



# Natural Resources Depletion, Financial Risk, and Human Well-Being: What is the Role of Green Innovation and Economic Globalization?

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Accepted: 27 March 2023 / Published online: 6 April 2023  
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## Abstract

Human well-being is the top priority of all nations in the twenty-first century. However, depletion of natural resources and financial risk can negatively impact human well-being, which in turn can make it difficult to realize human well-being. Also, green innovation and economic globalization may play a significant role in human well-being. In this context, this study assesses the impacts of natural resources, financial risk, green innovation, and economic globalization on human well-being in emerging countries from 1990 to 2018. The empirical results from the Common Correlated Effects Mean Group estimator unveiled that natural resources and financial risk negatively affect the human well-being of emerging nations. Furthermore, the results show that green innovation and economic globalization positively contribute to human well-being. These findings are also verified using alternative methods. In addition, natural resources, financial risk, and economic globalization Granger cause human well-being but not the other way round. Furthermore, bidirectional causality exists between green innovation and human well-being. Considering these novel findings, sustainable utilization of natural resources and controlling financial risk are necessary strategies for realizing human well-being. More resources should be allocated

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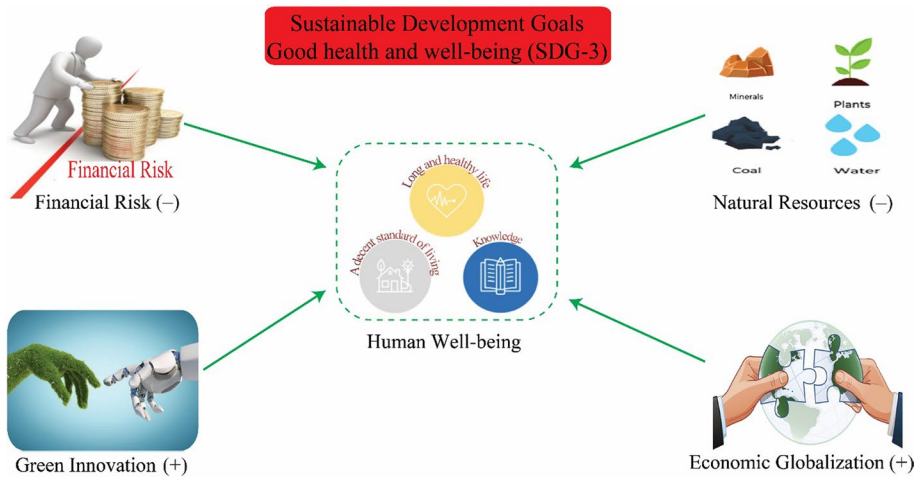
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for green innovation, and government should encourage economic globalization to attain sustainable development in emerging countries.

### Graphical Abstract



**Keywords** Natural resources · Financial risk · Green innovation · Economic globalization · Human well-being

## 1 Introduction

Increasing human well-being is the basic aim of nations, and this objective is not limited to a particular region or country. Therefore, many countries strive to increase human well-being within the framework of certain agreements because the ultimate goal of countries is to ensure the continuation of economic and social sustainability (Aman et al., 2022; Steinberger & Roberts, 2010). The concept of human well-being emerged along with economic development. In the 1960s, development was largely confined to the increase in national income. The main purpose of development was to transform the production and employment patterns from agriculture to industry and service sectors. Therefore, in those periods, the concept of national income per capita began to be used as an indicator of the changes in the welfare of the country (Anderson, 2012). However, over time, human well-being was redefined by considering other factors like education and health.

Well-being is one of the most vital indicators of the concept of development today. Well-being is mainly represented in the literature by the Human Development Index (HDI). HDI is an important parameter that shows the development of societies (Alatartseva & Barysheva, 2016). This parameter considers not only the income level but also the changes in the quality level of human life in terms of education and health (Van Tran et al., 2019). Well-being is the process of improving the quality of life for all people. Generally, there are three aspects of equal importance in the concept of well-being. Firstly, the improvement of people's living standards which includes an improvement in their incomes, food, health care, education, and other conditions along with economic growth. Secondly, the

improvement in social, cultural, political institutions, economic systems, the value given to people, and people's self-confidence. Thirdly, the increase in the freedom of people with the expansion of their options and the increase in the variety of commodities and services consumed (Rogers et al., 2012). Notably, the United Nations Development Organization takes into account the first aspect of human well-being, which is related to the improvement in the standard of life, to create the human development indices.

In recent years, scholars have been examining the effects of different parameters on well-being. Among these factors, natural resources have prime importance. Natural resources have the potential to impact well-being. The wealth of natural resources can affect the well-being level of a country in 3 ways. The income from natural resources can uplift financial incomes and domestic savings and reduce foreign currency scarcity. In this way, resource-rich countries provide new public goods. In addition, natural resources' income enables nations to make new investments (Gelb, 1988) to increase the level of well-being in the country. However, there is no complete consensus in the literature regarding the impacts of natural resources on human well-being. While some studies have concluded that natural resources increase the level of well-being, some studies have also concluded that natural resources negatively affect the quality of life (e.g. Ali et al., 2020; Bulte et al., 2005; Stijns, 2006).

Financial development is also among the parameters that may affect human well-being. Financial markets enable savings in a country to be accumulated in the system, and the accumulated funds to be transferred to appropriate projects. In other words, financial markets provide the funds that all people and institutions need for their efficient projects (Mahmood Ahmad et al., 2022). The lack of savings, especially in developing economies, brings with it difficulties in financing the real sector, which makes it difficult to reach the economic growth target. Developments in financial markets accelerate GDP by lowering information and transaction costs and shifting savings to areas with high social returns (Sehrawat & Giri, 2014). Considering the importance of finance, it is reasonable to believe that an unstable financial system with a high degree of risks can cause losses to the country's output and obstruct economic progress (Dell'Ariccia et al., 2008; Epstein et al., 2019). Notably, instability in the financial sector can make it very difficult to realize economic development which is an important component of human well-being. The COVID-19 has also dealt a massive blow to travel and tourism, which in turn has hindered financial stability and economic development (Aman et al., 2019; Geng et al., 2022; Li et al., 2022a, b). Further, financial risk can lead to a reduction in the financing facilities for the education system, which can negatively influence human well-being by hindering the educational infrastructure and the capacity of human capital. Besides, high financial risk and an unstable financial system can negatively impact the funding for healthcare which constitutes an important part of human well-being and sustainable development (Kara et al., 2021).

Knowledge is one of the most significant influencing factors of the well-being level of a country (Can & Can, 2022). It enables companies to engage in R&D activities which boosts the well-being level of countries (Kuada, 2015). Notably, green innovation requires a significant level of knowledge and technological infrastructure. Green innovations can affect the well-being levels of countries in different ways. Firstly, it promotes the development of new products that bring new business opportunities (Asongu, 2015). This contribution boosts the income level of the country. In addition, innovation in the health sector contributes to the prolongation of human life (Kliner et al., 2013). The trading of emerging green products also positively affects the environmental quality levels of the countries, which in turn improves the health of people (Can et al., 2021). In this context, green innovation is a parameter that has a significant impact on well-being.

World trade, which started as a result of industrialization, has continued to increase, except for periodic interruptions. Trade has led to the opening of the countries' borders to the outside world (Gözüör & Can, 2017). As a result, nations have become closer and more interdependent than ever before. This means the integration of economies making the world a single market (Noumba et al., 2022). Economic globalization contributes significantly to the well-being levels of countries, especially through trade. Individuals have access to many different products (cars, rugs, etc.) due to economic globalization, which leads to the improvement in well-being levels (Omri et al., 2019). In addition, economic globalization provides more business opportunities and increases the income level of individuals through trade (Buysse et al., 2018). In this context, economic globalization is one of the parameters that can potentially affect well-being.

This present study contributes to the existing body of literature in the following aspects. Firstly, this study investigated the impact of natural resource rents on human well-being in emerging countries. Emerging countries are rich in natural resources but lack of literature on the nexus between natural resources and well-being. Secondly, we examined the effect of financial risk on human well-being which has not yet been investigated by previous studies. Thirdly, unlike the previous studies, which ignore the role of green innovation for human well-being and, most importantly, the role of economic globalization in human development is investigated. Notably, no previous investigation has studied the impacts of the aforementioned factors on human well-being in a single study. Hence, this study evaluates the impacts of some new factors that may impact human well-being. Lastly, on the methodology side, the current study employs the recent empirical estimation approaches that deal with cross-sectional dependence, slope heterogeneity, non-stationarity, and endogeneity.

## 2 Literature Review

### 2.1 Natural Resources—Human Development

Nature and human beings are inseparable, and it is crucial to protect the well-being and natural environment (Katircioglu & Katircioglu, 2018). Over the past decades, countries have upgraded their economies and met the necessary human living conditions through the use of natural resources. Sinha and Sengupta (2019) explored the association between human development and natural resource rents in a study of 30 Asia–Pacific countries. The results showed that individualized natural resource rents promote human development, while rents derived from national pools of natural resources hinder human development. The study by Nchofoung et al., (2021) verified that resources have a favorable direct impact on inclusive human development in developing economies with regional and development-level heterogeneity. However, it has also been proved that resource-rich nations have lower rates of economic growth (Isham et al., 2005). Pérez and Claveria (2020) explored the connection between resource dependence and human development growth in ten African nations. The findings exposed a weak inverse association between mineral rents, and human development growth. In addition, overexploitation of resources may lead to poor environmental conditions that may impact the environmental quality. In this regard, studies by Umar et al. (2021) and Zhang et al. (2022) suggested that continuous depletion of natural resources can cause significant challenges to all living things. Although the abundance of natural resources can help an economy to rapidly improve in the short term, in the long

term, natural resources are finite and can cause an ecological crisis when they are used more than they can be regenerated.

## 2.2 Financial Risk—Human Development

Although there is no direct study on the association between financial risk and human well-being, some studies highlighted that financial risks might have a direct or indirect impact on the components that constitute human well-being at different levels. First, at the national level, a stable financial sector has an important contribution to the national and global economic levels (Salari et al., 2022). Whereas the emergence of the COVID-19 has caused great turmoil in the family income and financial market (Liu et al., 2022). The seminal study by King and Levine (1993) noticed a significant positive association between different indicators of financial development and economic growth for a sample of 80 countries. Subsequent studies have also confirmed that financial institutions promote economic growth by stimulating business investment (Levine, 2005). The increase in the economic level can meet the socio-economic conditions necessary for human life and is a major factor in promoting human development (Brady et al., 2007). The literature also suggests that if the financial system is unstable, it can cause losses to the country's output and hinder economic progress (Dell'Ariccia et al., 2008; Epstein et al., 2019). Moreover, instability in the financial sector will pose a shock for the middle class of a country. The weakened assets of the middle class imply an imbalance in the structure of household wealth across classes, affecting income inequality and budget allocation within societies, which can be detrimental to sustainable human development. A recent study shows that the impacts of the global financial crisis on changes in wealth inequality are influenced by country characteristics, and nations with higher levels of financial development are more affected (Shchepeleva et al., 2022).

At the industry level, stable and sustained financing for education can guarantee the steady development of the education sector, optimize the education system of society, and promote the sustainable goals of quality education (Kara et al., 2021). However, financial risks can cause a decline in the financing function associated with the education system, disrupt the arrangement of the education finance system, and make it impossible to further deepen and reform the education system. On the other hand, the shortage of education financing will not be able to meet the basic needs for educational infrastructure at all levels, reducing the operational efficiency in education, and thus affecting the overall human capital stock of society. In addition, stable financial risk will stimulate financing for the healthcare sector and increase healthcare budget allocations to promote sustainable goals for good health and well-being (Kara et al., 2021). In a latest study, Bell et al. (2020) proposed a framework for integrating the financial system with the healthcare system and confirmed that it improves financial stress for patients and helps low-income patients to actively seek care and improve their health status.

Finally, at the individual level, financial risks can lead to real estate price volatility and unemployment which can cause losses to residents and make them insecure. In this regard, Liu et al. (2020) in a study on China verified that the direction of transmission between financial stability and real estate price volatility is bidirectional and that stable finance has a greater impact on real estate prices than the reverse. Therefore, timely monitoring of the level of financial risk and a clear understanding of the possible impact on individuals' lives when financial instability occurs will help stabilize people's quality of life and enhance well-being.

### 2.3 Green Innovation—Human Development

Regarding innovation and human development, past literature has focused on two important aspects. First, the impact of innovations in information technology on human development, for example, Asongu and Le Roux (2017) argued that the enhancement of ICTs can contribute to inclusive human development. Similarly, Acheampong et al. (2022) confirmed that the diffusion and innovation of ICT promote human development. On the other hand, most scholars focus on the impact of green innovation on economic growth that is a vital part of human well-being. Ahmad et al. (2021) argued that green innovation technologies are one of the drivers of sustainable growth for the development of low carbon economies in G7 countries. And for important sectors in development, the development of green innovative technologies is equally crucial to achieving long-term growth (Guo et al., 2021). Moreover, ecological and environmental crises pose a great threat to the long-term development of human societies. In contrast, recent studies have shown that green innovation technologies have an important catalytic role in reducing the ecological footprint of developed countries (Munir Ahmad & Wu, 2022; Yang et al., 2022). This suggests that green innovation has a significant favorable effect on economic development and ecological conservation, which indirectly contributes to the improvement of people's quality of life and thus to the sustainable development of human beings.

### 2.4 Economic Globalization—Human Development

A growing literature has shown the importance of globalization in enhancing economic progress and achieving ecological sustainability (Dorninger et al., 2021). The study of de Oliveira and Moutinho (2022) on BRICS countries suggested that economic globalization is positively correlated with economic growth. Globalization, through the rational allocation of resources and enhanced capital flows, can lead to global economic integration and higher growth rates, which in turn can improve people's living standards and employment opportunities. A study by Usman et al. (2022) confirmed that globalization accelerates technological development and increases economic output in eight Arctic countries by increasing process efficiency. Similarly, other studies have argued that globalization has contributed to economic growth by promoting trade cooperation and attracting foreign capital (Latif et al., 2018). Whereas, Okunade et al. (2022) argued that globalization is primarily a driver of productivity growth rather than GDP because productivity in the effective use of resources adds to higher growth rates and well-being in many ways. Not only that, globalization has a great catalytic role in promoting human capital development through its positive impact on total factor productivity growth.

### 2.5 Research Gaps

Although the literature on human development has attracted much scholarly interest, gaps remain in a number of key research areas. These gaps are summarized as follows: First, past research does not identify the combined impact of financial risk, green innovation, natural resources, and economic globalization on human development. Second, there is no literature confirming the role of green innovation and economic globalization in mitigating the adverse effects of natural resource depletion and the financial risk in

human development. Previous studies have also not unfolded the effects of financial risk on human well-being. Finally, previous research works have not focused on the drivers of human development in emerging economies. And as one of the groups with the fastest GDP growth rates, it is necessary to make corresponding research and responses to their economic well-being to ensure the sustainable development of this group. Lastly, the previous literature on natural resources and human well-being ignored the potential slope heterogeneity and cross-sectional dependence that may exist within the panel data that could result in biased and misleading estimations. Thus, there is a need to study the determinants of human-well being using the appropriate estimation methods for better policy implications. In this context, this study probes the impacts of natural resources, financial risk, green innovation, and economic globalization on human well-being in emerging countries.

### 3 Material and Methods

#### 3.1 Theoretical Framework and Model Construction

The theoretical structure through which natural resources, financial risk, green innovation, and economic globalization impact human well-being is explained in this section. The abundance of natural resources can directly or indirectly impact human well-being. On the one hand, resource rents contribute to the growth of well-being. On the other hand, unsustainable extraction of natural resources generates emissions and destructively affects biocapacity, which in turn can reduce human wellness (Nchofoung et al., 2021).

The financial sector can impact human well-being in several ways. For instance, a stable and healthy financial sector enables countries to allocate more funds for education, healthcare, and infrastructure, which in turn fosters human development (Akhmat et al., 2014; Li et al., 2022a, 2022b; Matekenya et al., 2021). A well-functioning financial sector provides opportunities for poverty alleviation as well as economic and social development by providing access to financial services. Thus, ensuring human well-being entails investment from the governments in the form of budget allocation. In this perspective, financial risk of countries is supposed to affect financial sector operation, and risk levels can significantly influence budget allocation for education and health care. Becker and Tomes (1986) argue that when markets are perfect and complete, financing choices, involving those in human capital, are affected by the rate of return. But when markets are imperfect or incomplete, the human capital financing decisions, and separation of consumption no longer stands, and time dedicated to schooling is affected by family incomes.

The term green innovation has been interchangeably used with the terms, such as eco-innovation and environmental innovation (Jesus & Mendonça, 2018; Olawumi & Chan, 2018; Watson et al., 2018). Chen et al. (2006) defined the term green innovation as: “hardware or software innovation that is related to green products or processes, including the innovation in technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, and corporate environmental management”. From a theoretical perspective, the relationship between green innovation and human well-being is based on the social identity theory. This theory is based on the concept of the net effect of an activity on the well-being of families and individuals (Ashforth & Mael, 1989). Thus, green innovation can improve the quality of life and help generate social opportunities. The orthodox theory suggests that there should be no

welfare loss due to risk-sharing among countries that involve financial and trade liberalization. Yet there is widespread evidence of crises following liberalization in countries (Singh, 2012).

Based on the above theoretical background, we developed this model which is followed by.

$$LHW_{it} = \alpha_0 + \beta_1 LNR_{it} + \beta_2 LFR_{it} + \beta_3 LGI_{it} + \beta_4 LEG_{it} + \varepsilon_{it} \quad (1)$$

where in Eq. (1), HW is the dependent variable that denotes the composite human development index based on the three dimensions (i.e., decent standard of living, knowledge, and healthy lifestyle). LR denotes the natural resources, while financial risk (FR) denotes the core explanatory variables based on the financial risk rating index based on countries' debt service, international liquidity, foreign debts, stability of exchange rate, and the current account of a nation as a % of services & goods. A higher value of the financial risk rating index implies a lower risk. Therefore, following the study of Dennis and Shepherd (2011), we use the formula (1/FR) for the financial risk rating index data of ICRG (2021), so that regression results can be directly interpreted without any confusion. GI symbolizes green innovation that is assessed by the patents on environmental technologies. NR and EG denote the natural resources rent and economic globalization index. The symbol  $\alpha_0$  denotes the constant,  $\varepsilon$  is the error term, and  $i$  and  $t$  represent the cross-sections and time dimension, respectively. Furthermore,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ , and  $\beta_4$  are parameters of explanatory variables. All the variables are transformed into natural logarithm form (L) for better estimation.

### 3.2 Data

The data from 1990 to 2018 is collected for twenty emerging countries, namely, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Greece, Hungary, India, Indonesia, South Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russian Federation, South Africa, Thailand, and Turkey. The other emerging countries are skipped due to data unavailability. The data on human well-being (LW) is sourced from (UNDP, 2020), while the data on financial risk is acquired from (ICRG, 2021). The green innovation (GI) data is sourced from the OECD (2022) database. The data on natural resources rent and economic globalization is acquired from (WDI, 2021) and (Gygli et al., 2019), respectively. The data sources, symbols, and measures are presented in Table 1, while the descriptive statistics, correlation matrix, and multicollinearity test results are given in appendixes a, b, and c.

**Table 1** Variables measurement

Variable	Abb	Measurement	source
Human well-being	HW	Human development composite indices	UNDP (2020)
Natural resources	NR	Natural resources rent	WDI (2021)
Financial risk	FR	Risk rating index	ICRG (2021)
Green innovation	GI	Patents on environmental technologies (% of total)	OECD (2022)
Economic globalization	EG	Economic globalization index	Gygli et al., (2019)



### 3.3 Econometric Methodology

#### 3.3.1 Cross-Sectional Dependency Test

This study uses the panel time-series data with larger time dimensions and few cross-sections that require testing the potential primary issues, such as cross-sectional dependence (CD) and slope heterogeneity prior to the main analysis. In this globalized world, countries are inter-linked through various channels, such as culture, trade, finance, and social networks. Thus, shock in one country may spread to others (i.e., the financial crisis of 2008, COVID-19), which may generate spillover effects and affect the estimators' efficiency. This article uses the estimation method of Pesaran (2004) to test the independencies and dependencies of residual terms. The test can empirically be written as:

$$CSD = \sqrt{\frac{2T}{N(N-1)}} \left( \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\eta}_{ij} \right) \tag{2}$$

In Eq. (2),  $\hat{\eta}$  denotes the pair-wise residual correlation, N is for sample size, T indicates the time, and CSD for the Pesaran CD test.

#### 3.3.2 Slope Heterogeneity Test

Despite many interconnections among the panel countries, they may have varying rates of innovation, economic, demographic, and institutional structures that could affect the empirical results. Thus, to tackle this issue, this study relied on Pesaran and Yamagata's (2008) test to inspect the heterogeneity in panel countries. The test equation can be written as:

$$\tilde{\Delta}_{ASH} = (N)^{\frac{1}{2}} \left( \frac{2k(T-k-1)}{T+1} \right)^{-\frac{1}{2}} \left( \frac{1}{N} \tilde{S} - k \right) \tag{3}$$

$$\tilde{\Delta}_{ASH} = (N)^{\frac{1}{2}} \left( \frac{2k(T-k-1)}{T+1} \right)^{-\frac{1}{2}} \left( \frac{1}{N} \tilde{S} - k \right) \tag{4}$$

#### 3.3.3 Unit Root Analysis

This paper utilizes the cross-sectional Augmented Im-Pesaran-Shin (CIPS) test and the Augmented Dickey-Fuller (CADF) test of Pesaran (2007). These unit root inspection strategies are appropriate for heterogeneous panels and have stronger robustness than first-generation unit root tests. The results will accept the null hypothesis when there is no unit root problem. Conversely, when the p-value is less than a specific value, the existence of a unit root problem is justified, and the final order of integration must be determined. The form of the CADF is given in Eq. (5):

$$\Delta y_{i,t} = \varphi_i + \varphi_i Z_{i,t-1} + \varphi_i \bar{y}_{t-1} + \sum_{l=0}^p \varphi_{il} \Delta \bar{y}_{t-1} + \sum_{l=0}^p \varphi_{il} \Delta y_{i,t-1} + \mu_{it} \tag{5}$$

where  $y_{i,t}$  is the observation, and  $\bar{y}_{t-1}$  &  $\Delta \bar{y}_{t-1}$  are the averages. The CIPS is a simple average of the CADF, and it is illustrated in Eq. (6):

$$\widehat{CIPS} = \frac{1}{N} \sum_{i=1}^n CDF_i \quad (6)$$

### 3.3.4 Panel Cointegration Test

The cointegration test is the next step after unit root analysis. This test is designed to verify whether there is a long-term linkage among the related variables. This is a crucial step because the subsequent regression steps are meaningless if there is no cointegration link between the variables. In terms of validation strategy, this paper opted for two types of cointegration, namely Pedroni (2004) and Westerlund (2008). The application of Westerlund cointegration is based on the computation of one group and one-panel statistics by utilizing the Durbin–Hausman principle. This test is more reliable and produces efficient results during CD.

### 3.3.5 Long-Run Estimation and Robustness Test

Economists have suggested various econometric estimation methods to gauge the long-run relationship of panel data, such as ordinary least squares (OLS), fixed effect model, and generalized method of moments (GMM). However, under cross-sectional dependence and slope heterogeneity across countries, traditional estimation methods can generate unreliable and deceptive results (Sinha et al., 2022). Therefore, this study uses the Common Correlated Effects Mean Group (CCEMG) approach by Pesaran (2006) to gauge the long-run elasticities. This method is more flexible and tackles the cross-sectional dependence, slope heterogeneity, and endogeneity problem. Moreover, the CCEMG model avoids identification bias such as omitted variables and reverse causality because it induces time-variant unobservable with heterogeneous effects across panel members (Eberhardt, 2012). Afterward, the FMOLS and DOLS approaches are also adopted for assessing the reliability of the long-run analysis. These methods offer tempting advantages to counter the possible panel data problems such as serial correlation, endogeneity, and CD.

### 3.3.6 Panel Granger Causality Test

Although long-run results from the CCEMG, FMOLS and DOLS provide significant interface but the causal flow among must be assessed for the better policy suggestions. Therefore, in the last step, this study assess the causal connection among variables by using the Dumitrescu and Hurlin (2012) approach.

## 4 Results and Discussion

In the first step of empirical analysis, the CD test of Pesaran (2004) is applied. The outcomes in Table 2 depict the presence of CD in the panel countries, which is evident from the significance of the test statistics at a 1% level. The mean  $\text{abs}(\rho)$  values vary between 0.20 and 0.93, indicating that emerging countries are strongly interconnected. Despite strong interdependence, emerging countries have varying rates of innovation and economic and demographic structures that may create slope heterogeneity problems in empirical analysis. Table 3 reports the slope heterogeneity estimates. According to Pesaran and

**Table 2** CD test results

Variable	Test stat	Prob	Mean abs ( $\rho$ )
LHW	69.211*	0.000	0.932
LNR	39.606*	0.000	0.543
LFR	15.851*	0.000	0.325
LGI	8.877*	0.000	0.200
LEG	50.232*	0.000	0.711

Note: The symbol \* represents the significance level at 1%

Yamagata (2008), we can reject the null hypothesis of homogenous slope based on the delta and adjusted delta values.

Table 4 represents the unit root results of CIPS and CADF at a level and first difference. The findings depict that the variables of HE and NR have unit root problems at levels in the CADF test. In contrast, for all the variables, the alternative hypothesis is accepted at the level except for HW in the CIPS test. However, all the study variables become stationary after taking the first-difference in both methods.

We applied Pedroni (2004) and Westerlund (2008) to examine the cointegration among variables. The results Table 5 depicts that all the test statics from the Pednori method are significant at a 1% level, which suggests the rejection of no cointegration hypothesis. In addition, it can be observed that the group-based statistics ( $DH_g$ ) and panel-based statistics ( $DH_p$ ) from Westerlund’s test have a value of  $-2.045$  and  $-1.593$  with a significance level of 5% and 10%, respectively. It means that LHW, LFR, LGI, LNNR, and LEG are cointegrated in the long-term.

Table 6 depicts the long-run results from CCEMG estimates. Natural resources rent (LNR) is found to be a negative factor in attaining human well-being in emerging countries. The coefficient of LNR is negative with a value of  $-0.004$ . It implies that a 1% increase in LNR will impede human well-being by 0.004%. This result corroborates with

**Table 3** slope heterogeneity test results

Test	Value	P-value
$\tilde{\Delta}$	13.990*	0.000
$\tilde{\Delta}_{adjusted}$	15.709*	0.000

Note: The symbol \* represents the significance level at 1%

**Table 4** Unit root test results

Variable	CADF		CIPS	
	Level	First-difference	Level	First-difference
LHW	-1.480	-3.006*	-1.404	-4.408*
LNR	-1.994	-4.391*	-2.143**	-5.622*
LFR	-3.331*	-4.637*	-3.528*	-5.833*
LGI	-3.619*	-5.475*	-4.792*	-6.059*
LEG	-2.473*	-3.529*	-2.476*	-4.760*

Note: The symbols \* and \*\* represent the significance levels at 1% and 5%, respectively

**Table 5** Panel cointegration test results

	Value	P-value
Pedroni cointegration test		
Modified Phillips-Perron	5.393*	0.000
Phillips-Perron	5.180*	0.000
Augmented Dickey-Fuller	5.088*	0.000
Westerlund (2008) panel cointegration test		
$DH_g$	-2.045**	0.020
$DH_p$	-1.593***	0.056

Note: The symbols \*, \*\*, and \*\*\* represent the significance levels at 1%, 5%, and 10%, respectively

**Table 6** Long-run estimation results—CCEMG

Variable	Coefficient	Std. Error	Z-value	P-value
LNR	-0.004*	0.002	-2.59	0.009
LFR	-0.009**	0.004	-2.27	0.023
LGI	0.002**	0.001	2.22	0.026
LEG	0.017*	0.005	3.44	0.001
Constant	-0.126*	0.026	-4.82	0.000

Note: The symbols \* and \*\* represent the significance levels at 1%, and 5%, respectively

the conclusions of Numba et al. (2022) for 49 African countries and Sinha and Sengupta (2019) for 30 Asia Pacific nations. Our findings contradict the result of Stijns (2006) and Nchofoung et al., (2021), who claimed that natural resources rent positively impact human development. However, having dependence on natural resources might hinder the countries from endogenous ability and employment creation, as the national treasure is collected through the mining of resources. This phenomenon resonates with the discourse of “Club of Rome” which states that seamless natural resources extraction will “limit to growth” and hereafter development (Meadows et al., 1972). Lack of capacity building might bring hyperinflation, lead to gradual deterioration of education infrastructure, and negatively affect human well-being (Sinha & Sengupta, 2019).

The findings indicate the coefficient of financial risk (LFR) is negative, with a value of -0.009 at the 5% significance level. It implies that a 1% increase in LFR will impede human development by 0.009% in the long run. A stable financial and economic environment is conducive to stimulating investment in health and education, which increases well-being (Sethi et al., 2019). Our results portray that financial risk negatively impacts human well-being in emerging countries. Financial and economic hardship can have a devastating effect on human capital. The recent outbreak of the COVID-19, in particular, has dealt a massive blow to household incomes, tourism, and economic development. This has an adverse effect on the development of human beings (Geng et al., 2022; Li et al., 2022a, 2022b).

Countries worldwide face growing risk from financial fragility created by the conflict among countries, uncertainties, and global financial crisis. Finance can affect well-being through aggregated growth and changes in the distribution of income (Beck et al., 2007).

Financial risk affects climate-related policies and allocation of green finance which inevitably leads to social disorder.

The results further suggest that green innovation (LGI) positively influences human well-being (LHW) in emerging countries. Numerically, a 0.002% improvement in LHW can be achieved by a 1% increase in LGI. Thus, this result illustrates that an increase in green innovation stimulates human well-being and thus, can influence the achievement of SGDs. The concept of innovation is critical to addressing social inequalities, significantly impacting the extension of human abilities and generating social opportunities that bring improvement in quality of life (Dakhli & De Clercq, 2007). The results can be justified on the ground that LGI plays a pivotal role in reducing emissions compared to traditional technologies. Thus, LGI can improve human well-being by improving environmental quality. Our results coincide with Qureshi et al. (2020), who disclosed that technological innovation enhances human development in technologically superior nations.

The results further indicate that economic globalization (LEG) significantly promotes human well-being in emerging countries. Numerically, a 1% increase in LEG will foster human well-being by 0.017%. These results are reasonable because economic globalization enhances both inclusive and exclusive economic activities that can lead to human development in emerging countries. This argument is further justified on the ground that emerging countries increased trade and financial openness during the last two decades, which positively impacted their development process in terms of employment opportunities, skill development, and capacity building, which in turn promoted inclusive growth. Our conclusions are comparable to the results of Nounba et al. (2022) and Sinha and Sengupta (2019), who found a positive relationship between overall globalization and human development.

For robustness check, this study employed the FMOLS and DOLS methods. The outcomes in Table 7 illustrate that financial risk and natural resources rent are negatively connected with human well-being. However, green innovation and economic globalization have a positive impact on well-being. These results endorsed the findings of the CCEMG method.

Table 8 represents the Granger causality results, indicating that LNR, LFR, and LEG Granger cause human well-being (LHW). It implies that an increase or decrease in natural resources, financial risk, and economic globalization influence LHW but not the other way round. Moreover, bidirectional causality exists between LHW and LGI,

**Table 7** Robustness check

Variables	FMOLS		DOLS	
	Coefficients	T Stats	Coefficients	T Stats
LNR	-0.011***	-1.918	-0.013**	-1.993
LFR	-0.118*	-4.818	-0.150*	-3.853
LGI	0.029*	4.883	0.039*	3.716
LEG	0.282*	17.566	0.289*	21.877
R-squared	0.906	-	0.956	-
Adjusted R-squared	0.902	-	0.911	-
Long-run variance	0.004	-	0.003	-

Note: The symbols \*, \*\*, and \*\*\* represent the significance levels at 1%, 5%, and 10%, respectively

**Table 8** The DH non-causality test results

Variables	LHW	LNR	LFR	LGI	LNEG
LHW	–	2.773* (0.005)	2.714* (0.006)	4.353* (0.000)	6.024* (0.000)
LNR	2.739 (0.361)	–	2.531** (0.011)	2.066** (0.038)	5.428* (0.000)
LFR	0.865 (0.387)	2.983* (0.003)	–	3.311* (0.000)	5.547* (0.000)
LGI	3.663* (0.000)	3.659* (0.000)	2.433* (0.015)	–	4.931* (0.000)
LEG	1.107 (0.268)	3.278* (0.001)	3.701* (0.000)	1.048 (0.294)	–

Note: The symbols \*, and \*\* represent the significance levels at 1%, and 5%, respectively

indicating that any change in LGI will Granger cause LHW and vice versa. A similar causal association is also found between LFR-LNR, LGI-LNR, and LEG-LNR. A bidirectional causal connection between LFR and LGI is also noticed. It implies that any changes in financial risk influence green innovation, while green innovation also Granger causes financial risk. In addition, LEG influences LGI, indicating that any changes in economic globalization influence green innovation. Thus, emerging countries should design policies to enhance economic globalization, which may promote green innovation.

## 5 Conclusion and Policy Implications

We have studied the impacts of natural resources, financial risk, green innovation, and economic globalization on 20 emerging countries from 1990 to 2018. The second-generation panel techniques utilized in our paper involved Pesaran (2004) test for CD and Pesaran and Yamgata (2008) test for slope homogeneity. In addition, to inspect the data for the presence of unit roots the Pesaran (2007) CIPS and CADF tests are applied. Pedroni (2004) and Westerlund (2008) cointegration tests are deployed to verify whether there is a long-term cointegration among the related variables. Next, this study uses the Common Correlated Effects Mean Group (CCEMG) approach to gauge the long-run elasticities, while FMOLS and DOLS tests are used to verify the long-run findings. Finally, we also determined the causal linkage among the variables by employing Dumitrescu and Hurlin (2012) test.

The results provide some concerns about the data, such as the CD and the slope heterogeneity. Additionally, the CIPS and CADF tests revealed that all variables are guaranteed to be smooth after first-order differencing. The outcomes of the cointegration analysis confirm the long-term cointegration association in all models. The finding from the CCEMG test depicts that natural resources and financial risk negatively affect human well-being in emerging countries. The results further indicate that green innovation and economic globalization positively and significantly impact human well-being. Our robustness test also verifies these findings. Moreover, the panel Granger causality results indicate unidirectional causality from natural resources, financial risk, and economic globalization to LHW. In addition, LHW has bidirectional causality with green innovation. Moreover, financial risk and economic globalization Granger cause green innovation in emerging countries.

Based on empirical results, this paper proposes the following policy suggestions: (1) Our study shows that natural resources negatively impact human well-being in emerging nations, so they should be cautious in utilizing the revenue from non-renewable sources. Economic benefits from these resources should be used to build the endogenous capacity of the economies, such as employment creation, skill development, capacity building, and long-term developmental goals. (2) Financial risk hinders human well-being, so nations should aim to reduce financial risk for stable economic and social growth, thus promoting human well-being. (3) Thirdly, the government should pursue policies that support green innovation, as it promotes human well-being. Green innovation will lead to the development of cost-effective alternative energy sources, which will provide cleaner energy and reduce the harmful effects of fossil fuel extraction and usage. Policymakers should allocate funding for research and development to foster green innovation, leading to increased energy efficiency in emerging nations. Encouraging innovation-focused policies will aid in the transition from fossil fuels to more sustainable energy sources and improve human well-being.

Lastly, our research indicates that economic globalization has a positive impact on human well-being in these nations. Policymakers should therefore continue to facilitate economic integration through liberal trade policies and reductions in foreign investment taxes. The process of foreign investment should be streamlined, and tax incentives should be provided to attract more investment. Regional trade agreements and collaboration will allow emerging nations to fully realize the benefits of economic globalization.

## 6 Limitations

The study analyzed the impact of natural resources, financial risks, green innovation and economic globalization on human well-being in 20 emerging countries from 1990 to 2018. Emerging economies as a group of booming, its economic level is accelerating development. In the course of development, factors such as natural resource endowments and financial market instability can have specific impacts on the economic well-being of emerging economies. But for advanced economies, with their abundant natural resources and long stable financial markets, the impact on human well-being can vary slightly. Therefore, the results of this study may not be universal to other advanced economies. However, this study has a unique perspective, and there are few related literature records, which provides more possibilities for future research.

## Appendix A: Descriptive Statistics

Variables	Obs	Mean	Std. Dev	Minimum	Maximum	Jarque–Bera	Prob
LHW	580	-0.379	0.188	-1.100	-0.090	298.943	0.000
LNR	580	0.626	1.623	-4.056	3.249	115.827	0.000
LFR	580	-3.625	0.143	-3.882	-2.944	256.265	0.000
LGI	580	2.272	0.499	0.140	3.833	218.924	0.000
LEG	580	3.950	0.286	2.674	4.442	168.783	0.000

## Appendix B: Pairwise Correlation Matrix

Variables	LHW	LFR	LNR	LGI	LEG
LHW	1.000				
LFR	0.014	1.000			
LNR	-0.452	-0.125	1.000		
LGI	0.294	-0.140	0.009	1.000	
LEG	0.277	-0.112	-0.122	0.127	1.000

## Appendix C: Multicollinearity Test Results

Test	VIF	1/VIF
LFR	1.050	0.953
LGI	1.046	0.956
LNR	1.036	0.966
LEG	1.033	0.968
Mean VIF	1.041	-

**Author Contributions** MA: Conceptualization, Methodology, Software, Data curation, Formal analysis, Writing-Original Draft. ZA: Writing-Original Draft, Writing review & editing, Supervision, Project administration. XY: Conceptualization, Writing-Original Draft, Writing review & editing. MC: Writing-Original Draft, Writing review & editing.

**Funding** This study was supported by the Fundamental Research Start-up Funds from Shandong University of Technology (Project No. 4033/721020).

**Data Availability** The raw data supporting the conclusions of this article is available in the public sources mentioned in the article.

## Declarations

**Conflict of interest** The authors declare no conflict of interest.

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