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To cite this article: Jianhua Ye, Ahmad Al-Fadly, Pham Quang Huy, Thanh Quang Ngo, Doan Dang Phi Hung & Nguyen Hoang Tien (2022) The nexus among green financial development and renewable energy: investment in the wake of the Covid-19 pandemic, Economic Research-Ekonomiska Istraživanja, 35:1, 5650-5675, DOI: [10.1080/1331677X.2022.2035241](https://doi.org/10.1080/1331677X.2022.2035241)

To link to this article: <https://doi.org/10.1080/1331677X.2022.2035241>



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Published online: 17 Feb 2022.



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The nexus among green financial development and renewable energy: investment in the wake of the Covid-19 pandemic

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ABSTRACT

Environmental protection has become a significant issue around the globe. The extensive use of renewable energy and green finance is considered as the solution to this dramatic issue, especially in the Covid-19 lockdown. To answer this demand, the present study examines the impact of green financial development such as green credit, green investment, and green securities along with corporate social responsibility (CSR) in reporting renewable energy investment based on evidence from an emerging economy. Economic growth was used as the control variable of the study. The data was gathered from the central bank and World Development Indicators (WDI) from 1976 to 2020. The error correction model (ECM) was used to test the nexus among the variables. The findings revealed that green credit, green investment, and green securities along with CSR reporting and economic growth have a significant positive nexus with renewable energy investment in the selected emerging economy. These outcomes are helpful for new arrivals to investigate this area in the future along with regulators who want to formulate policies related to green finance and renewable energy usage and investment in the context of emerging and developing countries.

ARTICLE HISTORY

Received 28 October 2021
Accepted 23 January 2022

KEYWORDS

Green credit; green investment; green securities; CSR reporting; renewable energy investment; economic growth

JEL CLASSIFICATION

O1; Q4; A1; H1

1. Introduction

Economic growth is the amalgam of different financial factors and the trading efficacy of the business sector (Corrás-Arias, 2020). Green financial development and green economy-related programs are new in the world economy. Sustainable development

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[#]This research is partly funded by University of Economics, Ho Chi Minh City, Vietnam

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and eco-friendly practices result in prosperous outcomes. The developed countries' financial sector has transformed their old-fashioned financial planning to new and innovative green economic and financial development efforts. The newly developed green economy-related businesses are built from the Reduce, Reuse, and Recycle (3R) approach. The green economy approach is eco-friendly and easy to use and adapt (Jahid et al., 2020). The transition from capital centralized economic models to green economic and environmentally friendly financial approaches have revolutionized the world economy. In the present era, scientists and environmental biologists are working together on combined ventures to support the green financial economy and infrastructure (Islam, 2020). The green economy's visionary approach is based on the observation that the ecological crisis has evolved immensely in recent years. Global warming and ozone depletion related problems have changed the world altogether. Population pressure and the increased number of factories have changed the world's atmosphere. Ecological well-being and environmental balance have been disturbed. The need of the hour is to put an honest effort into the green economy and related businesses (Muller & de Klerk, 2020).

Green financing is one of the main themes of the green economic development program. Green financing refers to investment making in the environmental and social friendly projects that are carried out by commercial entities both on the private or state level. The facility of green financing encourages the investment in the acquisition or development of environmentally friendly resources in business organizations. Energy resources are an essential part of business organizations such as in manufacturing, transport, mining, and tourism industries among others. Energy resources may be renewable and nonrenewable (Zeidan, 2020). Nonrenewable energy resources may be cheap while being acquired or used, but they may affect the health of the general people, environmental quality, and the quality of natural resources. In the end, they also add to the total cost and adversely affect economic growth. On the other hand, renewable energy resources need more financial resources, but they do not put negative impacts on the health of the general public, environmental quality, and the quality of natural resources. Green financing makes it possible for the business organization to carry out renewable energy programs in order to encourage renewable resources for energy purposes (Alshater et al., 2021). During the spread of the Coronavirus disease 2019 (henceforth Covid-19), green financing is the most significant source to protect the health of the people, natural environment and save the economy from damage or fall. Covid-19 is a contagious disease caused by the severe acute respiratory syndrome coronavirus 2. It started in Wuhan, China, in December 2019. The disease has spread worldwide, leading to an ongoing pandemic, which has adversely affected people's health. It spreads through air or touch. It does not know the boundaries of regions. It is not only a threat to the health of the people but also the society and economy, which led to the government encouraging environmental protection programs. Green finance to renewable energy programs is a great contribution to environmental protection and economic growth during the Covid-19 pandemic (Lagi, 2020).

The energy sector plays a backbone role in the economy of any country (Chien, Pantamee, et al., 2021). Over time, this sector is becoming increasingly important.

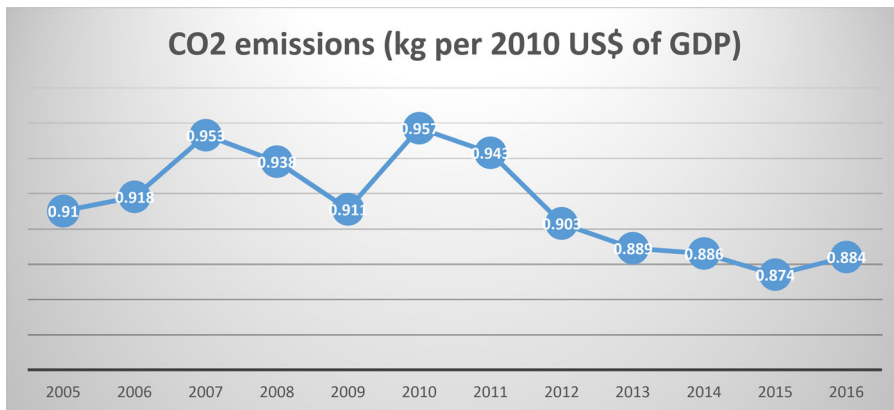
The Islamic Republic of Pakistan reaches Central Asia in the north-west zone of South Asia. It borders East India, West Iran and Afghanistan, and North China. It has a southern shore in the Arab Sea. It is the sixth most populated nation in the world, with an approximate population of 195.4 million. The country's economy has displayed signs of change in recent years. The Gross Domestic Product (GDP), which experienced the fastest growth since 2007, has risen by 5.3% in 2017 (Chien, Sadiq, et al., 2021). This rise is attributable to numerous factors such as increased foreign-exchange reserves, decreased budget deficits, and improved security. Two other significant factors have led to economic stability: a dramatic decrease in world oil prices and increased foreign remittances. Pakistan's key electricity sources include natural gas, oil, hydropower, coal, and nuclear energy. Natural gas and oil account for 43% and 36% of the overall production of primary resources (TPES) respectively in 2015 (Chien et al., 2020). The balance of recoverable natural gas reserves decreased in June 2014 from 31 trillion cubic feet in 2009 to 23.64 TSCF. Still, the proportion of natural gas in the energy mix is forecasted to grow (Raza et al., 2019). In 2006, crude, for example, accounted for 28.27% of TPES, 32.04% in 2011 and 34.42% in 2015. Over 2006-2015, the total annual oil use increased by 4.5%. A decline in oil rates in 2014 contributed to a fall in the import bill. Crude oil accounted for USD 14.77 billion (USD) in 2014, USD 12.167 billion in the year 2015, and USD 7.668 billion in the year 2016 as part of the overall bill of imports (Huang et al., 2020).

The remaining sources include hydropower, LPG, gas, nuclear, biomass, and energy imports. Pakistan has expanded its nuclear power share, with an additional 2880 megawatts (MW) potential under development. Renewables (except hydroelectricity) in 2015 were just 0.3% of the TPES (Hydrocarbon Development Institute of Pakistan, 2016). Most of the world's rural population depend on conventional usage of biomass, but the government officially does not quantify the year and publish it. The IEA reports that in 2014, there were 105 million Pakistanis who depended on conventional biomass. According to IRENA's 2015 final figures on green energy use, conventional biomass usage was 8.2 Mtoe. The major sources of LPG and manufactured power are Iran and a limited share of the overall energy supply. In 2015, final energy consumption (including energy production use) amounted to 41.98 Mtoe. Thirty-six percent of the final energy use was for the manufacturing sector, preceded by transport (32%), domestic (also called household or residential) (24%), commercial (4%), and agricultural (2%) industries. In the year 2015, only agriculture had a negative annual compound growth rate. In the past decade, no sufficient increased capacity has been matched by population development nor by increasing industrial and commercial energy demand. The country's electrification rate has risen from 54% in 2006 to 73% in 2016, generating an emerging demand-supply grid disparity in the second half of 2005. In the year 2006 (NEPRA, 2008), it crossed 55 MW and increased further to 4,574 MW in the financial year 2008, to a historic peak of 6,758 MW in for the year 2012. The Planning Commission forecasts that the power market will begin to grow annually by 4–5% in the next five years (Li, Chien et al., 2021; Nguyen et al., 2021). The CO₂ emission in Pakistan from 2005 to 2016 is given in Table 1. There are mixed increasing and decreasing trends reported.

Table 1. CO2 emissions (kg per 2010 US\$ of GDP).

Sr.	Year	CO2 emissions (kg per 2010 US\$ of GDP)
1	2005	0.910
2	2006	0.918
3	2007	0.953
4	2008	0.938
5	2009	0.911
6	2010	0.957
7	2011	0.943
8	2012	0.903
9	2013	0.889
10	2014	0.886
11	2015	0.874
12	2016	0.884

Source: Census and Economic Information Center (CEIC) Data World Bank.

**Figure 1.** CO2 emissions (metric tons per capita) in Pakistan.

Source: Census and Economic Information Center (CEIC) Data World Bank.

The CO2 emission in Pakistan from 2005 to 2016 is given in Figure 1. There is an increasing trend reported in CO2 emission from 2012 onwards. Initially, there was an increasing trend from 2005 to 2007. There is a mix of increasing and decreasing trends from 2008 to 2011.

Covid-19 is a contagious disease that poses a serious threat to the quality of natural resources, the environment, and the health of the general people since the beginning. It is caused by the respiratory syndrome coronavirus which affects people through breathing in the air or interaction and touch from someone affected. The disease has spread fast across the world, especially in regions that are exposed to a number of polluting factors like the spreading of carbon emissions into the atmosphere. Thus, regions which are industrialized and where the economy is mostly covered by manufacturing or transportation activities are more likely to be exposed to the spreading of Covid-19, leading to the ban on the movement of people and decline in economic growth (Mukherjee et al., 2020). In this difficult situation, green finance to environmental or eco-friendly programs is a powerful tool to overcome the spread of Covid-19 and related problems as this would encourage renewable energy, which is a great response to the carbon emission into the atmosphere. This is the most

serious issue which needs a long investigation and discussion (Chehal et al., 2020). Our study is also a struggle in this regard.

The main objective of the current study is to examine the impacts of green credit, green investment, and green securities along with CSR reporting and economic growth on renewable energy investment. 1) For a long time, the role of green finances in encouraging renewable energy production and consumption within the economy for the sake of controlling environmental pollution spreading has been analyzed but in a normal situation. As the current study analyzes the green fiancé in relation to renewable energy production during the covid-19 situation, it is a great addition to the literature. 2) green finance, like the impact of green credit, green investment, and green securities, and renewable energy in a mutual relationship, has been the subject of many studies. But either the studies have addressed green finance without its dimensions for determining the renewable energy investment or the impacts of green credit, green investment, and green securities on renewable energy investment individually. The present study, which examines the impact of green credit, green investment, and green securities on renewable energy investment at the same time, contributes to the literature. 3) In the economy of Pakistan, few studies have been conducted which examine the impact of green credit, green investment, and green securities on renewable energy investment. This study is the initial struggle to analyze the impact of green credit, green investment, and green securities on renewable energy investment.

The paper is composed of five portions. The 2nd portion describes the relationship among the green credit, green investment, and green securities, and renewable energy investment with references from past literature. The 3rd part describes the ways to handle data in support of the study. Then, the study results are set and supported by another study. Then, the study ends with a study conclusion and implications.

2. Literature review

Investors are people who directly and indirectly support the economy of a country. Better investment plans and options are always beneficial for a sustainable economy. Financially stable economies of the world have clear strategies for implementation. Global warming, greenhouse effects, ozone depletion, population over-growth, and the pandemic have destroyed the whole world's economies (Anagnostopoulos et al., 2020; Li, Chien, Hsu, et al., 2021). In the modern age, all business firms and factories must invest their funds in developing strategies to cope with all such environmental crises. Governments worldwide have added a new chapter in their by-laws that supports green economy development. The green economy is based on renewable energy resources, and these resources include fossil fuels and the use of biodegradable materials like plastic and paper (Sardianou & Kostakis, 2020). Novel strategies that can support biomass usage as fertilizers and ignition materials for all firms must be implemented. The smoke generated from these bio-degradable materials is not hazardous to nature, and the waste materials or effluents are also eco-friendly. They can be recycled economically using simple machines.

Since contagious diseases like the Covid-19 began to spread in the countries across the world, all economic, social, private, and government activities have been disturbed. Thus, all economic and social organizations and private and government entities have paid attention to serious matters and try to overcome issues that may cause an increase in the cases of Covid-19 (Ali et al., 2020). Changes have been made in policies, strategies, and the rules of any economic or social sector so that the capacity of all social and economic entities to maintain the environmental sustainability can be improved. Just like other sectors of the economy, the financial sector has also been active in implementing strategies to overcome pollution and thus enable all social and economic entities to fight against Covid-19. Green financing is an initiative by financial institutions to overcome environmental pollution by encouraging renewable energy consumption during Covid-19 (Verma et al., 2021). Many studies have been conducted to analyze the impacts of green financing on renewable energy consumption during Covid-19, some of which are cited below.

The investment in renewable energy resources is not only eco-friendly, but also economically sound (Han, 2020; Nawaz, Hussain, et al., 2021). The Covid-19 pandemic has not ended, yet it has caused complexities in all situations. The use of masks made up of biodegradable materials is essential for waste management practices. These masks and other personal protective equipment are economically sound and cost-effective for manufacturing purposes (Al Asbahi et al., 2019; Shair et al., 2021). Thus, investment in renewable energy resources helps the well-being of the environment in enduring circumstances during the pandemic (Hager & Hamagami, 2020; Nawaz, Seshadri, et al., 2021). Green credit is the investment into a specific interest rate on eco-friendly business ventures. Developed countries have a well-developed and organized infrastructure to support the green economy (Mengyao, 2020). Business firms that lend loans to start new business projects based on eco-friendly approaches are well-established throughout the world. Business companies are investing more and more funds in green economic projects (Baloch et al., 2020). Developing countries like Pakistan have initiated the investment into new business ventures, but the efforts are not emerging at large scales (Wang et al., 2020). The Covid-19 pandemic has created great havoc for economic well-being and financial stability. The healthcare cost increment has devastated all economic sectors. Business firms are nowadays struggling to cope with the crisis. The need of the hour is to devise new and innovative ways to support green credit investment initiatives (Li et al., 2020; Sun et al., 2020).

Green credit initiatives are important to make the economy of Pakistan stable and well-established. Eco-friendly biofuels and recyclable material usage are essential for the growth of the economy (Chien, Ajaz, et al., 2021; Mohsin et al., 2021). Green credit investment options are beneficial for Pakistan's prosperity (Pan et al., 2020). Green securities are safe investment options for the well-being of green economic growth and development. The use of environmentally friendly materials in business firms for manufacturing purposes is imperative for the community's well-being (Al-Mutairi et al., 2020; Chien, Kamran, Nawaz, et al., 2021). Developed countries like China have implemented safe financing approaches for the well-being of their economy, including companies which have proper strategies to support health insurance

and other health-related implications. Environmental sustainability options are essential to support prosperity and economic growth (Pisedtasalasai & Edirisuriya, 2020).

The coronavirus lockdown has disturbed the budget of all people globally and has specifically destroyed developing countries like Asia and Africa. In these countries, the workforce is usually comprised of the poor and daily wagers (Chien et al., 2021; Zhuang et al., 2021). They cannot perform their routine activities during this lockdown, and as a result of these implications, all will have to cope with this havoc with wise planning and cooperation (Wahyuningrum et al., 2020). Like the USA and UK, the developed countries of the world have started new projects that will support the native and small-scale firms to scale up their production and manufacturing practices. These initiatives will improve the condition of the business in developing countries (Baloch et al., 2021; Ermakova, 2020). Healthcare costs due to corona-related issues have also increased. The need of the hour is that all business firms and industrial units should devise new strategies and plans to support their staff. These initiatives will support the business firms and the confidence of the staff in their employers (An & Pivo, 2020).

Green investment initiatives are credit options that have future implications for the development and prosperity of the economy of a country. In developing countries like Pakistan, insurance-based options are scarce, but efforts are in progress for the economic sector's well-being (Li et al., 2020). Business communities throughout the world have focused on the development of green insurance-based options. Companies are providing green investment platforms that support overall green credit loans. Companies around the world have a transparent set of social and economic development initiatives that supplement the overall green economy and investments. These initiatives support eco-friendly approaches and show the extent of social responsibility in industries. New and innovative production units generate no harmful effluents and waste materials. These plants are not only cost-effective but also supportive of the growth and development of economic growth initiatives. Biomass and agricultural wastes are abundant in developing countries like Pakistan. Pakistan can use all these wastes for the generation of bio-friendly fuels. These fuels can easily produce new and innovative products (Ehsanullah et al., 2021) that can support the infrastructure of the country. Industrial units that have adopted eco-friendly ways of production have more production rates than traditional industrial units. The need is to enhance the number of such eco-friendly and economically sound industrial units (Dwivedi et al., 2020).

Green investment is the main theme of the green economic development program. These investments are made in renewable and eco-friendly raw materials, producing more efficient and cost-effective products (Rosefielde, 2019). Developed countries like the USA and UK are already investing in green fuels and production units (Rajiani & Ismail, 2019), which have huge benefits for environmental protection and the ethical well-being of the world's economies. In Covid-19 crisis-related situations, all companies that have started green investments could manufacture more and more products. Their businesses have flourished ten-fold compared to other manufacturing units. Developing countries like Pakistan have not modernized much in green investment areas, so most production units are dependent on imported raw materials and products (Tran et al., 2020).

In the Covid-19 crisis, as the world transportation and delivery options were stopped and banned, many businesses were not able to operate as usual (Hsu et al., 2021; Li, Chien, Ngo, et al., 2021), and they have fired most of their poor workers due to this situation (Siala & Jarboui, 2019). On the other hand, production units in developed countries have proper materials and eco-friendly manufacturing units that can produce eco-friendly products in a very minute period. Thus, green investment approaches have a very promising future. All these initiatives are cost-effective and essential for the development of countries' economies. In developed countries, green investment initiatives have provided a complete cover to all economic development efforts (Wu & Li, 2020). Corporate social responsibility is the proper, financially stable approach for the well-being of the economy. In developed countries, all companies and business firms are responsible for showing cooperative social responsibility and planning initiatives for their economic infrastructure's well-being. Corporate social responsibility has improvised the living and health standard of all serving employees of a specific business or company. In developed countries, all employers strictly obey the government's restrictions and implications, which are devised by the government for the support of the employee's health and well-being.

In developing countries like Pakistan and other Asian countries, employers do not follow the government's proper rules and regulations. In the recent era, Covid-19 has devastated the whole world and economy of all developing countries. The hour's need is to support and respond ethically to all environmental protection initiatives implemented by the government. The social responsibility of all business firms is for the support of eco-friendly initiatives. Green economy measures have a great tendency to support the economic growth of the country. Bio-friendly approaches are important for human beings. The trickle-down effect of the green economy supportive measures also support animals and plants' well-being. The green economy ensures well-regulated economic growth that supports societies' environmental and social well-being. In the modernized world, there are many parameters to gauge economic growth, and most important of these measures is the implementation of an information technology system in the economic and health sector (Meyer & Meyer, 2020).

A proper implementation of a CIS system in healthcare practices can make the economic sector better. An improved communication system is the most helpful tool in modernized medical practices. All medical staff in the corona pandemic must have up-to-date knowledge for data collection, data management, and storage of the patient's entire medical history. The Patient Care Information System (PCIS) is a digitalized platform to collect, store, and cross-verify the entire medical history of a patient. The working professional or paramedical staff in ER and OPD must have complete knowledge of all the SOPs related Covid ICUs. All paramedics must have fundamental knowledge of effective communication and data sorting. Professional software-based knowledge is essential for the well-being of the economy as well. The knowledge of data management and nursing information systems coordinated with the budgeting and finance department is useful. The medical staff's responsibility in this pandemic is to maintain complete documentation of drug usage, dosage information, schedule management, and maintenance of the complete record of body temperature.

The practical implementation of all the healthcare safety practices, communication skills, utilization of all the healthcare devices, and proper knowledge of ethical standards can be improvised with continued practice (Shi et al., 2019). These efforts serve as the gateway to a new and revolutionized world of telemedicine and information technology. The world has become a digitalized hub of technology (Hussain et al., 2020). The most innovative and effective way to keep up with the modernized world is to gain knowledge and technology expertise. The new trends of telecommunication have made this relatively easy. Tailored medicine and humanized medicine are modern terms in the medicine world. The knowledge for implementation of this digitalized technology is essential for every healthcare professional. In combination with modern medicine, bioinformatics is the future of the new and digitalized medical world after the Covid-19 pandemic (Wang et al., 2021).

Ancient knowledge and systems are based on the same mechanical principle. Modern-day systems are highly innovative and adaptable to change; for instance, natural systems are always unpredictable. The human body is like a complex organizational framework. It regulates itself according to the different inputs. The response time and nature of the response is dynamic and different for each input. Fruits and vegetables have different outcomes compared to fast food. Thus, it can be said that organizational setups are not homogenous, and they change frequently and continuously. The orthodox concept of organizations as fixed mechanical manufacturing units is changed altogether and is replaced by green management practices. Modernized organizational setups are complex entities with dynamic outcomes related to eco-friendly practices (Hussain et al., 2019).

Leadership is the essence of any organizational setup. Leaders must adopt an innovative and adaptable mindset to accept change. The notion that leaders can control the results or outcomes of a process is outdated. The new trend of leadership and an environment-friendly approach serves as clear guidance for the employees. Influential support can help employees to think independently and provide them with freedom of speech to coordinate and communicate with leaders. The notion of psychological safety and green process management practices in organizations is imperative for generating the desired outcome. Modernized companies have formulated new strategies and setups—the flexibility in managerial mindset is necessary. Organizational learning behavior provides an opportunity to integrate research and developmental strategies that are directly based on green economy-based approaches. The learning environment provides psychological security to all employees. When communicating effectively with lower managerial and clerical staff, the upper management then gets resolved quickly. The situational humility of the upper management is overcome by organizing to learn based setups. Business companies that adopt eco-friendly strategies can generate a promising future. The psychologically secure teaming environment, well-regulated green finances, and green investment-related initiatives help the staff work as a dynamic cooperative and communicative unit for a business ventures' well-being.

3. Material and methods

The present study examines the impact of green credit, green investment, and green securities along with CSR reporting on renewable energy investment in Pakistan.

Economic growth was used as the control variable of the study. The data was gathered from the SBP and WDI from 1976 to 2020. Based on the above-reviewed literature, the present study has estimated the following equation:

$$IRE_t = \alpha_0 + \beta_1 GC_t + \beta_2 GINV_t + \beta_3 GS_t + \beta_4 CSRR_t + \beta_5 EG_t + e_t \quad (1)$$

Where;

IRE = Investment in Renewable Energyt = Time Period

GC = Green Credit

GINV = Green Investment

GS = Green Securities

CSRR = CSR Reporting

EG = Economic Growth

The variables that have been used by the researchers include the investment in renewable energy that is measured by logarithm of investment on renewable energy sector development programs and is used as the dependent variable. In addition, green credit, green investment, and green securities are used as predictors of green finance and are measured as the ratio of green credit to total credit, the ratio of environmental protection public expenditure, and the ratio of environmental protection companies' market value, respectively (Anh Tu et al., 2021). The current study has taken three different measurements to measure green credit, green investment, and green securities that shows lack of chances of multicollinearity. In addition, green credit, green investment and green security are also used by the past studies like He et al. (2019) and Ren et al. (2020) and not faced multicollinearity issue. However, CSR reporting is also used as a predictor and is measured as the 1/0 indicator variable where 1 identifies that the country is publishing CSR report in year t (Sadiq et al., 2020), while economic growth is used as a control variable and measured as the GDP growth (annual %) (Chien et al., 2021). These measurements are shown in Table 2.

The selection of the models depends on the stationarity of the variables such as pooled OLS. All the constructs are stationary at a level while error correction model is used if all the constructs are stationary at the first difference. The autoregressive distributed lag (ARDL) model is used when some constructs are stationary at level but some constructs are stationary at first difference (Chien et al., 2021). The stationarity of the constructs has been checked by the Augmented Dickey-Fuller Test (ADF). The estimation equation for ADF is given below:

$$d(Y_t) = \alpha_0 + \beta t + \gamma Y_{t-1} + d(Y_t(-1)) + \varepsilon_t \quad (2)$$

The stationarity of the variables was examined individually and if the probability values are less than 0.05, that means that the variable is stationary and vice versa.

The individual variable was examined in the ADF procedure of checking the stationarity of the constructs. If the p-value is less than 0.05, the variable is said to be stationary, and these are the estimation model of ADF for all the constructs as given below:

Table 2. Variables with measurements.

S#	Variables	Measurement	Sources
01	Investment in Renewable Energy	Logarithm of investment on renewable energy sector development programs	Asian Development Bank
02	Green Credit	The ratio of green credit to total credit	State Bank of Pakistan
03	Green Investment	The ratio of environmental protection of public expenditure	State Bank of Pakistan
04	Green Securities	The ratio of environmental protection companies market value	State Bank of Pakistan
05	CSR Reporting	A 1/0 indicator variable where 1 identifies that country is publishing CSR report in year t	Thomson Reuters Data Stream
06	Economic Growth	GDP growth (annual %)	World Bank Database

$$d(IRE_t) = \alpha_0 + \beta t + YIRE_{t-1} + d(IRE_t(-1)) + \mathcal{E}_t \quad (3)$$

$$d(GC_t) = \alpha_0 + \beta t + YGC_{t-1} + d(GC(-1)) + \mathcal{E}_t \quad (4)$$

$$d(GINV_t) = \alpha_0 + \beta t + YGINV_{t-1} + d(GINV_t(-1)) + \mathcal{E}_t \quad (5)$$

$$d(GS_t) = \alpha_0 + \beta t + YGS_{t-1} + d(GS_t(-1)) + \mathcal{E}_t \quad (6)$$

$$d(CSRR_t) = \alpha_0 + \beta t + YCSRR_{t-1} + d(CSRR_t(-1)) + \mathcal{E}_t \quad (7)$$

$$d(EG_t) = \alpha_0 + \beta t + YEG_{t-1} + d(EG_t(-1)) + \mathcal{E}_t \quad (8)$$

This research has also used the ECM to analyze the nexus among variables because all the constructs are stationary at first difference. The estimation models of the ECM are as below:

$$Y_t = \alpha_0 + \beta_1 X_t + \beta_2 X_t + \beta_3 X_t + \beta_4 X_t + \mathcal{E}_t \quad (9)$$

$$\Delta Y_t = \alpha_0 + \beta_1 \Delta X_t + \beta_2 \Delta X_t + \beta_3 \Delta X_t + \beta_4 \Delta X_t + \mathcal{E}_t \quad (10)$$

The error term is also stationary at the level and the estimation model with error term is as follows:

$$\Delta Y_t = \alpha_0 + \beta_1 \Delta X_t + \beta_2 \Delta X_t + \beta_3 \Delta X_t + \beta_4 \Delta X_t + YECT_{t-1} \mathcal{E}_t \quad (11)$$

This research also formulated the ECM by using the understudy variables that are mentioned as below:

Table 3. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
IRE	45	5.450	3.639	7.634	13.288
GC	45	0.377	0.574	0.202	0.435
GS	45	0.554	0.367	0.286	0.716
GINV	45	0.368	0.065	0.084	0.634
CSRR	45	0.643	0.843	0.000	1.000
EG	45	3.566	4.950	2.440	3.448

Source: authors estimation.

$$\begin{aligned} \Delta IRE_t = & \alpha_0 + \beta_1 \Delta GC_t + \beta_2 \Delta GINV_t + \beta_3 \Delta GS_t + \beta_4 \Delta CSRR_t + \beta_5 \Delta EG_t \\ & + YECT_{t-1} \mathcal{E}_t \end{aligned} \quad (12)$$

The findings show the descriptive statistics that exposed the average value of IRE as 5.45 percent while green credit ratio is 0.377 on average. Meanwhile, green securities ratio is on average 0.554 and green investment ratio is on average 0.368. Finally, the average economic growth is 3.556 percent annually. The minimum value of IRE is 7.634 percent while the maximum value is 13.288 percent. In addition, the minimum value of green credit is 0.202 while the maximum value is 0.435. Meanwhile, the minimum value of green security is 0.286 while the maximum value is 0.716. Additionally, the minimum value of the green investment is 0.084 while the maximum value is 0.634. Finally, the minimum value of CSR reporting is 0 while the maximum value is 1. The minimum value of economic growth is 3.556 percent while the maximum value is 3.448 percent. These values are presented in [Table 3](#).

This study also presents the descriptive statistics of the variables in the form of graph that shows the minimum and maximum values along with standard deviation and means of the variables. These are shown in [Figure 2](#).

4. Results and discussion

This research also presents the constructs such as IRE, GC, GS, GINV, CSRR and EG in the form of scatterplots. These scatterplots are highlighted in [Figure 3](#) below:

The correlation matrix is also shown in the findings section that exposes the nexus among the variables. The figures highlighted that all the predictors such as green credit, green investment, green securities, CSR reporting, and economic growth have a positive association with investment in renewable energy. In addition, all the values are less than 0.90 which is an indication of no multicollinearity issue in the model. This nexus is mentioned in [Table 4](#).

The results also show the ADF unit root test that shows the stationarity of the variables. The statistics show that all the variables are stationary at the first difference, which indicates that ECM is appropriate for this study. These figures are highlighted in [Table 5](#).

This study also shows the Johnson co-integration test to check the co-integration in the model. The statistics show that only one co-integration exists in the model because the calculated f-statistics are larger than the critical value only in one case where the probability value is less than 0.05. These values are mentioned in [Table 6](#).

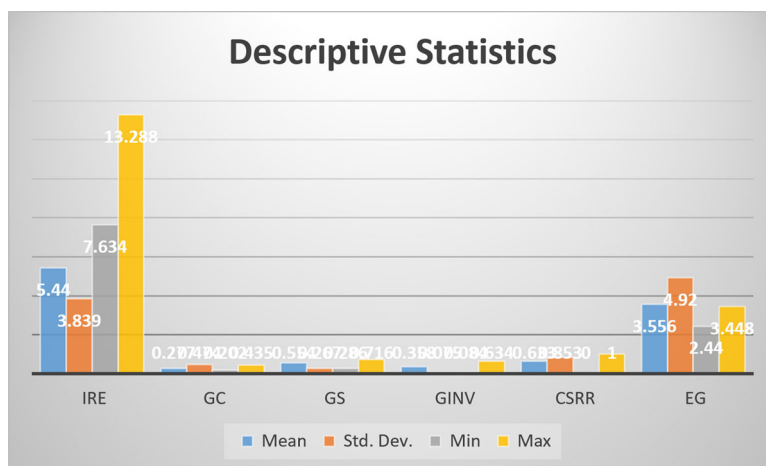


Figure 2. Descriptive statistics.
Source: authors estimations.

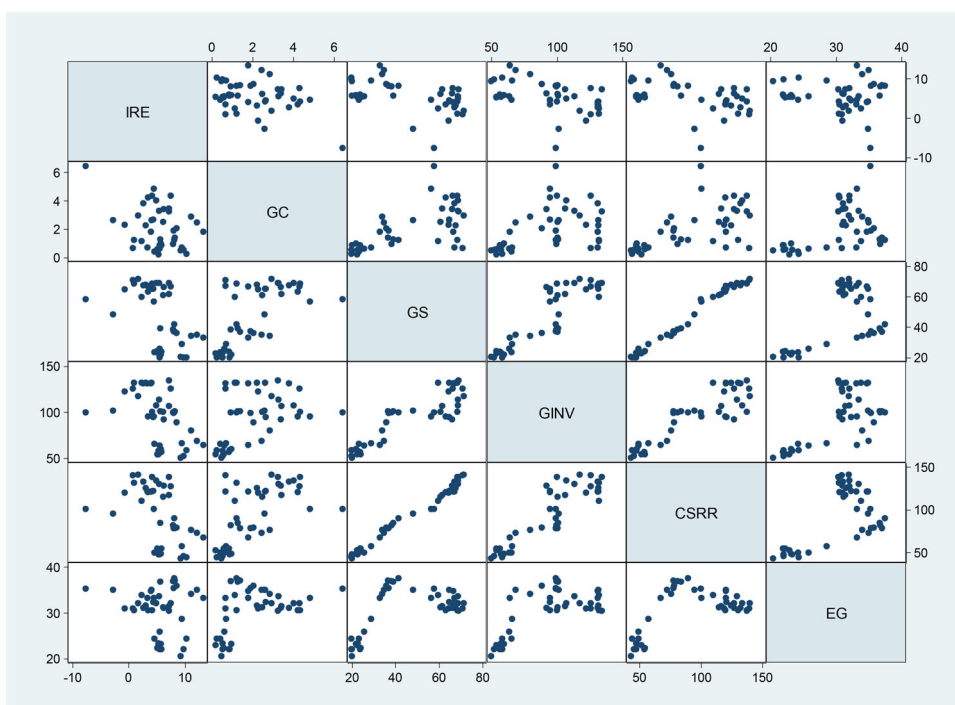


Figure 3. Scatterplot matrix.
Source: authors estimations.

Table 4. Correlation matrix.

Variables	IRE	GC	GS	GINV	CSRR	EG
IRE	1.000					
GC	0.451	1.000				
GS	0.484	0.654	1.000			
GINV	0.470	0.465	0.797	1.000		
CSRR	0.549	0.651	0.792	0.845	1.000	
EG	0.220	0.573	0.547	0.677	0.467	1.000

Source: authors estimation.

Table 5. Unit root test.

Augmented Dickey-Fuller Test (ADF)	Level	t-statistics	p-values
IRE	I(1)	-7.8129	0.0000
GC	I(1)	-9.5160	0.0000
GS	I(1)	-5.7969	0.0000
GINV	I(1)	-6.1079	0.0000
CSRR	I(1)	-6.5992	0.0000
EG	I(1)	-4.8054	0.0002

Source: authors estimation.

Table 6. Unrestricted co-integration rank test (trace).

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None**	0.538963	99.59343	93.8373	0.0402
At most 1	0.459299	67.14898	76.97177	0.2213
At most 2	0.428328	41.17318	54.07804	0.4145
At most 3	0.254643	18.75739	35.19175	0.7959
At most 4	0.119033	7.344216	20.16184	0.8785
At most 5	0.071923	2.610853	9.144546	0.6546

Source: authors estimation.

Table 7. Error correction model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GS)	1.561098	0.179265	8.708326	0.0000
D(GINV)	0.135345	0.064106	2.111268	0.0321
D(GC)	0.452276	0.241657	1.871562	0.0753
D(EG)	1.524372	0.220123	6.925092	0.0000
D(CSRR)	0.665342	0.083828	7.936990	0.0000
ECT(-1)	-1.076252	0.123059	-8.745821	0.0000
C	0.872625	0.329373	2.649352	0.0312
R-squared	0.767262	Mean dependent var		-0.146528
Adjusted R-squared	0.742309	S.D. dependent var		3.565338
F-statistic	20.39289	Prob(F-statistic)		0.000000

Source: authors estimation.

The results also revealed that green credit, green investment, green securities and CSR reporting and economic growth have a significant positive nexus with renewable energy investment in Pakistan. The beta values have positive signs that show a positive association among them while t-values are greater than 1.64 and p-values are less than 0.05 which is an indication of significant association among variables. The R square value shows that 76.72 percent variation among investments in renewable energy is due to all the predictors used by the study. These values are highlighted in Table 7.

This study also shows the nexus among the variables by using the regression plots. The results show that GC, GS, GINV, CSRR and EG have a positive association with the IRE of the study. These links are shown in Figure 4.

4.1. Robustness analysis

The results of robustness analysis also show that green credit, green investment, green securities, and economic growth have a significant positive nexus with renewable energy investment in Pakistan. The t-values are greater than 1.64 and p-values are

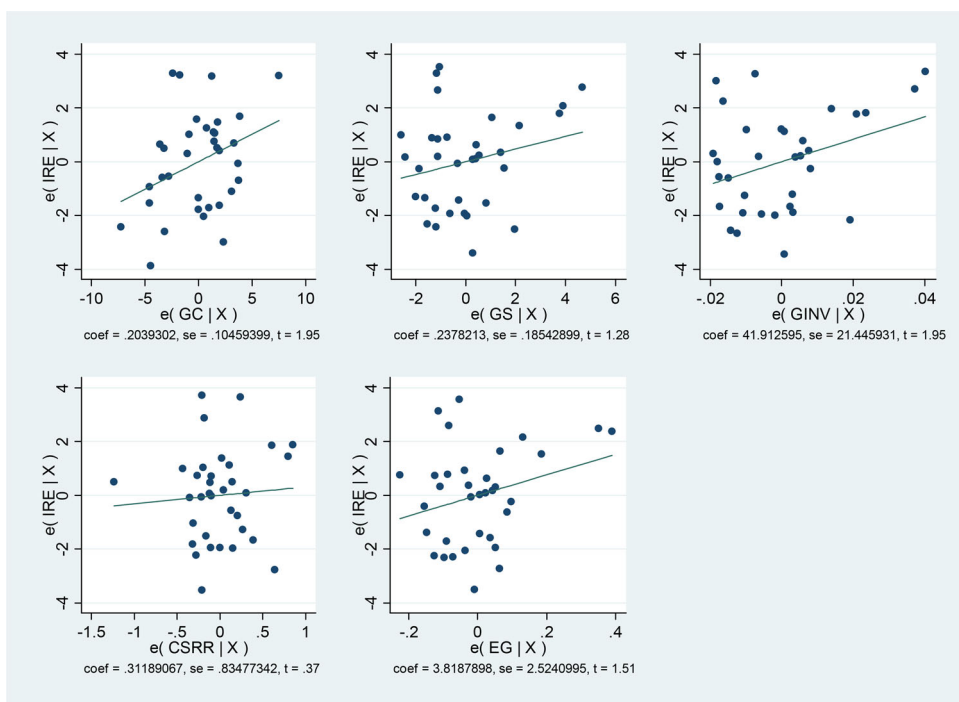


Figure 4. Regression analysis.

Source: authors estimations.

less than 0.05 which indicates significant association among variables. The R square value has shown that 74.25 percent variation in the investments of renewable energy is due to all the predictors used by the study. These values are shown in Table 8.

4.2. Discussions

This research investigation has revealed that the implementation of green credit policy is a part of green development in finance, which has positive impacts on the investment in renewable energy enterprises. The study examines the implication of green practices in the form of credit card and the conditions of the issuance of credits encourages investment in renewable energy enterprises. These results are approved by the studies of Liu et al. (2019), which show that the essential purpose of an eco-friendly credit policy is to protect the natural environment according to environmental regulations. This provides financial support to renewable energy enterprises based on eco-friendly principles. These results are also approved by the studies of Taghizadeh-Hesary and Yoshino (2020), which reveal that the implementation of green practices into the formation of credit cards and credit policies contribute a lot to renewable energy as the primary purpose of these practices is also to encourage eco-friendly projects. The results have revealed that during the prevalence of Covid-19, the green securities policy whether it is to issue equity or debt securities puts significant positive impacts on the investment tendency into renewable energy enterprises (Hussain et al., 2018). These results are in line with past studies of Wang and

Table 8. Robustness test.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GS)	0.369240	0.106902	3.454006	0.0019
D(GC)	0.322834	0.107669	2.998403	0.0059
D(EG)	0.955681	0.265161	3.604159	0.0013
D(GINV)	0.804539	0.277102	2.903405	0.0074
CointEq(-1)*	-0.707262	0.111239	-6.358035	0.0000
R-squared	0.742505	Mean dependent var		-0.074997
Adjusted R-squared	0.676055	S.D. dependent var		3.622024

Source: authors estimation.

Bernell (2013), which indicate that renewable energy enterprises whose objective is to remove the negative environmental impacts are encouraged to be invested with the introduction of green aspects in the policy of financial securities. These results also agree with the investigation of Berensmann and Lindenberg (2016) into the environmental performance of different economic sectors, which show the immense role of green financial securities in the growth of renewable energy projects.

New and innovative environmental well-being efforts have upgraded the human living standard (Ahmed et al., 2020). The global crisis can be considered a slow-paced problem, and Covid is a fast and highly stimulated environmental problem (Khaskheli et al., 2020). The outcomes of this pandemic are not only dangerous, but also alarming for every individual in the society. The supply and demand gap has increased more than ever in the post-pandemic era (Vo, 2020). The energy-food and water supply nexus is previously considered a burden to economies, but now health-related issues have increased this burden even further. Cost-effective, eco-friendly, and healthy protection-related efforts are necessary for the society's well-being (Cheng et al., 2020). Environmental protection has become a significant issue around the globe with the extensive use of renewable energy and green finance is considered as the solution to this dramatic issue especially, in the Covid-19 lockdown situation.

Covid-19 has changed the situation of the economy and business completely. In recent years, the business and the economy's issues were huge, but this virus has completely devastated all things. Businesses are shackled. The transportation and trading activities between different continents are banned, so every country's economy has crashed. Covid-19 is a medical emergency and a financial one (Yanling Wang, Xu, & Wang et al., 2020). The economic losses are huge due to this virus. The unavailability of vaccination and other preventive medication has resulted in the deaths of millions of people around the globe. This pandemic has changed the standards and lifestyles of all people around the globe. Health-based risks and insurances have become more important for employees and employers. The whole situation of sanitization and related precautionary measures have transformed all industries (Pesqueux, 2020). Nowadays, employees are more concerned about health and sanitization related aspects of the firms. This global problem can only be tackled with increased planning and by making more resource-efficient infrastructures. In the recent era, everyone must make their way into the business community. The business world is a resource-based community, and a green economy is now the only solution to devise resource-efficient and smart ways to run the businesses. In developed

countries, policymakers are generating new and innovative strategies that will supplement not only environment-friendly approaches but also Covid-19 preventive treatments (Khan et al., 2018).

Moreover, it has been represented by the results that the issuance of green investment policies from different insurers has positively influenced the investment into renewable energy. These results match the studies of Ping et al. (2014), which check the green financial development in the emerging economies and conclude that renewable energy projects are being financially supported by insurers who intend to maintain environmental protection. The results also match with the literary works of Mills (2012), which try to elaborate the contribution of green investment in finance to make possible the establishment of renewable energy enterprises and the improvement in its environmental performance. Furthermore, the results have indicated that green investment is one of the methods of green financial development which, even in the period of Covid-19, encourages investment in the renewable energy projects as the purpose of green investment is to put money in the projects whose basic objective is to protect the natural environment. These results are in line with the past studies of Pueyo (2018), which state that the encouragement in an economy to make the investment into eco-friendly projects also brings improvement to the performance of renewable energy enterprises by providing them with a sound financial basis. These results also agree with past studies of Nesta et al. (2014), which indicate that green economic development is an essential contributor to the financial sources of renewable energy enterprises because of their shared purpose of environmental protection. Besides that, the study findings have revealed that the corporate social responsibility report issued by different companies, as observed during the pandemic of Covid-19, has a positive relationship with the investment in renewable energy projects. These results are in line with the studies of Bonsón and Bednárová (2015). These studies examine the periodic corporate social responsibility report issued by the business organization, which stresses the need to have sustainable environmental performance. For this purpose, they invest in renewable energy projects which can reduce the emission of toxic gases and chemicals with the recycling of energy resources. These results are also approved by the studies of Szczepankiewicz and Mućko (2016) which show that the periodical issuance of a social responsibility report from the business organization encourages investment in the enterprises that can renew energy resources and reduce pollution creation. Finally, the study findings revealed that economic growth has a positive relationship with investment in renewable energy projects. These results are in line with the research investigation of Eren et al. (2019). It states that when an economy is growing, all economic sectors have sound financial resources which enable them to make investments in projects like renewable energy projects which are beneficial for their success.

CSR reporting is essential for innovative business planning initiatives (Khan & Alam, 2020). The banking sector is the backbone of every economy. Pakistan has a dwindling economy, and its major reason is corruption (Bulovsky, 2020; Khan, 2007). Corrupt politicians have made the Pakistani economy weak and unsustainable. Corporate social responsibility and related efforts are vital for economic sustainability and environmental well-being (Shabbir et al., 2020). Pollution is a major hazard in

Pakistan. Air, water, and noise pollution are major problems in Pakistan (Van et al., 2020). All policymakers must formulate innovative planning strategies for new businesses that can make the economy stable and well-flourished. The use of ecologically sound raw material in factories and waste treatment initiatives can improve overall environmental health. Financial problems can easily be overcome with honest and well-coordinated efforts of all people belonging to different walks of life (Rehmana et al., 2020).

5. Conclusion and policy implications

This study sheds light on the changes in financial policies and eco-friendly inscriptions in government economic policies and explores their impacts on the investment in renewable energy projects in an emerging economy that is facing the prevalence of Covid-19. The study examines how financial sources can be made prosperous for renewable energy projects, which helps the economy to recover from the energy crisis and ensure environmental protection. The study examines the rise or fall in the equity of renewable energy enterprises and projects due to the inclusion of green aspects in the financial policies like credit policy, the policy of financial securities, and investment policies in Pakistan's economy in the period of Covid-19. The higher the eco-friendly economic and investment policies that are efficiently implemented and executed in the economy, the higher is tendency of investment in the renewable energy projects as there are rich financial sources available for these projects on comfortable conditions to create a sense of environmental responsibility in business entities. Similarly, the pressure from the environmental regulations on business organizations to produce a corporate social responsibility report after specific time intervals leads to the encouragement of spending money in carrying out the projects to renew the energy resource to avoid the occurrence of financial crisis. The movement in economic growth considerably affects the initiation and performance of renewable energy projects as the change in economic development changes the financial capacity of the organizations.

Due to the occurrence and spread of the Covid-19 pandemic, people's health has been exposed to an open threat as the virus affects human beings through air, touch, or by interacting with affected people. It has adversely affected all social, economic, private, and government activities and brings a fall in the economic growth of a country. In this situation, all economic sectors including financial institutions have made amendments in their policies and strategies to overcome the issues associated with the spread of Covid-19. As green finance is an effective tool to encourage ecological friendly programs and overcome the disturbance created by the Covid-19, the institution must bring positive changes in their policies related to green finance.

Since a contagious disease like Covid-19 pandemic has started and spread to countries across the world, all economic, social, private, and government activities have been disturbed. Thus, all economic and social organizations as well as private and government entities have paid attention to serious matters in trying to overcome issues that may cause an increase in Covid-19 cases. Changes have been made in policies, strategies, and the rules of any economic or social sector so that the capacity of

all the social and economic entities to maintain environmental sustainability can be improved. Just like other sectors of the economy, the financial sector has also been active in developing strategies to overcome pollution and thus enable all the social and economic entities to fight against the Covid-19. Green financing is one of the initiatives by financial institutions to overcome the environmental pollution by encouraging renewable energy consumption during Covid-19.

This investigation has great significance as it succeeds in making theoretical implications along with an empirical impact. It is of much importance if it is talked about in its theoretical essence on account of its contribution to the literature conducted on environmental protection. The study examines the development of green finance in an emerging economy and analyzes its contribution to environmentally friendly projects like renewable energy enterprises whose purpose is to protect the environment from pollutants. The implementation of eco-friendly practices inscribed in the credit, investment, and financial securities (both equity and debt securities) policies, which result in the beginning of different environmental projects, initiate the renewable energy enterprises in the economy. Similarly, the study suggests that the force from the government investment in the technologies and techniques to take care of environmental protection leads to the establishment of renewable energy enterprises by supporting them financially. Several past studies have been written which deal with eco-friendly projects, environmental-friendly economic and financial policies, and their impacts on the economy. However, this study is an initiation as it explores the same areas with reference to the economy, which threatened by the Covid-19 pandemic. The literary workout sheds light on the prevalence of Covid-19, its adverse impacts on the economic conditions, its problems, and then proposes the solution to those problems. This study is helpful for new arrivals that will investigate this area in the future, along with regulators who want to formulate policies related to green finance and renewable energy usage and investment.

The study also makes an empirical implication because of its considerable significance in the emerging economies especially the economies which has a large industrial sector and confronted to health crisis due to the prevalence of a pandemic like Covid-19. Such economies have to face health problems and destruction of the resources. The resources and healthy public are crucial for the growth of the country. This is guideline for the government and environmental regulators as it helps them in maintaining ecological protection.

It drives them on how to encourage environmental-friendly projects like renewable energy projects with eco-friendly amendments in fiscal policies or financial policies the credit, securities, and investment policies. Environmental protection can be maintained by the government by increasing the growth rate of the economy and the force on the issuance of a periodic social corporate report. This study is also a theoretical guideline for the economists on how they can save the planet and people for the future economic growth along with the improvement in present as it tells with the encouragement of the green integration in the finance practices which boost up investment in renewable energy investment. Moreover, this study is useful to the economists and government in the sense that they guide on how to mitigate the health destructive impacts during covid-19 and maintain the economy with the rise in the green finances.

5.1. Limitations and future directions

This study also carries several limitations. These limitations motivate future researchers and academics to give insight into their subject and to take specific steps to remove these limitations. The study has been supported by taking data from a single source. So, a question may arise on the adequacy and accuracy of data that future scholars should answer with the collection of data through multiple sources. Moreover, the implementation and the execution of the green practices in finance and its contribution to the investment in renewable projects is examined in the economy of Pakistan, an emerging and lower-middle-income economy. These results are true and accurate in Pakistan's economy or similar economies, but they may not as suitable in developed economies. These results relate to the introduction of environmental aspects into financial policies like green investment and securities and thereby, the movement in the establishment and development of the renewable energy enterprises in an economy where Covid-19 prevails. Thus, the study lacks generalizability, which should be recovered by future scholars while addressing the same associations between the underlying variables. Future studies must also address the green development in different financial areas and check the influences on the financial sources of renewable energy enterprises in the typical situation, which may prove to be a guideline for the economists of any era rather than for the economy suffering from a pandemic.

Acknowledgment

This research is partly funded by University of Economics, Ho Chi Minh City, Vietnam. This paper is partly funded by Van Lang University, Vietnam.

Disclosure statement

No potential conflict of interest was reported by the authors.

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