the selected time period. As the global economy and countries are struggling to achieve economic development. However, in the last three decades, many natural and non-natural events occur, which causes a change in the economic and non-economic variables across time. Such events include the Gulf war, global oil price hike, global financial crisis, and the recent Covid-19 pandemic outbreak. Therefore, it is expected that the variables under consideration could be affected in response to these events and hold structural breaks. In this regard, we utilized the (Dickey and Fuller, 1979) ADF unit root test and the (Elliott et al., 1992) proposed DF-GLS unit root test. The estimated outcomes of these tests are provided in Table 3. The said table below represents the empirical findings for both the leveled (I(0)) and first differenced (I(1)) data. The estimated result of both ADF and DF-GLS reveal that all the variables are insignificant at level, which leads to the conclusion that I(0) data is non-stationary. Besides, all the variables are found highly statistically significant at I(1) data. The significance level of 1%, 5%, and 10% leads to the rejection of the null hypothesis and concludes that GDP, TNR, NGR, ORR, and QPA are stationary, which allows us to identify the long-run association that exists between these variables.

The unit root tests reveal the stationarity of data at I(1), which allows us to analyze the cointegration association between the variables. Therefore, the current study employed the (Bayer and Hanck, 2009) combined cointegration test, which combinedly considers the (Engle and Granger, 1987) (EG) (Johansen, 1991), (J) (Banerjee et al., 1998), (Ba), and (Boswijk, 1994) (Bo) cointegration tests. Besides, this test also

| Variables | Intercept | Trend |
|-----------|-----------|-------|
| ADF       | I(0)      | I(1)  |
| GDP       | -0.716061 | -4.656926*** | -1.257767 | -4.670845*** |
| TNR       | -2.185391 | -4.987628*** | -2.101236 | -5.052327*** |
| NGR       | -1.085864 | -6.924068*** | -2.343037 | -6.546348*** |
| OR        | -2.554085 | -5.306301*** | -2.412264 | -5.026050*** |
| QPA       | -1.777581 | -6.573668*** | -1.735267 | -6.768194*** |

Note: ***, ** and * is for level of significance at 1%, 5% and 10%.
provides the combined estimates for \((\text{Engle and Granger}, 1987)\) (EG) and \((\text{Johansen}, 1991)\) (J). The examined outcome of the said test is provided in Table 4. Regarding the separate estimations of each coinTEGRATION test \((\text{Johansen}, 1991)\), and \((\text{Boswijk}, 1994)\) provide significant estimates for both models. At the same time \((\text{Engle and Granger}, 1987)\), and \((\text{Banerjee} \text{ et al.}, 1998)\) provide insignificant estimates for both the models. Besides, the empirical estimates of EG-J and EG-J-Ba-Bo provide highly statistically significant estimates at 1%, 5%, and 10% levels. This rejects the null hypothesis of no cointegration association between the under-discussion variable. Thus, the \((\text{Bayer and Hanck}, 2009)\) combined cointegration test reveals that the cointegration relationship exists between GDP, TNR, NGR, ORR, and QPA.

The cointegration association between the variables under consideration allows this study to estimate the specific influence of each exogenous variable on the global economic performance in the long run. In this regard, the current study utilized three long-run estimators: FMOLS, DOLS, and CCR. The estimated outcomes of these long-run approaches are provided in Table 5. The said table presents the long-run estimates for both the constructed models. With reference to the findings of Model-1, all the three FMOLS, DOLS, and CCR estimators indicate that total natural resources negatively influence global economic performance in the selected period of time. However, the other three exogenous variables, i.e., NGR, OR, and QPA, significantly and positively contribute to global economic performance. Specifically, the three estimators reveal that a one percent increase in the TNR significantly reduces economic performance by 0.542 (FMOLS), 0.593 (DOLS), and 0.520 (CCR) percent at a 1% level. Although the magnitude of influence slightly varies, while the direction of influence remained the same. The estimated result of the current study is found consistent with the earlier studies of \((\text{Hayat and Tahir}, 2021)\), \((\text{Guan et al.}, 2021)\), and \((\text{Chien et al.}, 2021)\), which empirically investigates the negative influence of natural resources price volatility on economic growth. The reason for the negative influence of natural resources price volatility on economic performance is that the volatility in prices creates uncertainty in both the natural resources and stock market. This led investors to postponed investments in these stocks due to future benefits at stake. Thus, the economic and production activities tend to decline, and the economic growth is adversely affected. Similarly, in the Covid-19 pandemic period, the global lock-down creates uncertainty due to reducing the natural resources demand. However, reduction in the demand causes more volatility in the natural resources price, contributing to economic slow-down \((\text{Yang and Kallio}, 2002)\).

### Table 4

| Analysis                | Model-1       | Model-2       |
|-------------------------|---------------|---------------|
| EG                      | 3.490***      | 3.418***      |
| Johansen (J)            | 59.179***     | 96.109***     |
| Banerjee (Ba)           | 3.960***      | 6.260         |
| Boswijk (Bo)            | 43.158***     | 239.213***    |
| EG-J                    | 57.564***     | 56.630***     |
| EG-J-Ba-Bo              | 112.826***    | 111.892***    |

Note: ***, ** and * is for level of significance at 1%, 5% and 10%.

### Table 5

| Variables | Without Interaction Term | CoefficientsFMOLS | CoefficientsDOLS | CoefficientsCCR |
|-----------|--------------------------|-------------------|------------------|-----------------|
| TNR       | -0.542***                | -0.593***         | -0.520***        |
| NGR       | 0.210*                   | 0.182**           | 0.162*           |
| QPA       | 0.124**                  | 0.164**           | 0.155***         |
| Constant  | 1.294***                 | 1.824***          | 1.252***         |
| With Interaction Term | -0.481***          | -0.479**          | -0.561*          |
| NGR       | 0.182**                  | 0.173*            | 0.178*           |
| OR        | 0.1039***                | 0.099**           | 0.1043*          |
| QPA       | 0.183***                 | 0.129*            | 0.112*           |
| QPA*TNR   | 0.1008*                  | 0.0984*           | 0.0981           |
| Constant  | 1.003***                 | 1.042***          | 1.044***         |

Note: ***, ** and * is for level of significance at 1%, 5% and 10%.

QPA*TNR is interaction of QPA with TNR.

Graphical Representation of Results

- **TNR (−ve)**
  - **0.479-0.593%**
- **NGR (+ve)**
  - **0.173-0.210%**
- **OR (+ve)**
  - **0.099-0.164%**
- **QPA (+ve)**
  - **0.105-0.183%**
- **QPA*TNR (+ve)**
  - **0.098-0.10%**
In addition, a one percent increase in the NGR significantly promotes global economic performance by 0.210 (FMOLS), 0.182 (DOLS), and 0.162 (CCR) percent at 5% and 10% levels, respectively. As one of the primary sources of energy, NGR fulfills the energy requirement for industrial and other economic activities to run. Thus, NGR positively contributes to global economic performance. The current findings are consistent with the earlier empirical findings of (Galadima and Aminu, 2020) (Etokakpan et al., 2020) that provide evidence that natural gas consumption is advantageous to economic growth. Furthermore, the variable OR is found to have a positive effect on global economic performance by 0.124 (FMOLS), 0.164 (DOLS), and 0.155 (CCR) percent, if it is increased by one percent. The estimated results are highly statistically significant at 1% and 5% levels, respectively. As mentioned earlier, oil is the prominent energy source globally, covering about 33% of the global energy requirement. Therefore, OR plays an important role in stabilizing the country’s economic performance. Similar findings regarding OR is provided by (Hayat and Tahir, 2021), (Chien et al., 2021), and (Atil et al., 2020). These studies empirically demonstrate that natural resources promote economic activities and enhance financial activities, contributing to economic growth. Besides, volatility in oil prices is important for financial system development (Atil et al., 2020), which is a crucial factor of economic performance.

Regarding QPA, the empirical results reveal that public administration quality significantly promotes global economic performance. Specifically, a one percent increase in the QPA causes a significant increase of 0.109 (FMOLS), 0.138 (DOLS), and 0.105 (CCR) percent at the 10% level. Enhancement in the quality of public administration holds important as it promotes the culture of check and balance, corruption control, and efficient utilization of resources. In the same line, the findings of (Maruta and He, 2020), (Epo and Faha, 2020), and (Ji et al., 2014) are found consistent with current findings. These studies prove that public administration and institutional quality stimulate economic activities such as foreign aid and natural resources to promote the region’s economic growth.

With reference to the empirical findings of Model-2, the estimated results are provided in the same Table 5. The results of FMOLS, DOLS, and CCR provide the same direction of influence on global economic performance. However, a slight difference has been observed in the coefficients’ magnitude. Specifically, the influence of TNR is found negative, while NGR, OR, and QPA positively affect global economic performance. This indicates that the influence of each explanatory variable remains the same in both models. Here, Model-2 includes an interaction term of QPA and TNR (i.e., QPA*TNR), which positively influences global economic performance. Specifically, a one percent increase in the QPA*TNR significantly increases economic performance by 0.1008 (FMOLS) and 0.0984 (DOLS) percent at 10% level each. However, the empirical findings of CCR reveal a positive but insignificantly significant effect of QPA*TNR on global economic performance. This indicates that the improvement in public administration quality promotes global economic performance. This leads to the conclusion that these specific natural resources play a role in additional income that enhances economic, industrial, and financial activities and speeds up economic performance (Atil et al., 2020; Hayat and Tahir, 2021). Besides, natural resources such as oil and natural gas are considered the basic energy requirements in any county or region. These natural resources play a significant role in regulating economic and industrial activities, reducing unemployment, and increasing the general public’s per capita income. Hence, the positive influence of both oil rents and natural gas rents is beneficial for global economic performance. Although these two natural resource rents positively impact global economic performance. Still, total natural resources are the combination of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. From empirical results, it is noted that total natural resource rents significantly reduce economic performance. This indicates that natural resources are not consistent over time yet volatile. While volatility in natural resources adversely affects regional and global economic performance (Hayat and Tahir, 2021; Ma et al., 2021). This further demonstrates that volatility in natural resources leads to an uncertain situation, which creates fear amongst investors and industries regarding natural resources. Hence, the investors tend to postpone investments, due to which industrial production temporarily stops and reduces economic performance. This reduction in economic performance is detrimental to higher economic growth. Since the literature provides empirical results regarding the positive influence of the Covid-19 pandemic on natural resources due to reduction in demand, which leads to slow-down economic performance and growth. Hence, it is concluded that demand deterioration is also the major contributor to lower economic performance and growth (Yang and Kallio, 2002). A well-developed economic system allows for quality institutions and public administration. It is well known that lower quality of public administration is majorly responsible for the lagging of the economy.

### 4.2. Managerial implications

To analyze the influence of each explanatory variable, i.e., total natural resources rents, oil rents, natural gas rents, and public administration quality on global economic performance, the current study used three long-run estimators. Such estimators include FMOLS, DOLS, and CCR. Also, a robustness test has been performed to assure the specific impact of each explanatory variable. The empirical findings noted that oil rents and natural gas rents exhibit positive and significant influence on global economic performance. This leads to the conclusion that these specific natural resources play a role in additional income that enhances economic, industrial, and financial activities and speeds up economic performance (Atil et al., 2020; Hayat and Tahir, 2021). Besides, natural resources such as oil and natural gas are considered the basic energy requirements in any county or region. These natural resources play a significant role in regulating economic and industrial activities, reducing unemployment, and increasing the general public’s per capita income. Hence, the positive influence of both oil rents and natural gas rents is beneficial for global economic performance. Although these two natural resource rents positively impact global economic performance. Still, total natural resources are the combination of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. From empirical results, it is noted that total natural resource rents significantly reduce economic performance. This indicates that natural resources are not consistent over time yet volatile. While volatility in natural resources adversely affects regional and global economic performance (Hayat and Tahir, 2021; Ma et al., 2021). This further demonstrates that volatility in natural resources leads to an uncertain situation, which creates fear amongst investors and industries regarding natural resources. Hence, the investors tend to postpone investments, due to which industrial production temporarily stops and reduces economic performance. This reduction in economic performance is detrimental to higher economic growth. Since the literature provides empirical results regarding the positive influence of the Covid-19 pandemic on natural resources due to reduction in demand, which leads to slow-down economic performance and growth. Hence, it is concluded that demand deterioration is also the major contributor to lower economic performance and growth (Yang and Kallio, 2002). A well-developed economic system allows for quality institutions and public administration. It is well known that lower quality of public administration is majorly responsible for the lagging of the economy.
The positive impact of public administration quality signifies that it is an important factor for regulating global economic performance via the culture of check and balance, corruption control, and efficient utilization of resources (Maruta and He, 2020). Moreover, in volatile natural resources, the improved quality of public administration plays a significant role in transforming its negative impact on global economic performance to a positive one (Ji et al., 2014). Hence, an improved public administration quality is required to reduce the negative influence of natural resources volatility.

5. Conclusion and policy implications

5.1. Conclusion

Since the last three decades, the global economic performance and natural resources have faced many changes due to various natural and non-natural events. Currently, the world has faced the challenge of Covid-19, which causes a global lock-down and economic recession. In this regard, researchers and policy-makers got attention to regulating the volatility of natural resources and global economic performance. However, an extensive literature has been provided that empirically investigated natural resources price volatility and economic performance in different times and regions. Still, the findings are contradictory, and the recent literature ignored the most important event of current times, i.e., Covid-19 pandemic and public administration quality. However, this study investigates the global data’s nexus of natural resources volatility, economic performance, and public administration quality. The data covers the period from 1990 to 2020, including the earlier and Covid-19 pandemic peak period(s). As this study deals with the time-series data, therefore time-series estimating approaches have been adopted. Firstly, this study used ADF and DF-GLS unit root tests, which confirmed that the data is stationary at I (1) (Bayer and Hanck, 2009). Combined cointegration test revealed that the cointegration relationship exists between the variables. After confirming the cointegration relationship, this study utilized three long-run correlations estimating approaches to identify the influence of each exogenous variable on global economic performance.

After employing the FMOLS, DOLS, and CCR approaches, the empirical findings reveal that TNR negatively influences economic performance across the selected time period. However, NGR, OR, and QPA are found to positively influence global economic performance. The results are found statistically significant and consistent with the earlier empirical findings. Moreover, the interaction term QPA* TNR, reveals that the advancement of public administration quality significantly transforms the negative impact of natural resources and their volatility to positively affect global economic performance. The findings of these three estimators are robust, as validated by Robust regression.

5.2. Policy implications

Based on the empirical findings, the current study provides some practical policy implications, which could be advantageous to the governors, policy-makers, and researchers. Firstly, the empirical findings suggest that volatility in natural resources is detrimental to global economic performance. Therefore, it is recommended that either the price ceiling or price freezing policy could be adopted, which will regulate or overcome fluctuations in the natural resources. Secondly, hedging of natural resources could provide security in the shape of no or low prices fluctuation in both the short and long run. Therefore, policies must consider the hedging of natural resources, particularly energy-related natural resources and precious metals, which will have favorable long-run outcomes. Lastly, the role of public administrative quality is found substantial in global economic performance. Therefore, policies must be revised in order to strengthen public administration, which simultaneously helps regulate the positive influence of natural resources and their volatility on global economic performance. Moreover, improvement in public administration quality will improve accountability, promote check and balance, and reduce corruption, which are unfavorable factors of higher economic growth and performance.

Furthermore, the Covid-19 pandemic, which created uncertainty in the global market, must be tackled by ensuring the general public’s vaccination and enhancing health facilities. This will reduce the fear of the public, investors, and industrialists and help resolve economic and industrial activities, an engine for economic growth.

Nonetheless, the current study empirically investigated volatility in natural resources, public administration, and global economic performance for 31 years. Yet this study holds limitations highlighted and suggested for future researchers. Firstly, the current study used data for global economic performance, which holds importance. Still, there are five categories based on which economies are classified, i.e., lower-income, lower-middle-income, middle income, higher-middle income, and higher-income countries. Therefore, future researchers are suggested to empirically analyzing the economic performance of individual countries or each category as mentioned above. Secondly, the current study used natural resources rents to represent natural resources volatility. However, natural resources commodity prices could be used as an appropriate variable to study natural resource volatility extensively. Therefore, future studies are recommended to examine various natural resources commodity prices in relation to economic performance. Thirdly, this study presents the influence of natural resources volatility and other explanatory variables on global economic performance, yet volatility in natural resources is not explored for most countries and regions. Therefore, researchers in the future could investigate volatility in natural resources by employing the traditional heteroscedasticity specifications such as ARCH and GARCH approaches and the wavelet approach. These specifications extensively analyze volatility, while the latter also helps examine the causal nexus of variables. Moreover, the time period could be extended for a broad measure of the analysis, while future researchers are also suggested to investigate the period of the Covid-19 pandemic for its specific influence.

Lastly, this study will provide a path for the researchers and policymakers to counter the issue of natural resources volatility and its adverse effect on global economic performance. Specifically, in a particular crisis event like the recent Covid-19 pandemic period, which creates uncertainty in global demand and supply of natural resources. This uncertainty slows down various economic and industrial activities and affects the investors’ behavior regarding future outcomes. Therefore, this investigation could be handy for the governors to regulate the distinguish problem via mentioned policy suggestions to help recover economic losses. Regarding this study, the dataset used is up to 2020, while data for the year 2020 is not directly available, which this study manage by using various search engines such as google and google scholar, among others.

Author statement

YICHI ZHANG: Conceptualization, Visualization, Methodology, Project administration, Writing-review & editing. QIAO WANG: Conceptualization, Investigation, Writing-review & editing; TIAN TIAN: Conceptualization, Data curation, Software, Formal analysis. YUAN YANG: Conceptualization, Supervision, Writing - original draft.

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