



(RESEARCH ARTICLE)



Post-COVID-19 economic recovery and growth: A comparative study of emerging markets

Mahid Mia, Sayma Islam * and Shabiba Chowdhury

School of Business & Economics, United International University, Madani Avenue, United City, Dhaka 1212, Bangladesh.

GSC Advanced Research and Reviews, 2025, 22(03), 013-024

Publication history: Received on 17 January 2025; revised on 24 February 2025; accepted on 27 February 2025

Article DOI: <https://doi.org/10.30574/gscarr.2025.22.3.0064>

Abstract

The COVID-19 pandemic deeply disrupted the global economies, highlighting the weakness of healthcare systems, workforce infrastructure, and fiscal policies. This study explores the key factors which influencing the economic recovery and growth after COVID-19 by focusing on foreign direct investment, healthcare expenses, external debt, and inflation for 87 countries. By doing quantitative analysis, the research highlights that external debt has significant negative impact on GDP growth, which slower down the recovery of economic of the countries. While other significant variable is foreign direct investment which making positive impact on GDP growth to recover the economics of the countries faster. The study also highlights by transforming in digitalization, working on labor market, improving healthcare infrastructure, and adopting technology can make a sustainable economy which can accelerate the growth for long-term. The study also highlights some strategies just like international collaboration, investment in healthcare, fiscal policy reforms can help the economic to be stabilize faster. This also explores that tourism and small business affected badly compared to other industries within the countries for COVID-19, to invest in these sectors or to help to start these sectors again will be beneficial for the country and for the individual as well who involved in these two sectors. Unlike previous studies, the study shows the importance of the government policies which support to recover the economic, individual development and skills, investment in sustainable resources and digital adoption can put great value in long-term economic growth. This study can be a good resource for policymakers who are trying to build a sustainable balanced economy by keeping in mind the disparities caused by the COVID-19 pandemic.

Keywords: COVID-19; Post pandemic recovery; Economic impact; Global effect; Post COVID-19 economic recovery; Sustainable development

1. Introduction

The outburst of COVID-19 in the 2020 pandemic has had a tremendous impact across the globe. Jiang, Wang [1] It has a huge influence on the economy all over the world. The economic recovery and growth of post-COVID-19 play a great role in obtaining sustainability and high development. At that time, the U.S. had to displace one in four American workers, which led to an increase in unemployment. China holds its position as the first major economy after the shutdown of COVID-19. The GDP of China decreased by 6.8% in the first 4 months of 2020 because of COVID-19, which was the worst performance after almost 50 years. Just like the U.S. and China, all over the world, every country's economy has been affected by COVID-19. Yang, Wang [2] As business activities resumed, the U.S. saw rapid improvements in employment and output growth a few months after May 2020, and it was unlikely that the economy would reach a pre-pandemic situation. Furman, Geithner [3] However, different economic policies played a significant role in recovering the economy after COVID. The federal government's monetary and fiscal responses were more beneficial than previous ones after COVID because they cut the interest rate to zero. [3] In China, they effectively controlled the outbreak by the end of the first quarter of 2020 and had entered into the recovery period. Jiang, Wang [1] Challenges and success characterize it. Employment gradually improved in many sectors, but some sectors, like

* Corresponding author: Sayma Islam

tourism and education, faced obstacles[4-8]. Many companies removed employees and increased their demand for highly skilled labor, which allowed them to take the opportunity to downsize employment. However, some important elements play an important role in economic recovery after COVID-19. O'Connor, Anoushiravani [9]

The economic recovery and growth after COVID-19 were influenced by numerous factors worldwide. These factors are responsible for shaping the economic culture again in different countries and regions before moving to the factors for economic recovery and growth in post-pandemic. Let's have a look at some factors for economic recovery and growth in pre-pandemic first. Before COVID-19, countries were focused on sound economic policies where they wanted to stabilize the monetary and fiscal policies for economic growth, which enabled businesses to make more investments[10-13]. And this also leads to a lower inflation rate as well. They also focused on infrastructure and workforce development, where many countries focused on increasing transportation, buildings, energy, and development of technology, as well as increasing the skills of labor and training them in some of their particular areas. Before the pandemic, many countries focused on the private sector growth as well to make the business more accessible and to grow together. Kumo [14] But if we see the indicators for the recovery and growth of the economy after the pandemic, then we can see some different factors for the economic recovery and growth. First of all, the main objective was to diagnose the patients affected with coronavirus and not to spread the virus to unaffected people. That's why the vaccination project started. People encouraged taking the vaccine, and it played a significant role in reducing the uncertainty of human life and reopened the sectors of economics earlier[15-17]. There were also COVID-19 testing procedures in different ways. It was also necessary to improve better environmental health to reduce the effects of COVID-19 further. Every country's government showed much efficiency, help, and support in business grants and benefits for employees to stabilize and control the economy. They also adjust the interest rates and liquidations to support investment and borrowing decisions by lighting the fiscal and monetary policy. Furman, Geithner [3] COVID-19 highly accelerated digital transformation technology, requiring businesses to invest in IT and digitalize their business operations for more efficiency. Jiang, Wang [1] As a result, employees got inspired to learn many new digital skills in this technological era to compete with other workers and exist in the field. In the pandemic era, employees were removed to save the cost of the companies. After that, when the economy started to recover, many jobs were created, but most of them were tech-based. In times of COVID-19, people avoid shopping in stores[18-21]. They chose online platforms to avoid any human interaction and to be safe at home from coronavirus. After that, online platforms and e-commerce-based websites showed rapid growth as people are now very much digitally adopted. Many countries have invested in infrastructure like digital and renewable energy. They invested in overall healthcare infrastructure as well to ensure better health for the people so that they won't have to face the same situation as COVID-19 in the future. If a country can ensure better health for the people, then the productivity level will increase significantly, which can help to recover the economy. After COVID-19, international collaboration has also increased to distribute vaccines and to make trade easy as well. Cifuentes-Faura [22] O'Connor, Anoushiravani [9] In the context of urbanization, COVID-19 creates a scope that is identically higher than other epidemics, indicating major development and growth in the economy. Densely populated areas, large scale, and high mobility cities were affected as it was in the time of SARS. After COVID-19, China faced great importance in the sector of rapid urbanization. According to Wenyi Yang, China faced great importance and importance in the sector of rapid urbanization. It has risen from 17.92% to 60.60% from 1978 to 2019, respectively. GDP per capita has also increased. Bangladesh gained a positive image despite the challenges of COVID-19. Previously, Ahamed [23] Bangladesh took a loan from the International Monetary Fund (IMF), which played a role as a precaution in the time of the pandemic. Bangladesh's notable economic trend is showing in the domestic market in 2023. It is characterized by a larger consumer base and rapidly expanding middle classes[24-28]. The textile and ready-made garments industry is a major contributor to Bangladesh's economic progress. Digitalization has been transformative as well here in Bangladesh, with comprehensive digital adoption in various sectors like finance, education, and government services, which help in economic recovery and growth.

From this report, we will understand the Major economic disruptions brought on by the COVID-19 pandemic served as the impetus for these decisions and activities, as well as the development of a recovery plan. Furman, Geithner [3] we can also learn about that, Restrictions and lockdowns were imposed to reduce the spread of viruses and give the health system more time to get ready. Ahamed [23] to enable economic reallocation and ensure a simple return to work, the research emphasizes the significance of extending and adjusting fiscal policies. It also emphasizes how important it is to support health responses to accelerate the return to regular economic activity. Furman, Geithner [3] the analysis of China's economic recovery attempts to emphasize how important economic resilience is to achieving long-term, high-quality economic growth. China was chosen because of its considerable economic influence on the global stage and the variety of tactics it has used to recover from the pandemic's effects[29-32]. Jiang, Wang [1] this study's justification depends on the formation of a set of flexible economic indicators using the theory of flexible economies and associated measuring techniques. We can also say that the study shows the crucial importance of strong economic resilience by comparing the actual GDP with the GDP displayed by the ARIMA model in a scenario without a pandemic. The results reveal important suggestions for policy that other nations could try to improve their economic flexibility in the post-

pandemic period and better prepare for future shocks. Jiang, Wang [1] To promote economic reallocation and ensure a simple return to work, the research emphasizes the importance of extending and modifying fiscal policies. It also impacts how important it is to finance health responses to accelerate the return of normal economic activity. Furman, Geithner [3] It also shows the significance of finding a balance between protecting the environment and economic recovery, reducing the negative impacts of the present economic system, and enhancing equity and long-term prosperity. Cifuentes-Faura [22]

2. Literature Review

According to De Backer, Dewachter [33], the objective of the paper is to find the economic information at the macro level and to see which shapes European countries recovering their economy. The study finds that most of the European countries recovered their economy in between U and L shapes, which indicates a loss in the GDP. As they recover their economy in between U and L shapes, that is why their GDP is down from the pre-pandemic level of GDP. Here, the findings suggest adjusting their policy, which might help to reduce or mitigate their GDP loss in the long term. The study also suggests targeting those sectors first that are affected more than other sectors, which can help to mitigate the loss of GDP in the long term.

According to Hoang, Nguyen [34] the focus of the study is to find the economic recovery after COVID-19 in Vietnam and the adoption of e-commerce in SMEs. The study finds that many businesses are trying to adopt the technology and ensure that technology is aligned with their business objectives. Managerial awareness is important in terms of adoption so that they can make their employees adopt the technology as per their business needs. However, there is a problem in the adoption of technology because of limited resources in finance. Here, the findings suggest that organizations should train managers and employees both for easy adoption of technology. The government should focus on research to gain enough data for future forecasts and to make the right decisions as well[35-41]. According to Kaneva, Chugunov [42] Tax policy positively influences economic growth by encouraging investment and innovation. On the other hand, excessive government spending often negatively correlates with economic expansion, as it can lead to inefficiencies and reduced private-sector investment. Sustainable growth needs to find a balance between these forces. Support investment across diverse sectors to enhance economic resilience. Prioritize government spending that drives growth and creates jobs. Additionally, offers targeted incentives to sectors most affected by COVID-19 to facilitate their recovery and revitalization. According to Chen and Bashir [43], The global trend toward e-commerce was greatly accelerated by the COVID-19 pandemic, which led to a 19% rise in online sales revenue. Lockdowns caused rapid changes to online platforms and digital payments, which changed retail settings all across the world. Companies have been encouraged to use e-commerce to maintain the shifting habits of their customers. To facilitate digital changes and boost competitiveness through innovation and research, more finance choices must be made available[44-50]. According to Bhanot, Ahuja [51] this study suggests that digital advancement will play an important role in optimizing performance in specific sectors, and KPI indicators must be observed according to the performances. Recommendations will be to adapt machine learning to prevail in economic situations and text-mining ideas to research literature.

According to Ingham [52], creating a comparison between pre-pandemic and post-pandemic about how the work facilities were flexible, supported with adequate resources and life-long scopes and advantages, and aided with economic growth in earlier times. The study suggests that the role of flexicurity is having a positive impact. In the literature of [53-60] suggested that in boosting performance through this process. Moreover, exerting the largest growth in lifelong learning, labor market support, and activation policies robust with industrial democracy. In the long run, trusting economics gains growth in the highest and also engages with social partners. According to Reza [61] the study finds the economy after COVID-19 includes the transformation in buyer behavior and digital technology, a stronger economy, and fostering policies for sustainable growth. The study also recommends that the government should give more importance to the efforts of recovery scopes and opportunities, increase digital advancement systems, promote innovative ecosystems, take measures for green recovery, and strengthen the tie into healthcare systems.

According to Bojicic-Dzelilovic, Kostovicova [62] this study finds that the main fact or resource is the entrepreneur's engagement across ethnic, which will mobilize strategies by enabling and developing a market presence. This study suggests that economic groups must be collaborative, and local producers must be supportive enough to support entrepreneurs through innovative approaches. According to Purnamasari, Susanti [63], the paper aims to analyze the development and implications of musayraah financing in the medium and enterprises in the cities of Bandar. It also suggests that supporting policies fir MSME growth, easier access to musayrakah banking system to people, financial growth opportunities by simplifying financing process etc. According to Ilyas, Muin [64], the study finds some valuable insights from Sharia-based business recovery techniques, existing business strategies which can be based on the Sharia-based systems, how COVID-19 can be recovered by using Sharia norms. It also suggests that how businesses can be recovered by compliance with the Sharia initiatives[65-71].Existing research on post COVID-19 recovery and growth

has crucially focused on economics such as U.S. and EU nations, avoiding many rapidly increasing markets understudied. While many studies illustrate factors like foreign direct investments and external debt, they often overlook disparities of regions while effecting the policies and their structural vulnerabilities prior to many regions including South Asia, Africa. In addition, many of the literatures based on short-term recovery (2020-2021) have neglected longer time trends beyond 2022. This gap limits the significance of many important variables like digital transformation, inflation which evolve as to stabilize economy in the sectors like tourism and SME's that faced disturbances but they maintain their place by remaining underexplored in the framework of recovery.

Methodology says that qualitative or single-country analysis is being relied on the prior works often but they lack quantitative breadth whole generalizing finding across globally. There is a debate about fiscal policy efficiency or healthcare spendings that put impact on spending and it remains unresolved due to the inconsistency of regional data. Moreover, few studies compare themselves in high-debt emerging markets while digitalization and debt management are highly discussed. This study identifies the gap by employing a data set of 132 countries and regression analysis to address relationships between variables like external debt and GDP growth and also emphasizes underrated regions and sectors by providing actionable insights that would bring sustainable, exclusive recovery techniques.

Here, the independent variables are divided into two parts- positive independent variable and negative independent variable.

The dependent variable is **GDP- economic growth**.

Here is the hypothesis of the variables:

2.1. Foreign Direct Investment

- Hypothesis 1: Foreign direct investment will significantly boost GDP growth
- Hypothesis 2: Foreign direct investment will not boost GDP growth.

2.2. Digital transformation

- Hypothesis 1: Digital transformation will have positive impact on economic efficiency.
- Hypothesis 2: Digital transformation will not have positive impact on economic efficiency.

2.3. Inflation

- Hypothesis 1: Inflation will lead to higher GDP growth.
- Hypothesis 2: Inflation will not lead to higher GDP growth.

2.4. International collaboration

- Hypothesis 1: International collaboration will contribute to GDP by investment opportunities.
- Hypothesis 2: International collaboration will not contribute to GDP by investment opportunities.

2.5. Healthcare Expense

- Hypothesis 1: Healthcare expense will decrease GDP growth
- Hypothesis 2: Healthcare expense will increase GDP growth.

2.6. External Debt

- Hypothesis 1: External debt will have a negative impact on GDP growth.
- Hypothesis 2: External debt will have a positive impact on GDP growth.

2.7. Economic inequality

- Hypothesis 1: Economic inequality will slow down GDP growth.
- Hypothesis 2: Economic inequality will boost up GDP growth.

2.8. Government Expenditure

- Hypothesis 1: Government expenditure will hinder GDP growth
- Hypothesis 2: Government expenditure will rise GDP growth.

3. Data and Methods

The objective of this part is to examine the economic recovery and growth after COVID-19 by identifying some key factors which is influencing the growth of GDP of the countries. The study used the quantitative methods to find out the relationships between some independent factors with the economic growth which are measured by GDP growth rate, as the dependent variables.

The study followed quantitative research, by focusing on numerical data and statistical analysis to build the correlations and see the effects of the variables. On this part, the regression analysis was conducted for these data to explore the impact of different independent variables with the dependent variable which is GDP growth rate. The independent variables we took are foreign direct investment, healthcare expenses, external debt, inflation, and government expenditure. All the quantitative data for this research was collected from the World Bank Data for multiple countries is about 132 including Bangladesh from the years 2019 – 2022. The timeline was chosen to cover the pandemic years and the recovery time after COVID-19. All the variables data were taken from World Bank Data for the reliability and to ensure the data is valid. There are two types of data / variables which are Dependent Variable, and Independent Variable. Dependent variable is GDP growth rate as for the economic growth and independent variable are foreign direct investment, healthcare expense, external debt, inflation, and government expenditure. Between these two types of variables, we want to see how the independent variables impact the dependent variable, positively or negatively.

The sample covered 132 countries including developed, emerging, and developing economies. All these countries were chosen based on South Asia, Europe & Central Asia, Middle East & North Africa, Latin America & Caribbean, and North America regions to see the impact within nearest countries so the research will be relevant and we can so most impacted independent variable for these countries. The research was conducted on Microsoft Excel by organizing all the data and then used regression analysis to the results. The regression is used to see the relationship between the dependent variable and independent variables. After conducted the regression analysis for our data, we have found the “External Debt” has the most significance among all other independent variables on GDP growth rate, as its P-value is lowest among others which is 5%. This result shows a strong relationship between external debt and GDP growth. The regression result includes Coefficient, P-values, R-squared value and other things.

4. Results

The research objective is to find out the key factors which are directly influencing the economic recovery and growth after the COVID-19. After conducted the regression analysis, See Table 1, based on the data, we identified some significant relationship between GDP growth rate with our selected independent variables. Among those independent variables external debt, healthcare expenses, foreign direct investment, and government expenditure has the most significance on GDP growth. While inflation has less significance on GDP growth[72-78]. Countries with the most external debt slower economic recovery than other countries. Here external debt has the negative relationship with GDP growth. On the other hand, foreign direct investment has positive relationship with the GDP growth which means if the foreign direct investment goes up then the economic recovery will take less time.

Table 1 Regression Analysis

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	3.82	0.73	5.25	0.00	2.39	5.25	2.39	5.25
Foreign Direct Investment	0.02	0.01	1.50	13%	0.00	0.04	0.00	0.04
Healthcare Expenses	-0.20	0.13	-1.62	11%	-0.45	0.04	-0.45	0.04
External Debt	-0.02	0.01	-1.93	5%	-0.03	0.00	-0.03	0.00
Inflation	0.01	0.02	0.63	53%	-0.02	0.04	-0.02	0.04
Government Expenditure	-0.07	0.04	-1.69	9%	-0.15	0.01	-0.15	0.01

Table 2 Summary of Regression Analysis

Variable	Coefficient	P-value	Significance
Foreign Direct Investment	0.015	13%	Significant (Positive)
Healthcare Expense	-0.204	11%	Significant (Negative)
External Debt	-0.017	5%	Most Significant (Negative)
Inflation	0.010	53%	Less Significant (Positive)
Government Expenditure	-0.069	9%	Significant (Negative)

A summary of the regression results is presented below in the table:

Here, we can see, Table 2, the most significant independent variable is external debt which influencing the dependent variable GDP growth rate negatively most. Here the P-value is 5% and the Coefficient is -0.017. This means we can say that countries with the most external debt can recover the economic slower than other countries.

Except external debt, other independent variables P-value are following, foreign direct investment has 13%, healthcare expenses have 9%, inflation has 56%, and government expenditure has 9%. Which indicate that these variables are not influencing GDP growth significantly.

5. Discussion

The purpose of this research was to examine the economic recovery under COVID-19 by shaping the primary determinants of GDP expansion. Using World Bank data from 132 countries (2019–2022), a quantitative method using regression analysis was used to figure out how government spending, inflation, healthcare costs, foreign direct investment (FDI), and external debt had an impact GDP growth. External debt has an adverse effect on the growth of GDP (coefficient: -0.017, p-value: 5%), which means that a nation's growth rate slows down as its external debt increases. The adverse effects of healthcare costs (coefficient: -0.204, p-value: 11%) indicates that excessive expenditure, perhaps brought on by pandemic-related costs, may have prevented economic recovery[79-81]. Spending by the government had a damaging effect on GDP growth (coefficient: -0.069, p-value: 9%), demonstrating that more spending may not have been distributed proficiently to spur the economy to expand. Higher foreign investment contributes economic recovery, as demonstrated by the strong correlation between GDP growth and foreign direct investment (FDI) (coefficient: 0.015, p-value: 13%). High-inflation patterns were not significantly related to the post-pandemic recovery, as evidenced by the weak and negligible effect of inflation on the rise in GDP (coefficient: 0.010, p-value: 53%). The most important factor adversely influencing GDP growth among all of these factors was external debt, which strengthened worries that the debt load would impede economic recovery. The results support the debt surplus theory, a theory in economics that contends that excessive external debt limits expansion by directing expenditures away from profitable companies and towards repaying debts. Severe debt-to-GDP ratios have been repeatedly linked to a decline in economic expansion, as evidenced by the recovery since the pandemic of several emerging economies.

Furthermore, prior research that highlights foreign investment as a major contributor to economic growth is consistent with the beneficial function of FDI. Infrastructural advancement, employment creation, and foreign investment are all generally has accelerated by increased FDI. However, common economic hypotheses that contend that public investment promotes expansion are contradicted by the detrimental effects of healthcare and expenditures by government. This could possibly be the result of pandemic-related costs are incurred, which were essential but did not support ongoing concern.

5.1. Policy Implications

- **Strategies for managing debt:** In order to keep foreign debt from delaying the recovery of the economy, governments must make it their top objective. Potential tactics to guarantee reasonable financing involve reconsidering the terms of the debt, looking for relief initiatives, along with improving financial regulations.
- **Encouraging FDI:** Since FDI supports GDP growth, governments are encouraged to pass laws that are welcoming to investors, cut down on regulations, and provide subsidies to the market.
- **Efficient Public Funding:** Due to government spending and health services have an adverse influence on GDP growth, governments demand to make sure the revenue is distributed effectively to industries that are profitable like creation, construction projects and educational opportunities.

- **Inflation Management:** Maintaining steady pricing levels is still vital for the sustainability of the economy, regardless of how inflation has little effect.

5.2. Theoretical Implications

The findings reinforce debt overhang theory, showing how excessive external debt limits economic recovery. The study supports investment-driven growth models, where FDI plays a crucial role in post-pandemic recovery. The results challenge traditional Keynesian perspectives on government and healthcare spending, suggesting that poor allocation of funds can slow down growth.

Despite offering valuable information, the study has a number of drawbacks that should be noted:

The data comes from World Bank sources, but differences in how countries report financial indicators might introduce minor inconsistencies. Future research should consider a longer timeframe, include qualitative insights, and focus on country-specific policies to gain a deeper understanding of external debt's long-term effects.

6. Conclusion

With the objective to consider the post-COVID-19 growth in the economy, that research identified the major drivers of GDP growth in 132 different countries between 2019 and 2022. The goal was to evaluate the effects of spending by the government, rate of inflation, health care spending, foreign direct investment, and external debt upon GDP growth to figure out with the greatest important recovery-related influencing variables.

- Global debt had the highest unfavorable effect on GDP growth (p-value: 5%, coefficient: -0.017), highlighting how large collections of debt limit revival of the economy.
- The GDP growth was also negatively impacted by government spending (-0.069, p-value: 9%) and healthcare costs (-0.204, p-value: 11%), indicating that inefficient spending may have impeded economic advancement.
- FDI's involvement in accelerating recovery was further supported by the fact that it positively contributed to GDP growth (coefficient: 0.015, p-value: 13%).
- The impact of inflation was not as important (0.010, p-value: 53%), demonstrating that variations in wholesale prices had minimal impact on considering economic growth.

These results demonstrate how important intelligent fiscal responsibility, strategies for investing, and strategically timed expenditures by governments are to boosting the economy.

6.1. Enhancement of Credit Handling

The guidelines that promote reasonable financing should be put in place, and governments should rely fewer on external debt. Monetary responsibilities can be lowered through debt repayment initiatives and debt bargaining. Revenue raising taxes that increase internal income generation can lessen a heavy reliance on foreign debt.

6.2. Encouraging An Increase in Foreign Direct Investment (FDI)

Decreasing administrative hurdles can help legislators foster a secure and investor-friendly atmosphere. Offering tax breaks, expanding building materials, and promising legal barriers can all foster a rise in foreign direct investment.

6.3. Increase the Effectiveness of Public Spending

Transportation, technology, and education are all instances of high-impact expenditures that governmental bodies ought to value since they create sustainable growth. It is important to carefully plan government and healthcare spending so that there are long-term financial gains.

6.4. Continue to keep Inflation Persistent

Despite this GDP growth was not greatly influenced by price hikes, governments ought to continue maintaining a close grip on pricing in order while avoiding economic unexpected outcomes.

In order to build on these conclusions, future research should:

- Evaluate the long-term impacts of global debt after 2022 in order to find out its long-run impact on the economy.

- Explore the policies significant to each nation to learn how various economies control debt and plans for investing.
- Investigate differences in the consequences of various sorts of external debt on recovery, such as subsidized and non-concessional financing.

Employ qualitative evaluation while considering trade agreements, governance stability, and international economic patterns into perspective.

Compliance with ethical standards

Acknowledgments

We have completed this paper fulfilling guidelines. Our course instructor Dr. Md. Qamruzzaman provided co-operations, supervision, and instructions while we were working on this paper. We would like to thank Qamruzzaman sir who always motivated and guided us in the preparation of this paper. His inspiration and guidance to achieve all the problems we faced during this course and also preparing this paper.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Jiang, D., X. Wang, and R. Zhao, Analysis on the economic recovery in the post-COVID-19 era: Evidence from China. *Frontiers in Public Health*, 2022. 9: p. 787190.
- [2] Yang, W., et al., COVID-19, urbanization pattern and economic recovery: An analysis of Hubei, China. *International journal of environmental research and public health*, 2020. 17(24): p. 9577.
- [3] Furman, J., et al., Promoting economic recovery after COVID-19. Washington: Economic Strategy Group, The Aspen Institute, 2020. 16.
- [4] Deng, X., M. Qamruzzaman, and S. Karim, Unlocking the path to environmental sustainability: navigating economic policy uncertainty, ICT, and environmental taxes for a sustainable future. *Environmental Science and Pollution Research*, 2024: p. 1-27.
- [5] Farzana, N., M. Qamruzzaman, and P.M. Mindia, Interplay of digital financial inclusion, technological innovation, good governance, and carbon neutrality in the top 30 remittance-receiving countries: The significance of renewable energy integration. *International Journal of Energy Economics and Policy*, 2024. 14(4): p. 408-425.
- [6] Feng, T., et al., Bridging environmental sustainability and organizational performance: The role of green supply chain management in the manufacturing industry. *Sustainability*, 2024. 16(14): p. 5918.
- [7] Guan¹, C. and M. Qamruzzaman, governance and globalization? *Environmental Risk and Corporate Behaviour*, 2024: p. 123.
- [8] Kor, S. and M. Qamruzzaman, Decoding the environmental synergy in BRI nations: analyzing the influence of renewable energy adoption, financial evolution, FDI, and capital resilience on sustainability. *International Journal of Energy Economics and Policy*, 2024. 14(3): p. 582-599.
- [9] O'Connor, C.M., et al., Economic recovery after the COVID-19 pandemic: resuming elective orthopedic surgery and total joint arthroplasty. *The Journal of arthroplasty*, 2020. 35(7): p. S32-S36.
- [10] Qamruzzaman, M., Does Environmental Degradation –Led Remittances flow? Nexus between environmental degradation, Uncertainty, Financial inclusion and Remittances inflows in India and China. *International Journal of Energy Economics and Policy*, 2023. 13(2): p. 9-26.
- [11] Qamruzzaman, M., Does economic policy uncertainty influences personal remittances: Evidences from AARDL and NARDL. *World Journal of Advanced Research and Reviews*, 2023. 18(01): p. 14-34.
- [12] Qamruzzaman, M., An asymmetric nexus between clean energy, good governance, education and inward FDI in China: Do environment and technology matter? Evidence for chines provincial data. *Heliyon*, 2023. 9(5).

- [13] Qamruzzaman, M., Do environmental and institutional quality attribute to inflows of FDI in Lower-Middle income Nations? Evidences from asymmetric investigation. *GSC Advanced Research and Reviews*, 2023. 15(3): p. 079-104.
- [14] Kumo, W.L., Infrastructure investment and economic growth in South Africa: A granger causality analysis. *African development bank group working paper series*, 2012. 160.
- [15] Qamruzzaman, M., Nexus between environmental qualities, institutional quality and FDI inflows in Lower-income Countries. *World Journal of Advanced Research and Reviews*, 2023. 18(03): p. 321–345.
- [16] Qamruzzaman, M., Does financial innovation foster financial inclusion in Arab world? examining the nexus between financial innovation, FDI, remittances, trade openness, and gross capital formation. *PloS one*, 2023. 18(6): p. e0287475.
- [17] Qamruzzaman, M., Clean energy-led tourism development in Malaysia: Do environmental degradation, FDI, Education and ICT matter? *Heliyon*, 2023. 9(11).
- [18] Qamruzzaman, M., Nexus between foreign direct investment, gross capital formation, financial development and renewable energy consumption: evidence from panel data estimation. *GSC Advanced Research and Reviews*, 2024. 18(1): p. 182-200.
- [19] Qamruzzaman, M., An assessment of the effect of gross capital formation and financial development on Renewable Energy Consumption in middle-income nations: Does FDI act as a boosting factor? Evidence from CS-ARDL and NARDL framework. *World Journal of Advanced Research and Reviews*, 2024. 21(1): p. 1053–1071.
- [20] Qamruzzaman, M., Do natural resources bestow or curse the environmental sustainability in Cambodia? Nexus between clean energy, urbanization, and financial deepening, natural resources, and environmental sustainability. *Energy Strategy Reviews*, 2024. 53: p. 101412.
- [21] Qamruzzaman, M., Nexus between financial development, foreign direct investment, and renewable energy consumption: Evidence from SSA. *GSC Advanced Research and Reviews*, 2024. 18(03): p. 265–280.
- [22] Cifuentes-Faura, J., Circular economy and sustainability as a basis for economic recovery post-COVID-19. *Circular Economy and Sustainability*, 2022. 2(1): p. 1-7.
- [23] Ahamed, F., Macroeconomic Impact of Covid-19: A case study on Bangladesh. *IOSR Journal of Economics and Finance (IOSR-JEF)*, 2021. 12(1): p. 2021.
- [24] Qamruzzaman, M., Urbanization, trade openness, and industrialization as a deterrent of clean energy consumption: Evidence from BRI nations. *World Journal of Advanced Research and Reviews*, 2024. 21(03): p. 1561–1574.
- [25] Qamruzzaman, M., Clarifying the nexus between Trade Policy Uncertainty, Economic Policy Uncertainty, FDI and Renewable Energy Demand. *International Journal of Energy Economics and Policy*, 2024. 14(2): p. 67-382.
- [26] Qamruzzaman, M., Environmental Sustainability in Bangladesh through renewable energy, foreign direct investment, and trade openness: Evidence from Load Capacity Factor and Inverted Load Capacity factor with Fourier Functions. 2024.
- [27] Qamruzzaman, M., Navigating the Path to Environmental Sustainability: Insights From CIVETS on the Intersection of ICT Diffusion, Natural Resources, and Green Technological Innovation. *Plos One*, 2024. 19(12): p. e0309264.
- [28] Qamruzzaman, M., Unlocking the nexus: Tourism, clean energy, innovation, and environmental sustainability in the top 20 tourist nations. *Sustainability Analytics and Modeling*, 2025. 5: p. 100037.
- [29] Qamruzzaman, M., Green finance, environmental taxation, and green innovation: unraveling their influence on the growth-quality nexus in China—a provincial perspective. *Environmental Research Communications*, 2025. 7(1): p. 015009.
- [30] Qamruzzaman, M., N. Farzana, and P.M. Mindia, Unveiling the path to environmental sustainability through energy efficiency, environmental innovation, and institutional quality in Southeast Asian Countries. *International Journal of Energy Economics and Policy*, 2024. 14(6): p. 322-343.
- [31] Qamruzzaman, M. and S. Karim, Does public-private investment augment renewable energy consumption in BIMSTEC nations? Evidence from symmetric and asymmetric assessment. *Energy Strategy Reviews*, 2023. 49: p. 101169.

- [32] Qamruzzaman, M. and S. Karim, Clarifying the relationship between green investment, technological innovation, financial openness, and renewable energy consumption in MINT. *Heliyon*, 2023. 9(11).
- [33] De Backer, B., H. Dewachter, and L. Iania, Macrofinancial information on the post-COVID-19 economic recovery: Will it be V, U or L-shaped? *Finance Research Letters*, 2021. 43: p. 101978.
- [34] Hoang, T.D.L., H.K. Nguyen, and H.T. Nguyen, Towards an economic recovery after the COVID-19 pandemic: empirical study on electronic commerce adoption of small and medium enterprises in Vietnam. *Management & Marketing*, 2021. 16(1): p. 47-68.
- [35] Qamruzzaman, M. and S. Karim, Green energy, green innovation, and political stability led to green growth in OECD nations. *Energy Strategy Reviews*, 2024. 55: p. 101519.
- [36] Qamruzzaman, M. and S. Karim, Unveiling the synergy: Green finance, technological innovation, green energy, and carbon neutrality. *PloS One*, 2024. 19(10): p. e0308170.
- [37] Qamruzzaman, M., S. Karim, and S. Kor, Does environmental degradation matter for poverty? Clarifying the nexus between FDI, environmental degradation, renewable energy, education, and poverty in Morocco and Tunisia. *Environmental Science and Pollution Research*, 2023. 30(18): p. 52872-52894.
- [38] Qamruzzaman, M., S. Karim, and S. Kor, Nexus between Innovation–Openness–Natural Resources–Environmental Quality in N-11 Countries: What Is the Role of Environmental Tax? *Sustainability*, 2024. 16(10): p. 3889.
- [39] Qamruzzaman, M. and R. Kler, Do clean energy and financial innovation induce SME performance?: clarifying the nexus between financial innovation, technological innovation, clean energy, environmental degradation, and SMEs performance in Bangladesh. *International Journal of Energy Economics and Policy*, 2023. 13(3): p. 313-324.
- [40] Qamruzzaman, M. and S. Kor, Nexus between technological innovation, trade, education and institutional quality: Evidence from dynamic SUR estimation. *World Journal of Advanced Research and Reviews*, 2023. 19(03): p. 153-171.
- [41] Qamruzzaman, M. and S. Kor, Institutional quality-led Technological Innovation in Lower-income nations: Does Trade and Education matter. *GSC Advanced Research and Reviews*, 2023. 16(03): p. 026-044.
- [42] Kaneva, T., et al., Tax policy for economic recovery and sustainable development after covid-19. *Problemy Ekonomii*, 2022. 17(2).
- [43] Chen, M. and R. Bashir, Role of e-commerce and resource utilization for sustainable business development: goal of economic recovery after Covid-19. *Economic Change and Restructuring*, 2022. 55(4): p. 2663-2685.
- [44] Qamruzzaman, M. and S. Kor, Navigating the path to environmental sustainability: Insights from CIVETS on the intersection of ICT diffusion, natural resources, and green technological innovation. *PloS one*, 2024. 19(12): p. e0309264.
- [45] Rathnayaka, I.W., R. Khanam, and M.M. Rahman, Examining Monetary Policy Measures and Their Impacts During and After the COVID Era: OECD Perspectives. *Economies*, 2024. 12(6): p. 154.
- [46] Sennoga, E. and L. Balma, Fiscal sustainability in Africa: Accelerating the post-COVID-19 recovery through improved public finances. *African Development Review*, 2022. 34: p. S8-S33.
- [47] Serfraz, A., M. Qamruzzaman, and S. Karim, Revisiting the nexus between economic policy uncertainty, financial development, and FDI inflows in Pakistan during covid-19: does clean energy matter? *International Journal of Energy Economics and Policy*, 2023. 13(4): p. 91-101.
- [48] Su, S., M. Qamruzzaman, and S. Karim, Charting a sustainable future: the impact of economic policy, environmental taxation, innovation, and natural resources on clean energy consumption. *Sustainability*, 2023. 15(18): p. 13585.
- [49] Sun, J. and M. Qamruzzaman, Technological innovation, trade openness, natural resources, clean energy on environmental sustainability: a competitive assessment between CO2 emission, ecological footprint, load capacity factor and inverted load capacity factor in BRICS+T. *Frontiers in Environmental Science*, 2025. 12.
- [50] Tan, Y., M. Qamruzzaman, and S. Karim, An investigation of financial openness, trade openness, gross capital formation, urbanization, financial development, education and energy nexus in BRI: Evidence from the symmetric and asymmetric framework. *Plos one*, 2023. 18(12): p. e0290121.

- [51] Bhanot, N., et al., A sustainable economic revival plan for post-COVID-19 using machine learning approach – a case study in developing economy context. *Benchmarking: An International Journal*, 2023. 30(6): p. 1782-1805.
- [52] Ingham, H., COVID-19, the Great Recession and Economic Recovery: A Tale of Two Crises. *JCMS: Journal of Common Market Studies*, 2023. 61(2): p. 469-485.
- [53] Verma, S. and A. Gustafsson, Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *Journal of business research*, 2020. 118: p. 253-261.
- [54] Wang, R., M. Qamruzzaman, and S. Karim, Unveiling the power of education, political stability and ICT in shaping technological innovation in BRI nations. *Heliyon*, 2024. 10(9).
- [55] Wang, Y., M. Qamruzzaman, and S. Kor, Greening the future: Harnessing ICT, innovation, eco-taxes, and clean energy for sustainable ecology—Insights from dynamic seemingly unrelated regression, continuously updated fully modified, and continuously updated bias-corrected models. *Sustainability*, 2023. 15(23): p. 16417.
- [56] Wang, Y., et al., Does financial deepening foster clean energy sustainability over conventional ones? Examining the nexus between financial deepening, urbanization, institutional quality, and energy consumption in China. *Sustainability*, 2023. 15(10): p. 8026.
- [57] Weixiang, S., et al., An empirical assessment of Financial Literacy and Behavioural Biases on Investment Decision: Fresh Evidence from Small Investor Perception. *Frontiers in Psychology*, 2022: p. 5746.
- [58] Williams, E.A., et al., Renewable energy sources for the present and future: An alternative power supply for Nigeria. Ebuete Abinotami Williams, Raimi Morufu Olalekan, Ebuete Ibim Yarwamara & Oshatunberu Modupe (2019) *Renewable Energy Sources for the Present and Future: An Alternative Power Supply for Nigeria*. *Energy and Earth Science*, 2019. 2(2).
- [59] Xia, C., M. Qamruzzaman, and A.H. Adow, An asymmetric nexus: remittance-led human capital development in the top 10 remittance-receiving countries: are FDI and gross capital formation critical for a road to sustainability? *Sustainability*, 2022. 14(6): p. 3703.
- [60] Xiangling, L.I.U. and M. Qamruzzaman, The role of ICT investment, digital financial inclusion, and environmental tax in promoting sustainable energy development in the MENA region: Evidences with Dynamic Common Correlated Effects (DCE) and instrumental variable-adjusted DCE. *PLOS ONE*, 2024. 19(5): p. e0301838.
- [61] Reza, M., Economic Challenges and Opportunities in the Post-Pandemic Era Towards Recovery and Innovation. *Innovative Economics Journal*, 2024. 1(1): p. 8-15.
- [62] Bojicic-Dzelilovic, V., D. Kostovicova, and F. Čaušević, Tested by the COVID-19 economic shock: peace-positive entrepreneurship and intergroup collaboration in post-conflict business recovery. *Conflict, Security & Development*, 2024: p. 1-26.
- [63] Purnamasari, F., Y. Susanti, and W. Rosilawati, Implementation of Musyarakah Financing On Micro, Small, and Medium Enterprises (MSME): Solutions for Regional Economic Recovery Post Covid-19 Pandemic. *Dinar: Jurnal Ekonomi dan Keuangan Islam*, 2025. 12(1): p. 92-101.
- [64] Ilyas, A., et al., Strategies of Sharia-Based Business Recovery of Post-Covid-19: A Case in Lombok Island, West Nusa Tenggara, Indonesia. *Calitatea*, 2025. 26(204): p. 275-284.
- [65] Xiao, Z. and M. Qamruzzaman, Nexus Between Green Investment and Technological Innovation in BRI Nations: What Is the Role of Environmental Sustainability and Domestic Investment? *Frontiers in Environmental Science*, 2022. 10.
- [66] Xie, X., et al., Covid-19 and market discipline: Evidence from the banking sector in emerging markets. *International Review of Economics & Finance*, 2024. 89: p. 612-621.
- [67] Xu, S., M. Qamruzzaman, and A.H. Adow, Is financial innovation bestowed or a curse for economic sustainability: the mediating role of economic policy uncertainty. *Sustainability*, 2021. 13(4): p. 2391.
- [68] Yan, H., M. Qamruzzaman, and S. Kor, Charting a Sustainable Future: The Impact of Economic Policy, Environmental Tax, Innovation, and Natural Resources on Clean Energy Consumption. *Sustainability*, 2023. 15(18): p. 1-30.
- [69] Yan, H., M. Qamruzzaman, and S. Kor, Nexus between green investment, fiscal policy, environmental tax, energy price, natural resources, and clean energy—a step towards sustainable development by fostering clean energy inclusion. *Sustainability*, 2023. 15(18): p. 13591.

- [70] Yang, Y., et al., Do Tourism and Institutional Quality Asymmetrically Effects on FDI Sustainability in BIMSTEC Countries: An Application of ARDL, CS-ARDL, NARDL, and Asymmetric Causality Test. *Sustainability*, 2021. 13(17): p. 9989.
- [71] Yi, X. and M. Qamruzzaman, Unlocking environmental harmony through export earnings: exploring the impact of remittances and infrastructure growth. *Frontiers in Environmental Science*, 2024. 12: p. 1388056.
- [72] Yin, C. and M. Qamruzzaman, Empowering renewable energy consumption through public-private investment, urbanization, and globalization: Evidence from CS-ARDL and NARDL. *Heliyon*, 2024.
- [73] Yin, C. and M. Qamruzzaman, Empowering renewable energy consumption through public-private investment, urbanization, and globalization: Evidence from CS-ARDL and NARDL. *Heliyon*, 2024. 10(4).
- [74] Yingjun, Z., S. Jahan, and M. Qamruzzaman, Technological Innovation, Trade Openness, Natural Resources, and Environmental Sustainability in Egypt and Turkey: Evidence from Load Capacity Factor and Inverted Load Capacity Factor with Fourier Functions. *Sustainability (2071-1050)*, 2024. 16(19).
- [75] Yingyi, W., et al., DOES FINANCIAL DEEPENING FOSTER CLEAN ENERGY SUSTAINABILITY OVER CONVENTIONAL ONES? EXAMINING THE NEXUS BETWEEN FINANCIAL DEEPENING, URBANIZATION, INSTITUTIONAL QUALITY, AND ENERGY CONSUMPTION IN CHINA. 2023.
- [76] Zhang, J., R.d. Jong, and D.R. Haurin, Are US Real House Prices Stationary? New Evidence From Univariate and Panel Data. *Studies in Nonlinear Dynamics and Econometrics*, 2016. 20(1): p. 1-18.
- [77] Zhang, K.-m. and Z.-g. Wen, Review and challenges of policies of environmental protection and sustainable development in China. *Journal of environmental management*, 2008. 88(4): p. 1249-1261.
- [78] Zhang, Y., et al., Nexus between Economic Policy Uncertainty and Renewable Energy Consumption in BRIC Nations: The Mediating Role of Foreign Direct Investment and Financial Development. *Energies*, 2021. 14(15): p. 4687.
- [79] Zhao, L. and M. Qamruzzaman, Do Urbanization, Remittances, and Globalization matter for Energy Consumption in Belt and Road Countries: Evidence from Renewable and Non-Renewable Energy Consumption. *Frontiers in Environmental Science*, 2022. 10: p. 723.
- [80] Zheng, G., et al., Factors Affecting the Sustainability Performance of Financial Institutions in Bangladesh: The Role of Green Finance. *Sustainability*, 2021. 13(18): p. 10165.
- [81] Zubedi, A., et al., Sustaining Low-Carbon Emission Development: An Energy Efficient Transportation Plan for CPEC. *Journal of Information Processing Systems*, 2018. 14(2).