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# Role of public and private investments for green economic recovery in the post-COVID-19

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## ABSTRACT

This study evaluates the outlook of government expenditure through public and private financing for the green economic revitalization after COVID-19 in Canada. The various econometric estimations are used to measure the impact of government expenditure on green economic recovery. The implementation of public investment is explicitly associated with private funding. The results suggest that the government policy incentives and non-government financing influence fossil fuel energy sources proportions on non-government investment, which is additional than the feed-in tariffs. According to fixed effects results, the distribution of fossil fuel energy sources is an essential obstacle in solar energy investment. In contrast, the presence of varied types of renewable energy encourages non-government climate investment. Throughout the study period after the breakout of the pandemic phase, neither fossil fuel energy sources nor economic policy is marginally efficient. The different macroeconomic programs in green economic recovery might be ideal for attaining the needed impact. The critical policy conclusion of the results of this research is that an influential role of the public and private investment may be part of an optimal firm innovation plan for green economic recovery in the post-COVID-19 period.

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## 1. Introduction

COVID-19 has caused price fluctuation in energy carriers, impacting economic growth and triggering a worldwide recession and public unease due to its spread. Since the introduction of immunization programs, worldwide sectors have begun to recover from their losses, increasing employment and purchasing power and improving overall economic activity (Azad et al., 2021). On the other hand, in 2020, 256

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million full-time employees lost \$3.8 trillion in wages because of wasted work hours. US\$13 trillion or more is expected to be lost by the end of the year 2021, even though US\$18 trillion has been invested in an economic stimulus (Gates, 2020). COVID-19's disproportionately socioeconomic impact on poorer countries and weaker demography puts them in greater danger of not meeting their SDG goals. A crisis provides an opportunity to show how vital and urgent SDG adoption is in light of varying people's degrees of susceptibility and their varying core causes.

Nevertheless, the economic recovery from the first plunge has been comparatively rapid in the face of robust policy reactions measures (Chen et al., 2021; Gao et al., 2020; Huang et al., 2021; Lei et al., 2021). For instance, stock prices for significant industries bounced back about 60% of their worth, which decreased nearly half a year after the first economic plunge (Caballero-Morales, 2021; Deardorff et al., 2020). The pandemic has impacted all economies crunched, whether developed or developing countries alike. So, there is now an apparent growing path to end the pandemic crises by falling on mass inoculation programs in pace and magnitude (Hilbers et al., 2019; Khosravi et al., 2019; Kordej-De Villa & Slijepcevic, 2019; Ozoike-Dennis et al., 2019). However, the execution is multifaceted and risky, whereas the extended-term ramifications of the Covid-19 on health, acquiring skills, and the quick spread of the technology continue to be significant in doubt (Abdullah et al., 2020; Gao et al., 2021; Haruna & M. Hanafiah, 2017; Soo Mun Peng, 2019).

Furthermore, multilateral economic partnerships can play a significant part in COVID-19 and reduce the risk of contagion. These multilateral partnerships could be the long-run costs from the exceptional Covid-19 relics and optimize the gains from national commitments to bounce back stronger (Mohsin et al., 2022a; 2022b). Thus, within the scenarios of more significant uncertainty in China, alongside creditors, on the whole, are scaling back credits, governments have come to their rescue by absorbing the growth in credit risk, making sure firms can access funding throughout the pandemic period (Fang et al., 2022; Mohsin et al., 2022a) and (Irfan et al., 2022). Moreover, the public sector is well placed to give credit when there is a greater risk (Gootjes & de Haan, 2022). Governments have recapitalized state-run financial institutions concerning different happenings and increased public credit assurance policy. I.e., Comprising 70% to 90% of the credit, assisted by vast buys of a portfolio of debts (He et al., 2020; Yang et al., 2021). The possibility of quickly realizing varied policy choices among countries hinges on the institutional context (He et al., 2020; Yang et al., 2021). For instance, while certain nations have a good number of state-run financial institutions, the rest do not. Issues regarding implementing this set of policies will increase to the degree that new supply chains might need to be formed (Raies, 2020).

Several environmental and economic issues have been creating trouble for various regions of the globe, depending on their population and geographic regions, such as health issues, flooding, drought, rising temperatures, forest fires, and storms (Sun et al., 2020; Tjep et al., 2021). Globalization has become a significant concern, particularly when it comes to international economic systems. Financial institutions, businesses, and mass transit must have better access to developing markets. Decreased regulations and global economic openings promote financial services and the global stock of assets and debts. Because of financial globalization, the financial

sector is feasible. Voiced (Cantore & Freund, 2021) concern regarding the duration of these gains, stating that although confinement efforts implemented in the wake of the COVID-19 epidemic resulted in cleaner air, the problem of air pollution was not significantly alleviated. We may thus deduce that recognizing the COVID-19-generated accidental positive benefits on the natural surroundings is premature and that the emphasis should instead be on how to preserve the acquired advantages via granular policy choices throughout the construction of COVID-19 stimuli and recovery packages. (Baloch et al., 2020; Sun et al., 2020).

Corporate financing may not be reactive to reduce interest rates alongside the coronavirus actions and the uncertainty about the headwinds' scale and length. Also, certain central banks have equally sent cash assistance to financial institutions at a reduced cost, with incentives to increase, resulting in the development of the actual economy. Unlike the usual financial crunch, financial institutions have not faced liquidity challenges (Danielson et al., 2020). Instead, they ought to tackle alongside a separate expansion in the credit risk of companies that relies on the scale and length of the pandemic headwinds (Krüger & Meyer, 2021). Similarly, some investment gatekeepers have limited banks' Basel III capital requirements in countercyclical capital buffers, conservation backups, systemic risk buffers, and pillar II costs. In addition, to be efficient, banks would require to change the announced capital into greater crediting to enterprises within the context of expanded risk. These measures only may not give adequate inducements for them to do so. Additionally, not all nations have institutionalized incentives to do so (Agyekum et al., 2021; Zhang et al., 2021). Further, not all nations have institutionalized the Basel capital accord, and consequently, not the entire countries attain the latitude to cut capital costs (Trading Economics, 2020).

This paper evaluates the resilience, the ability to bounce back stronger from the economic headwinds of the coronavirus, provinces in the Canadian Union after the 2008 financial crisis.

Contribution To measure the outlook of government expenditure for economic recovery by using econometric estimations and the mediating role of public and private investment. This study deliberates on certain norms concerning general scientific modeling. It concentrates on government investment and economic recovery in Canada that outlines the robustness of monetary policy to attain specific objectives. To analyze the impacts of the pandemic on economic recovery by using the case study of Canada and by far providing implications for different lower-middle-income countries to recover effectively from economic challenges caused by a coronavirus by using insights obtained from the recovery from the 2008 financial crisis, hence applying the recoverability model approximates. Employment would have entirely rebounded after the crisis. As a result, the experience of current monetary policy reduces the economic and financial effects of coronavirus on US. consumers and businesses. The research focuses on post-pandemic recovery to better understand the contribution to evaluating existing research. The review sheds light on the significant aspect of the study being undertaken before the start of the coronavirus. The research demonstrates that, when researched from varied viewpoints, the concurrent impacts of the contagion have been meaningful and multifaceted.

The rest of the analysis is arranged as follows: The following units present a broader view of the context of the study. Section three sheds light on the dataset estimations methods, whereas section four discusses the descriptive analysis and the findings of the econometric approach. Eventually, the final unit ends the study with conclusions and policy consequences.

## 2. Literature review

Several analyses have formally evaluated the association between the pandemic and the financial markets on the presumptions that financial markets respond quickly to news of contagion outbreak, giving a quick redlight concerning contagion diffusion's economic consequences (Guo et al., 2022). For instance, Suescun (2020) discover significant volatility amongst China's stock markets indexes and the bitcoin through the heights of the contagion (Stoian & Iorgulescu, 2020). Another expansion in the association of stock market returns between China and the group of seven nations through the pandemic phase: high-level financial companies over non-financial companies (Chien et al., 2021; Iqbal et al., 2021; Li et al., 2021). Batool et al. (2021) discovered that the correlation is lopsided and varies in magnitude and locations at several quantiles. Overall, asset profits are responsive to the increase in the pandemic deaths (Mirza et al., 2020a, 2022; Naqvi et al., 2021). Song and Zhou (2020) finds that meaningfully adverse performance of equities and commodities plus spikes in the volatility of their profits are correlated to reported growths in the contagion cases. Lang and Schadner (2021) recorded a meaningful plunge in the stock profits of Chinese companies related to the affirmed amounts of the pandemic cases and fatalities (Mirza et al., 2020b; 2020c; Mosser, 2021; Yarovaya et al., 2021). Consider a reputational-based pandemic view of contagion and depict the enterprises with corona-correlated corporate images negatively functioned through the pandemic. Additionally, responding to the news of the pandemic reported cases, investors react to different pandemic correlated news in the form of policy measures and other releases by the regulators.

Azad et al. (2021) detects the systemic danger in the financial institutions of the areas of the impacted nations grew from the beginning and attains uniformity within April 2020. Different research studies have evaluated markets' response to the pandemic correlated information, comprising policy interruptions and lockdown policies. Similarly, applying China's investment market data depicts those domestic stocks responding to the contagion reports before those companies with global footprints. They contend that this analysis is proof of information lopsidedness. So, in evaluating the response of the United States of America industry profits to the pandemic correlated news and policy reports. Chang et al. (2020) have it that specific sectors like restaurants and hotels experienced adversely unusual profits, whereas others, comprising of pharmaceutical products areas, had remarkable direct gains. Agosto and Giudici (2020) discover meaningful associations between the trading volumes of 26 stocks markets and the volume of reported cases and fatalities. Rizvi et al. (2020) found that while most investment funds suffered during the Covid-19 outbreak from January to June, social entrepreneurship funds remained resilient. Mirza et al. (2020a) explored that the spread of Covid-19 was a significant surprise, and it caused a global financial market crash between January and May 2020.

Entrepreneurship funds had a positive effect. Hasnaoui et al. (2020) suggested that funds invest in human capital to increase their funds' resilience to stress on the human capital efficiency during COVID-19 in five EU countries. Countries. Rizvi et al. (2020) concluded that the coronavirus (Covid-19) outbreak impacted several businesses across Europe. It shows the sales growth and cash flow, potentially increasing corporate bankruptcies. The data imply that a tax deferral is adequate for a moderate economic decline. Mirza et al. (2020) concluded that investments can increase the human capital efficiency to overcome macroeconomic shocks during COVID 19 in Latin America.

Yarovaya et al. (2020) conducted a study on the contrast between the risk-adjusted performance, investment approaches, and volatility timing of Islamic equities funds with conventional equity funds. Specifically, Islamic equities funds outperformed non-Islamic peers during the peak months of the epidemic, indicating that they are more resilient to COVID-19 shocks. So, to increase the financial system's resilience to future black swan events, policymakers should look into Islamic financial assets and their principles. Rizvi et al. (2020) explored the influence on non-financial European firm valuations. They consider the effect of COVID-19 on predicted sales and the cost of equity. As a result of lower sales and higher equity costs, values have fallen across all industries. Naqvi et al. (2021) explored those institutional sizes and nations show significant asset quality declines, and defective capital and default risk have increased in COVID –19 in UEU. Naqvi et al. (2021) studied the COVID 19 epidemic, Asian equity funds' performance, market, and instability. It is found that investments with higher human capital efficiency outperform funds with lower efficiency in 16 COVID-19 diseases in Asian countries.

Paule-Vianez et al. (2022) evaluated the bond markets that provide insurance for bitcoin uncertainty indices. According to et al. (2021), green energy-based investments have increased due to socio-economic effects and increased funding flows and concluded that the green funds outperform brown and black funds risk-adjusted. Naqvi et al. (2021) highlighted that green financing increase the capital adequacy of banks due to the low cash flow volatility of carbon-neutral financial creditors. Ji et al. (2021) investigated the influence of rising commodity prices on capital adequacy. The results reveal that spreads decreased during the oil shock, and it has emerged as a winner in US economic uncertainty. Price volatility is a risk for Bitcoin in the US (Rabbani et al., 2021; Ullah et al., 2021) formulated a consumer purchase fear index and depicted that the twofold domestic and global virus spread the news and government policy releases elucidate the flows in the fear index. These analyses imply that information movements regarding the double documented pandemic incidence and policy implementations are vital to determine financial cost flows. The body of knowledge indicates that the correlation between the pandemic incidence and asst profits is country peculiar, relying partly on how freely information is circulated and on financiers' confidence in a country's institutions.

### **3. Data and methodology**

#### **3.1. Data**

We use data from the Bloomberg New energy finance repository, economic cooperation, development organization, and the World Bank development indicators. Data

**Table 1.** System of variables.

Acronyms	Variable
Puinv	Public Investment
Pinv	Private investment
STax	The stringency of the diesel tax
EFP	Expansionary fiscal policy
CFP	Contractionary fiscal policy
GDP	Gross domestic product
R	Interest rate
EMP	Expansionary monetary policy
CMP	Contractionary monetary policy

Source: 'Authors' compilation.

set of renewable energy sources are funding are obtained from the individual-level data set changed (Steffen, 2018), that adds up to conclude at an annum government and non-government financing sources of renewable energy technologies, including biomass, geothermal, Marine, micro-hydro, marine, solar and wind generation sources; it also entails biofuels investment in transport. As explained straightforwardly by Guild (2020), self-projects may have different investors. The resulting government and private methods separate the government and non-government parts and projects with heterogeneous investors (Olakojo et al., 2021). To ensure the comprehend the effect of government and non-government investment, which explain in the given equation beneath, to be the dual integration of non-government investors regarding projects where government investment needs to occur and future years projects.

Further, the world bank development indicators provide data on per annum necessary energy requirement per head. The organization's Economic cooperation development per annum dataset system gives data on various policy tools implemented nationwide, entailing market-based mechanisms, i.e., tax cuts and different incentives and non-market tools. i.e., command and control. Table 1 shows the system of variables.

### 3.2. Methodology

To the national bureau of economic research work, the economic recession began briefly after the subprime mortgage problem in December 2007 and went on for nearly half of 2009. Over 15 million people forever lost their jobs throughout this period, the unemployment rate expanded from almost 4.8% to almost 10%, and actual gross domestic product fell. Hence, the urgency of formulating an appropriate monetary policy to counterbalance the crisis and improve an economic build-back increased dramatically. By utilizing a fixed model estimated by way of total generalized least squares estimators, the model is constructed below (model 1):

$$\begin{aligned}
 \text{Public investment} = & \alpha + \beta_1 \text{Pinv} + \beta_2 \text{STax} + \beta_3 \text{EFP} + \beta_4 \text{CFP} + \beta_5 \text{GDP} + \beta_6 r \\
 & + \beta_7 \text{EMP} + \beta_8 \text{CMP}
 \end{aligned} \tag{1}$$

Pinv is represented private investment, STax depicts stringency tax, EFP depicts expansionary fiscal policy, Interest is represented by r, EMP represents the expansionary monetary policy, and CMP depicts contractionary fiscal policy. Here i represents

cross-sectional dependence, and  $t$  represents the timeframe (Funashima, 2020). A nonstationary panel re-estimation analysis by including the past dependent variable to be an independent one (Johnston et al., 2018), as depicted in the model (2),

$$\begin{aligned} \text{Public investment} = & \alpha + \beta_1 \text{Pinv} + \beta_2 \text{STax} + \beta_3 \text{EFP} + \beta_4 \text{CFP} + \beta_5 \text{GDP} + \beta_6 r \\ & + \beta_7 \text{EMP} + \beta_8 \text{CMP} \end{aligned} \quad (2)$$

To obtain a robust analysis of different effects of environmental program interruptions, it is estimated that the model with general moment methods estimators for panel data. Such estimators create room for moderate endogeneity between dependent and exploratory variables. Notably, the independent variables may associate with the random variable; instrumenting parameters pass this context alongside previous level figures of the experimental variables. Overall, a rationale suitable variable essentially has to meet these necessities: (i) To obtain a correlation with the estimator nonetheless (ii) To obtain a correlation with the random variable. Although the analysis tests the robustness of the variables, it is clear that the previous figures could be weakly external to the model. i.e., they are linked to the random variable at phase T (Dorsey-Palmateer & Niu, 2020). The first differenced model presents a consistent asymptotically efficient estimate with heteroscedasticity. Thus, the present, which also requires not robustly exogenous variables, is grounded on modifying the dependent variable as vertical digression deviation since the changed random term assumes a complete variance and is not correlated. Within these models, the rigor of the variables is confirmed by utilizing the analysis. Also called the J-statistic, for the interpretation of overidentifying constraints. (equally known as J-statistic) (Embrett et al., 2021; Klomp, 2020; Loayza & Pennings, 2020). Mainly analyze the vertical amongst the variables and the random variables. Within the analysis, an instrument for parameters is the previous values of the endogenous variables. Concerning the Arellano-Bond approximator, analyze the presence of sequential correlation (Sarwar et al., 2020).

In addition, (i) an entire generalized least square on a static longitudinal with the fixed effect. (Equation 1) (ii) a full generalized least square on dynamic longitudinal alongside fixed development (Equation 2). Further, all models are reevaluated differently for the different double types of generations sources, Wind and Solar, suggesting the other time series for investment and feed-in tariffs regarding these productions' types. Due to the variables in Equations (1) and (2) being estimated in different approximations are leveled, causing the authors to analogy the estimated factors. The endogenous variable  $\text{Puin}$  is not standardized. Nonetheless, it is seen in a log form. Hence, this ensures that the authors comprehend and estimate the factors as fractions variations in the stage of personal investment; afterward, a single standard deviation increases in the set of the selected exogenous parameters.

## 4. Results and discussion

### 4.1. Private investment during the Covid-19 pandemic

To evaluate the effect of the coronavirus pandemic on economic recovery, approximating the impacts of monetary policy on the financial market. It analyzes various



**Table 2.** Results of whole sample.

	(1)	(2)	(3)	(4)	(5)	(6)
Pinv	0.19*** -0.03	0.21*** -0.02	0.20*** -0.02	0.23*** -0.09	0.24*** -0.04	0.25*** -0.03
STax	0.13*** -0.04	0.15*** -0.03	0.16*** -0.04	0.23*** -0.07	0.26*** -0.08	0.06 -0.06
EFP	0.02 -0.07	-0.03 -0.05	-0.01 -0.05	-0.11 -0.11	-0.08 -0.12	0.07 -0.1
CFP	0.21*** -0.11	0.05 -0.09	0.14*** -0.07	0.11 -0.08	0.03 -0.06	0.11*** -0.07
GDP	0.03 -0.06	0.02 -0.07	0.02 -0.04	0.01 -0.05	0.04 -0.06	0.05 -0.07
R	0.13*** -0.03	0.13*** -0.04	0.15*** -0.05	0.07 -0.06	0.09 -0.07	-0.01 -0.03
EMP	0.01 -0.05	0.01 -0.07	0.05 -0.06	0.06 -0.11	-0.02 -0.09	0.05 -0.08
CMP	0.09* -0.04	0.08* -0.07	0.13* -0.08	0.13* -0.07	0.14* -0.05	0.15*** -0.06
C	6.19*** -0.19	7.32*** -0.28	7.28*** -0.25	5.34*** -0.55	1.83*** -0.17	0.13*** -0.05
Observations	192	182	172	170	148	148
Durbin-Watson	1.42	1.83	1.61	1.77	-	-
Prob (J-statistic)	-	-	0.16	0.33	0.42	0.17

\* $p < 0.10$ . \*\* $p < 0.05$ . \*\*\* $p < 0.01$ . Standard error in parentheses; Source: 'Authors' calculation.

scholarly works to estimate public and private investment variations for economic recovery.

Results in Table 2 shows that a country's prevailing energy freedom affects the incentives to invest in renewable energy sources. This evaluation is due to an exclusive group of countries that show noticeable varied features concerning domestic trading of goods and services. Countries that rely on traditional energy production sources have limited Interest in investing in solar energy. Despite owing ecological context approval for solar energy, Australia rightly demonstrates this practice own one of the reduced finance stages for solar energy investment between the organization for economic cooperation development. i.e., the renewable energy sources altogether, owing principally to the critical consumption of traditional energy sources, producing 0.015ktoe of conventional energy per source.

This finding seems to be opposite to the experimental associated with an expansion stock in index profits (Table 3). For instance, Loayza and Pennings (2020) discovered the ten-year government bond yield. i.e., the substitute interest rates and stock profits flow similarly in EU nations, irrespective of whether it changes in time plus crosswise time differences (Martínez-Rodríguez et al., 2020). I have noticed the co-advancement amongst the ten-year Treasury yields and stock profits centered on a sample of a group of seven nations. For instance, a fall in the policy explains an expansionary monetary policy, and financiers anticipate inflation. Alike, inflation anticipations cause financiers to expect raw material costs, resulting in more significant investment costs and lower corporate returns. In this vein, corporate valuations plunge, and financing profits fall in the short run. In another scenario, when the central bank cuts policy rates, investors see the economic growth potential to be discouraging and diminish their stock holdings. Hence, reducing the interest rates could make stock profits fall.

**Table 3.** Private investment in solar energy sources.

	(1)	(2)
Pinv	0.43*** −0.05	
STax		0.11*** −0.04
EFP	0.37*** −0.07	0.37*** −0.04
CFP	0.17* −0.07	0.14** −0.05
GDP	0.37*** −0.07	0.05 −0.09
r	0.05* −0.06	0.03** −0.07
EMP	0.31*** −0.04	0.19*** −0.04
CMP	0.01 −0.05	0.07 −0.07
C	4.45*** −0.17	4.77*** −0.31
Observations	193	173
Durbin-Watson	1.76	1.74
Prob (J-statistic)	−	−

\* $p < 0.10$ . \*\* $p < 0.05$ . \*\*\* $p < 0.01$ . Standard error in parentheses; Source: Authors' calculation.

Table 4 shows that a detailed form, models one and two, attaining a total generalized least square estimators, show an individual standard separation expansion in the degree of government direct investment findings in an expanded in self-funding of about 20%. When the analysis was carried out on the effects of varied programs instrument, it unraveled that expansion in taxes on traditional sources and the feed-in tariffs directly affects private investment in monetary policy, which is beneath the growth levels generated by private investment. Different from model 1 and model 2, a varying panel model is estimated starting with past private and government investment values. The first analysis estimated with the entire generalized least square in models one and two is confirmed by the remainder of models three and six, whose factors are estimated using OLS estimators; An expansion in direct government investment spurs the substantial. Investment affects non-public investment or the private sector. One standard deviation expansion in government investment in relaxed fiscal policy brings growth in investment of 19% in model 3, 28% in models 4 and 5, plus 24%

#### 4.2. Feed-in tariff

Feed-in tariffs also determine private investment in renewable energy sources; nonetheless, the effect is methodically beneath what they produced by direct government investment. The exchange rate and policy rate are meaningfully adversely associated. That implies that the tightening monetary policy will result in depreciations of exchange rates. Several studies have been done on the same finding. For instance Klomp and Sseruyange (2021), Putnam (2021) and Tian (2021) formulate a framework of currency headwind and conclude that expansion in domestic interest rates might lead to a devaluation of the domestic currency. Kreso et al. (2021) illustrates that the nominal exchange rates of group seven nations devalue within nearly ten

**Table 4.** Results of private investment in wind energy resources.

	Model 1	Model 2
Pinv	1.13*** -0.03	
STax		0.11*** -0.03
EFP	0.33*** -0.04	0.37*** -0.03
CFP	0.13* -0.07	0.13** -0.05
GDP	0.31*** -0.11	0.05 -0.05
r	0.04* -0.06	0.03** -0.07
EMP	0.13*** -0.03	0.13*** -0.04
CMP	0.01 -0.05	0.07 -0.07
C	3.45*** -0.17	4.77*** -0.31
Observations	153	173
Durbin-Watson	1.33	1.73
Prob (J-statistic)	0.31	0.37

Source: Authors' calculation \*  $p < 0.10$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . Standard error in parentheses.

months in reaction to the growth of United States monetary policy (Mundle & Sahu, 2021; NEDA, 2020). Thus, an expansion in policy ratios can trigger CDS expansion to increase. Inversely, a growth in policy percentages starts a thriving economy to fall. The bond issuers' resettlement burden expands quickly and causes a danger of nonpayment. After the demand for safeguarding against risk, the CDS diffusion grows. Table 5 shows the impact of feed in tariff on renewable energy sources

The policy has meaningful adverse impacts on stock index profits and exchange rates regarding current monetary policies, i.e., depicted in Equations (2) and (3) in Table 2 nonetheless nonsignificant impact on government bond yields or CDS expansion. As it is understood, the dual traditional and modern monetary policies are principally growing throughout the pandemic. The growth of current economic policies may cause market actors to be extra cynical concerning the economy, making the stock index fall.

The impact of traditional monetary policies on exchange rates varies from the conventional monetary policy. Growth in conventional monetary policy results in a devaluation of the local currency, in harmony with the findings derived by Inoue and Rossi (2019). Within the timeframe, it can summarize that in Table two, traditional or modern monetary policies have meaningful impacts on all four financial market indicators throughout the pandemic phase. Table 6 shows fixed effect analysis.

An explicit coefficient of about 10% is found in models one to three. Conversely, nonsignificant factors are depicted in four and six. Regulatory actions such as pollution standards don't result in a positive effect on self-clean energy investment. This extraordinary analysis results from a statistical issue linked to the approximation of the variable analysis in Table 7.

From the analysis, the evaluation depicts that the total level of human activity on the gross domestic product directly affects self-investment in models (1), (2), and (6). At the same time, energy per capita has a non-meaningful effect on the quantum of

**Table 5.** Impact of feed in tariff on renewable energy sources.

	(1)	(2)	(3)	(4)	(5)	(6)
Feed-in tariff	1.28***	1.12***	1.22***	1.28***	1.22***	1.18***
	-0.06	-0.06	-0.08	-0.08	-0.06	-0.02
STax	0.18***	0.17***	0.10***	0.12***	0.11***	0.04***
	-0.06	-0.06	-0.06	-0.07	-0.02	-0.02
EFP	0.22***		0.21***	0.28***	0.24***	0.18
	-0.06		-0.04	-0.07	-0.06	-0.01
CFP	0.11*			0.18*	0.18**	0.12
	-0.08			-0.06	-0.08	-0.02
GDP	0.18***				0.16***	0.11***
	-0.12				-0.04	-0.02
r	0.04*				0.08**	0.08
	-0.06				0.06	-0.06
EMP	0.12***					-0.01
	-0.12					-0.04
CMP	0.01					
	-0.07					
C	2.27***	4.87***	6.66***	6.14***	-	-
	-0.18	-0.21	-0.22	-0.26	-	-
Observations	182	182	172	170	148	148
Durbin-Watson	1.87	1.82	1.86	1.77	-	-
Prob (J-statistic)	-	-	0.26	0.28	0.28	0.18

Source: Authors' calculation \*  $p < 0.10$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . Standard error in parentheses.

**Table 6.** Fixed effects analysis.

Test	Test	Significance
Cross-section F	28.43	0
Cross-section $\chi^2$	253.44	0
Breusch-Pagan LM	146.54	0.06
Pesaran scaled LM	1.59	0.01
Pesaran CD	3.20	0
Likelihood ratio	139.43	0
Likelihood ratio	2.94	0.21

Source: Authors' calculation.

self-investment. It is observed the twofold all-encompassing part of total efficiency. The reach efficiency lowered next to 2015, and slow macroeconomic growth in conformity alongside the path of the world's economy. Initially, financiers did not anticipate the young, insufficient, and uncertain monetary policies implemented throughout the coronavirus phase. This inadequate past knowledge deals with less reactive actors to economic policies than they would have been in usual times. Nonetheless, some researches depict that significant asset is comparatively ineffective in giving a haven for financiers (Ji et al., 2020). Financiers are less likely to move liquidity assets by substituting investment assets when the pandemic is spreading globally and causing systematic risk. As a result, they respond less after monetary policy releases.

### 4.3. Impact of public intervention

According to previous research and expectations, the analyses imply that government functions are directly linked to private investment, such as government policy and public investment distribution. As a result, the relevance of renewable energy may

**Table 7.** Redundant fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)
Pinv	0.17*** -0.12					
STax		0.06*** -0.02				
EFP			0.09*** -0.13			
CFP				-0.05*** -0.11		
GDP					0.05*** -0.09	
R						0.019*** -0.03
EMP						
CMP						
C	6.35*** -0.30	5.89*** -0.24	4.99*** -0.32	5.54*** -0.39	- -	- -
Observations	172	174	214	203	214	178
Durbin-Watson	1.42	1.31	1.46	1.26	-	-
Prob (J-statistic)	-	-	0.27	0.24	0.36	0.21

\* $p < 0.10$ . \*\* $p < 0.05$ . \*\*\* $p < 0.01$ . Standard error in parentheses; Source: Authors' calculation.

result from the role played in the United States of America, that the country relied on this policy tool for the previous timeframes.

Integrating the approximates of the four models in Table 8 concluded that the emergence of the pandemic has made fragile the spread of the traditional monetary policy. The rationale for this decimating impact will be elucidated later. Indeed, the findings in Elyassi (2021) contend that through the coronavirus stage, the adverse headwinds on the United States policy rate yet result in a spillover currency devaluation of 10 in the developed world plus 25 in the developing world, which seems contrary to the findings. As a result of the dollar's standing, the United States monetary policy will logically trigger the variations of exchange rates against the United States dollar in several nations. Instead, examine the effect of the pandemic on the spread of the nation's self-monetary policy to its investment markets. Without evaluating the data, a viewpoint that throughout the pandemic phase; nonetheless, it can't solve the economic downturn. The experiential findings imply that monetary policy becomes less effective in controlling investment markets throughout the coronavirus stage. Consequently, the results corroborate the view (Mundle & Sahu, 2021) to a certain level and give additional compelling proof for the economic efficacy.

#### 4.4. Robustness analysis

The source of government financing has an explicit and noticeable association with the self-financing flow in the entire models interpreted, highlighting a common factor between self-flow and government financing. The variables of government finance are clear at present levels and crosswise phases. Frankly, the previous variables of government investment have greater magnitude over the concurrent variables.

Table 9 shows that in the reference model, only nuclear presence has a significant implicit association alongside energy from the solar investment in the renewable

**Table 8.** Impact of public intervention on renewable energy resources.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pui	0.33*** −0.02	0.31*** −0.07	0.33*** −0.07	0.19*** −0.09	0.32*** −0.05	0.33*** −0.02
STax	0.11*** −0.05	0.11*** −0.03	0.10*** −0.03	0.13*** −0.07	0.09*** −0.02	
EFP	0.13*** −0.05	0.37*** −0.03	0.17*** −0.02	0.35*** −0.07		
CFP	0.13* −0.07	0.13** −0.05	0.17*** −0.05			
GDP	0.19*** −0.07	0.05 −0.09	0.12*** −0.07			
r	0.12* −0.03	0.03** −0.07				
EMP	0.13*** −0.02					
CMP	0.16*** −0.01					
C	3.37*** −0.17	3.37*** −0.31	3.11*** −0.33	2.32*** −0.35	− −	− −
Observations	193	173	173	170	127	127
Durbin-Watson	1.33	1.77	1.57	1.56	−	−
Prob (J-statistic)	−	−	0.12	0.17	0.19	0.15

Source: Authors' calculation \*  $p < 0.10$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . Standard error in parentheses.

energy source. In 2018, the fed increased its fund's rates by four times by December; these percentages had attained 2.5%. The economy through 2018 performed well alongside gross domestic product expansion of 2.9% plus at 3.9% and the expansion lasting in 2019. Within the middle of 2019, economic growth had reduced gross domestic product.

#### 4.5. Discussion

The quick expansion and high-level stage of transmissibility of the pandemic occasioned the health experts to admonish public works to restrict movement, limitations on human activity, and lockdowns crosswise the nation. Also, human activity needed personal contacts, big crowds such as churches, the education sector, and other social gatherings. Commercial activity was the first-hand impact, earnings declined, and the United States stock investment companies expanded drastically. They significantly increased the non-availability of funds within the Treasury market (Lacalle, 2020). To undertake initial juxtapositions amongst the twofold crises-The Global Financial crisis and the coronavirus, the Fed's financial position grew from \$1 trillion in late 2008 to \$4.5T in late 2014. They stayed that way from 2015-to 2017. Likewise, the Fed went ahead with Quantitative contraction through the dual 2018 and 2019 and limited its financial position to \$3.6 T. Further, this exceptional expansion of about \$3.4 T realized a global financial crisis.

Moreover, the source of this health emergency this time is an external healthcare headwind, and huge doubts have encircled nearly all parts of the coronavirus crisis. Uncertainty indicators have attained their most significant figures in response to the pandemic and its breakout. Almost half a year after the flight of the coronavirus, little is sure about the disease. Uncertainties comprise the infectiousness and the long-run healthcare impact of the pandemic, the efficacy of the control measures, the period of

**Table 9.** Sensitivity test analysis.

	(1)	(2)	(3)	(4)	(5)	(6)
Pinv	1.11*** -0.15	1.21*** -0.12	0.61*** -0.12	0.63*** -0.1	0.63*** -0.15	0.65*** -0.13
STax	0.41*** -0.02	0.46*** -0.03	0.41*** -0.03	0.63 -0.04	0.41 -0.05	0.61 -0.03
EFP	0.13*** -0.05	0 -0.03	0 -0.05	0 -0.04	0 -0.04	0.21 -0.02
CFP	0.02 -0.04		-0.01 -0.05	-0.11 -0.11		0.11 -0.03
GDP	0.21*** -0.11			0.11 -0.06		0.11*** -0.04
r	0.03 -0.06					
EMP	0.13*** -0.03					
CMP	0.01 -0.05					
C	0.92*** -0.19	1.51*** -0.26	1.33*** -0.25	2.23*** -0.55	- -	- -
Observations	166	164	166	142	156	156
Durbin-Watson	1.34	1.65	1.32	1.65	-	-
Prob (J-statistic)	-	-	0.16	0.33	0.52	0.14

Source: Authors' calculation \*  $p < 0.10$ . \*\*  $p < 0.05$ . \*\*\*  $p < 0.01$ . Standard error in parentheses.

the required come out with a drug, and its effectiveness. Additionally, to the uncertainty concerning the pandemic, there is doubt about the COVID-19's duration, whether in the short or long-run economic impacts.

Within the short run, there is a real discourse, for instance, concerning the scale of the corona crisis, the pace of ultimate bouncing back, and the efficacy of various policies (Taghizadeh-Hesary et al., 2021; Taghizadeh-Hesary & Taghizadeh-Hesary, 2020; Taghizadeh-Hesary & Yoshino, 2019; 2020). In this vein, taking into account the extended horizon, there are significant doubts about whether the corona will generate endless variations in the manner of economic activity, making certain firms thrive and different ones collapse (Truger, 2020). The corona has increased some differences that were already within the way. Notably, the lockdown and restrictions have increased by applying digital technologies that encourage virtual communication and networking. The coronavirus has equally brought about an essential change in consumer expenditure and financing trends. Nonetheless, the point that these flows in economic activity will exist in the aftermath of the pandemic is yet to be observed.

Unlike the past crisis, economies confronted an amalgamation of distribution headwinds throughout the pandemic breakout. Most quickly, workers could not work, impacting production, disrupting distribution chains, freezing financing, and a demand headwind, making households and companies limit their demand for goods and services that have strengthened one another (Marelli, 2021). The range of the crisis is equally wide-ranging as in the previous macro-financial situation. Thus, the pandemic headwind has spread rapidly within the national boundaries across the world, bearing on economies globally in a highly synchronized manner. The effects of the integrated headwinds on companies have not been precedent. It has resulted in a quick fall in corporate earnings; corporate cash movements have reduced at unheard of rates. Companies have struggled to become viable as the pandemic decimates their seed capital which is consistent with Deng and Zhao (2022) and Ye et al. (2021).

Furthermore, the past data trajectory on the mean number of days companies protect their daily working expenditure with tier cash holdings demonstrates the degree of the financial crisis they have confronted since the pandemic. The findings illustrate that the liquidity access could aid companies in containing the coronavirus headwinds; nonetheless, the accessible liquidity would not be adequate in certain instances. For instance, certain firms that have been hit badly by the pandemic crisis, such as restaurants, retail shops, and service companies, would last for only a few weeks if earnings stopped entirely and expenditures stayed at before pandemic levels. Hence, companies' willingness to function within the coronavirus relies not only on the scale of the fall of their earnings but also on whether they can maximize additional financing and desire to modify expenditures. i.e., salaries, supplier payments, and other operating costs.

## 5. Conclusions and policy implications

This study measures an outlook of government financing for green economic recovery mediating the role of public and private investment. This research deliberates on econometric modeling and concentrates on public and private investment, and green economic recovery in Canada outlines the robustness of macroeconomic policy to attain specific objectives. This assessing framework is measured by an econometric equation applying monthly data for 2001–2020. Using econometric approximation, changing a model to calculate the before and after crisis phase. The result shows the proof that quantitative easing and the Fed's extensive commitments of more than seven years to cut long-run interest rates have proven to be statistically significant. Hence, the research reports that the observed fall in jobs is precisely linked to the economic recovery.

Likewise, the feed-in-tariff reacted by reducing the funds rate to 1.25% on March 3 and a few days later to 0.25% on March 15. So, by lowering the fed fund level to zero, they quickly and widely reported several measures to balance the financial system and the Canada's economy. These undertakings are explained in detail and equally draw a parallel on whether the pandemic measures are identical to those implemented through the global financial crisis or novel, specially formulated for the coronavirus. Thus, the analysis shows that the emergence of the coronavirus has made fragile the spread of macroeconomic policies to investment markets to government spending for green economic recovery even when the condition parameters are considered. Further, the estimation findings of the condition of the parameters depict that the varied backgrounds of industrialization and investment advancement deteriorate the effect of the pandemic on monetary policy. If a country attains a greater fossil fuel energy resources or nonrenewable energy consumption stage, the renewable energy generation for green economy have been interrupted, and the demand for nonrenewable energy consumption has reduced since the pandemic breakout. The variations in the effect of the coronavirus spread on macroeconomic policy due to varying levels fossil fuel energy sources proportion of government spending and public and private sectors investment for climate change to attain green economic recovery.

Nevertheless, a high-level stage of trade openness could decrease some of the deteriorating effects of the coronavirus spread on macroeconomic policy. Additionally, the fiscal policies implemented via the pandemic directly affect the exchange rate and



DCS to a certain level. The research equally proposes areas of research on resilience that require additional research. The initial is necessary to include estimating elucidating the resistances and bounce back comprising. Hence, the third aspect of research is the role of social distance standards and different earnings statuses at a provincial level in impacting the capability of countries to confront and bounce back from the headwinds in the form of the pandemic. Surprised by the coronavirus and its resultant economic headwinds have been the inadequate consistent global financial crisis. Policy formulators have effectively increased crisis measures from the 2008 financial crisis and have implemented tentative debt services relief for the developing nations.

In certain countries, debt sustainability will need to be faced on all fronts. When it ultimately occurs, monetary policy regularization could result in participation of public and private investment for green economic recovery. This study suggests global skills in different areas to tackle these correlated challenges. The initial is for the international monetary policy to carry the overall allotment of economic bounce back as a source of cash. A multilateral control trust fund could recycle special drawing rights allotments from different nations that don't require to those that need it. The next suggestion is to formulate a group of twenty nations' new standard model for sovereign debt compositing, launched in late 2020. Improvements should add more prominent information instruments and a complete public debt repository.

Third, the International monetary fund ought to formulate best practice recommendations for standardizing economic policy as the impacts of the corona diminishes, in line with improved protective lending institutions.

Ultimately, structural reforms to deepen capital markets in emerging nations ought to comprise: an expanded commitment to floating sustainable bonds by the group of 20 and securitization and credit warranties to maximize the financial position of multilateral development institutions.

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## References

Abdullah, M., Mamat, M. P., Abang Morni, A. A., Kamri, T., & Fui, L. H. (2020). The economic impacts of rehabilitation of Selabat Mudflats Nature Reserve, Kuching, Sarawak. *Malaysian Journal of Geosciences*, 4(1), 19–21. <https://doi.org/10.26480/mjg.01.2020.19.21>

- Agosto, A., & Giudici, P. (2020). A poisson autoregressive model to understand Covid-19 contagion dynamics. *Risks*, 8(3), 77. <https://doi.org/10.3390/risks8030077>
- Agyekum, E. B., Amjad, F., Mohsin, M., & Ansah, M. N. S. (2021). A bird's eye view of Ghana's renewable energy sector environment: A multi-criteria decision-making approach. *Utilities Policy*, 70, 101219. <https://doi.org/10.1016/j.jup.2021.101219>
- Azad, N. F., Serletis, A., & Xu, L. (2021). Covid-19 and monetary–fiscal policy interactions in Canada. *Quarterly Review of Economics and Finance*. <https://doi.org/10.1016/j.qref.2021.06.009>
- Baloch, Z. A., Tan, Q., Iqbal, N., Mohsin, M., Abbas, Q., Iqbal, W., & Chaudhry, I. S. (2020). Trilemma assessment of energy intensity, efficiency, and environmental index: evidence from BRICS countries. *Environmental Science and Pollution Research*, 27(27), 34337–34347. <https://doi.org/10.1007/s11356-020-09578-3>
- Batool, M., Ghulam, H., Hayat, M. A., Naeem, M. Z., Ejaz, A., Imran, Z. A., Spulbar, C., Birau, R., & Gorun, T. H. (2021). How COVID-19 has shaken the sharing economy? An analysis using Google trends data. *Economic Research-Ekonomska Istraživanja*, 34(1), 2374–2386. <https://doi.org/10.1080/1331677X.2020.1863830>
- Caballero-Morales, S. O. (2021). Innovation as recovery strategy for SMEs in emerging economies during the COVID-19 pandemic. *Research in International Business and Finance*, 57, 1–9. <https://doi.org/10.1016/j.ribaf.2021.101396>
- Cantore, C., & Freund, L. B. (2021). Workers, capitalists, and the government: Fiscal policy and income (re)distribution. *Journal of Monetary Economics*. <https://doi.org/10.1016/j.jmoneco.2021.01.004>
- Chang, C.-L., McAleer, M., & Wong, W.-K. (2020). Risk and financial management of COVID-19 in business, economics and finance. *Journal of Risk and Financial Management*, 13(5), 102. <https://doi.org/10.3390/jrfm13050102>
- Chen, D., Gao, H., & Ma, Y. (2021). Human capital-driven acquisition: Evidence from the inevitable disclosure doctrine. *Management Science*. <https://doi.org/10.1287/mnsc.2020.3707>
- Chien, F., Pantamee, A. A., Hussain, M. S., Chupradit, S., Nawaz, M. A., & Mohsin, M. (2021). Nexus between financial innovation and bankruptcy: Evidence from information, communication and technology (ict) sector. *The Singapore Economic Review*, 1–22. <https://doi.org/10.1142/S0217590821500181>
- Danielson, S. L., Ahkinga, O., Ashjian, C., Basyuk, E., Cooper, L. W., Eisner, L., Farley, E., Iken, K. B., Grebmeier, J. M., Juranek, L., Khen, G., Jayne, S. R., Kikuchi, T., Ladd, C., Lu, K., McCabe, R. M., Moore, G. W. K., Nishino, S., Ozenna, F., ... Weingartner, T. J. (2020). Manifestation and consequences of warming and altered heat fluxes over the Bering and Chukchi Sea continental shelves. *Deep Sea Research Part II: Topical Studies in Oceanography*, 177, 104781. <https://doi.org/10.11644/kiep.eaer.2020.24.4.381>
- Deng, L., & Zhao, Y. (2022). Investment lag, financially constraints and company value—Evidence from China. *Emerging Markets Finance and Trade*, 1–14. <https://doi.org/10.1080/1540496X.2021.2025047>
- Dorsey-Palmateer, R., & Niu, B. (2020). The effect of carbon taxation on cross-border competition and energy efficiency investments. *Energy Economics*, 85, 104602. <https://doi.org/10.1016/j.eneco.2019.104602>
- Elyassi, H. (2021). Economics of the financial crisis: Any lessons for the pandemic downturn and beyond? *Contemporary Economics*, 15(1), 100–121. <https://doi.org/10.5709/ce.1897-9254.438>
- Embrett, M., Bielska, I. A., Manis, D. R., Cooper, R., Agarwal, G., Nartowski, R., Moore, E., Lopatina, E., Conway, A., & Clark, K. (2021). Outcomes for implemented macroeconomic policy responses and multilateral collaboration strategies for economic recovery after a crisis: A rapid scoping review. *International Journal of Health Services*. <https://doi.org/10.1177/00207314211007100>
- Fang, Z., Razaq, A., Mohsin, M., & Irfan, M. (2022). Spatial spillovers and threshold effects of internet development and entrepreneurship on green innovation efficiency in China. *Technology in Society*, 68, 101844. <https://doi.org/10.1016/j.techsoc.2021.101844>

- Funashima, Y. (2020). Monetary policy, financial uncertainty, and secular stagnation. *North-American Journal of Economics and Finance*, 51, 100863. <https://doi.org/10.1016/j.najef.2018.10.011>
- Gao, H., Hsu, P. H., Li, K., & Zhang, J. (2020). The real effect of smoking bans: Evidence from corporate innovation. *Journal of Financial and Quantitative Analysis*, 55(2), 387–427. <https://doi.org/10.1017/S0022109018001564>
- Gao, H., Shi, D., & Zhao, B. (2021). Does good luck make people overconfident? Evidence from a natural experiment in the stock market. *Journal of Corporate Finance*, 68, 101933. <https://doi.org/10.1016/j.jcorpfin.2021.101933>
- Gootjes, B., & de Haan, J. (2022). Procyclicality of fiscal policy in European Union countries. *Journal of International Money and Finance*, 120, 102276. <https://doi.org/10.1016/j.jimonfin.2020.102276>
- Guild, J. (2020). The political and institutional constraints on green finance in Indonesia. *Journal of Sustainable Finance & Investment*. <https://doi.org/10.1080/20430795.2019.1706312>
- Guo, X., Liang, C., Umar, M., & Mirza, N. (2022). The impact of fossil fuel divestments and energy transitions on mutual funds performance. *Technological Forecasting and Social Change*. 176, 121429. <https://doi.org/10.1016/j.techfore.2021.121429>
- Haruna, S. N., & M. Hanafiah, M. (2017). Consumptive use of water by selected cash crops in Malaysia. *Malaysian Journal of Sustainable Agriculture*, 1(2), 6–8. <https://doi.org/10.26480/mjsa.02.2017.06.08>
- He, W., Abbas, Q., Alharthi, M., Mohsin, M., Hanif, I., Vo, X. V., & Taghizadeh-Hesary, F. (2020). Integration of renewable hydrogen in light-duty vehicle: Nexus between energy security and low carbon emission resources. *International Journal of Hydrogen Energy*, 45(51), 27958–27968. <https://doi.org/10.1016/j.ijhydene.2020.06.177>
- Hilbers, A. M., Sijtsma, F., Busscher, T., & Arts, J. (2019). Understanding added value in integrated transport planning: Exploring the framework of intelligence, design and choice. *Journal of Environmental Assessment Policy and Management*, Vol. 21, No. 03, 1950011 (2019). <https://doi.org/10.1142/S146433321950011X>
- Huang, C., Wu, X., Wang, X., He, T., Jiang, F., & Yu, J. (2021). Exploring the relationships between achievement goals, community identification and online collaborative reflection: A deep learning and bayesian approach. *Educational Technology & Society*, 24, 210–223.
- Inoue, A., & Rossi, B. (2019). The effects of conventional and unconventional monetary policy on exchange rates. *Journal of International Economics*, 118, 419–447.
- Iqbal, W., Tang, Y. M., Chau, K. Y., Irfan, M., & Mohsin, M. (2021). Nexus between air pollution and NCOV-2019 in China: Application of negative binomial regression analysis. *Process Safety and Environmental Protection*. <https://doi.org/10.1016/j.psep.2021.04.039>
- Irfan, M., Elavarasan, R. M., Ahmad, M., Mohsin, M., Dagar, V., & Hao, Y. (2022). Prioritizing and overcoming biomass energy barriers: Application of AHP and G-TOPSIS approaches. *Technological Forecasting and Social Change*, 177, 121524. <https://doi.org/10.1016/j.techfore.2022.121524>
- Ji, S., Pan, S., Cambria, E., Marttinen, P., & Philip, S. Y. (2021). A survey on knowledge graphs: Representation, acquisition, and applications. *IEEE Transactions on Neural Networks and Learning Systems*.
- Ji, Q., Zhang, D., & Zhao, Y. (2020). Searching for safe-haven assets during the COVID-19 pandemic. *International Review of Financial Analysis*, 71, 101526.
- Johnston, R. J., Besedin, E. Y., & Holland, B. M. (2018). Modeling distance decay within valuation meta-analysis. *Environmental and Resource Economics*, 1–34. <https://doi.org/10.1007/s10640-018-0218-z>
- Khosravi, F., Fischer, T. B., & Jha-Thakur, U. (2019). Multi-criteria analysis for rapid strategic environmental assessment in tourism planning. *Journal of Environmental Assessment Policy and Management*, 21(4), 1950013. <https://doi.org/10.1142/S1464333219500133>
- Klomp, J. (2020). Do natural disasters affect monetary policy? A quasi-experiment of earthquakes. *Journal of Macroeconomics*, 64, 103164. <https://doi.org/10.1016/j.jmacro.2019.103164>

- Klomp, J., & Sseruyange, J. (2021). Earthquakes and economic outcomes: Does central bank independence matter?. *Open Economies Review*, 32(2), 335–359. <https://doi.org/10.1007/s11079-020-09593-4>
- Kordej-De Villa, Z., & Slijepcevic, S. (2019). Assessment of local Councillors' attitudes towards energy efficiency projects in Croatia. *Journal of Environmental Assessment Policy and Management*, 21(4), 1950012. <https://doi.org/10.1142/S1464333219500121>
- Kreso, S., Lazović-Pita, L., & Duraković, S. (2021). Monetary and fiscal policy response during COVID-19 crisis in Bosnia and Herzegovina: Constraints and potentials. In *Macroeconomic Responses to the COVID-19 Pandemic*. [https://doi.org/10.1007/978-3-030-75444-0\\_9](https://doi.org/10.1007/978-3-030-75444-0_9)
- Krüger, N., & Meyer, N. (2021). Covid-19 pandemic business relief: A comparative study of south africa and selected european countries. *Polish Journal of Management Studies*, 23(2), 249–266. <https://doi.org/10.17512/pjms.2021.23.2.15>
- Lacalle, D. (2020). Monetary and fiscal policies in the COVID-19 crisis. Will they work? *Journal of Business Accounting and Finance Perspectives*, 2(3), 1. <https://doi.org/10.35995/jbafp2030018>
- Lang, S., & Schadner, W. (2021). The trilemma of expansionary monetary policy in the Euro area during the COVID-19 crisis. *Finance Research Letters*, 42, 102048. <https://doi.org/10.1016/j.frl.2021.102048>
- Lei, X.-u., Xu, Q.y., Jin, C.z. (2021). Nature of property right and the motives for holding cash: Empirical evidence from Chinese listed companies. *Managerial and Decision Economics*. <https://doi.org/10.1002/mde.3469>
- Li, W., Chien, F., Hsu, C. C., Zhang, Y. Q., Nawaz, M. A., Iqbal, S., & Mohsin, M. (2021). Nexus between energy poverty and energy efficiency: Estimating the long-run dynamics. *Resources Policy*, 72, 102063. <https://doi.org/10.1016/j.resourpol.2021.102063>
- Loayza, N., & Pennings, S. M. (2020). *Macroeconomic policy in the time of COVID-19: A primer for developing countries*. World Bank Research Policy Briefs.
- Marelli, E. (2021). Macroeconomic policies for recovery in Europe and in Italy. *Symphonya. Emerging Issues in Management*. <https://doi.org/10.4468/2021.1.07marelli>
- Martínez-Rodríguez, I., Callejas-Albiñana, F. E., & Callejas-Albiñana, A. I. (2020). Economic and socio-cultural drivers of necessity and opportunity entrepreneurship depending on the business cycle phase. *Journal of Business Economics and Management*, 21(2), 373–394. <https://doi.org/10.3846/jbem.2020.11848>
- Mirza, N., Abbas Rizvi, S. K., Saba, I., Naqvi, B., & Yarovaya, L. (2022). The resilience of Islamic equity funds during COVID-19: Evidence from risk adjusted performance, investment styles and volatility timing. *International Review of Economics & Finance*, 77, 276–295. <https://doi.org/10.1016/j.iref.2021.09.019>
- Mirza, N., Hasnaoui, J. A., Naqvi, B., & Rizvi, S. K. A. (2020a). The impact of human capital efficiency on Latin American mutual funds during Covid-19 outbreak. *Swiss Journal of Economics and Statistics*. <https://doi.org/10.1186/s41937-020-00066-6>
- Mirza, N., Naqvi, B., Rahat, B., & Rizvi, S. K. A. (2020). Price reaction, volatility timing and 'funds' performance during Covid-19. *Finance Research Letters*, 36, 101657.
- Mirza, N., Naqvi, B., Rahat, B., & Rizvi, S. K. A. (2020b). Price reaction, volatility timing and funds' performance during Covid-19. *Finance Research Letters*, 36, 101657. <https://doi.org/10.1016/j.frl.2020.101657>
- Mirza, N., Rahat, B., Naqvi, B., & Rizvi, S. K. A. (2020c). Impact of Covid-19 on corporate solvency and possible policy responses in the EU. *Quarterly Review of Economics and Finance*. <https://doi.org/10.1016/j.qref.2020.09.002>
- Mohsin, M., Taghizadeh-Hesary, F., Iqbal, N., & Saydaliev, H. B. (2022a). The role of technological progress and renewable energy deployment in green economic growth. *Renewable Energy*, 190, 777–787. <https://doi.org/10.1016/j.renene.2022.03.076>
- Mohsin, M., Taghizadeh-Hesary, F., & Shahbaz, M. (2022b). Nexus between financial development and energy poverty in Latin America. *Energy Policy*, 165, 112925. <https://doi.org/10.1016/j.enpol.2022.112925>

- Mosser, P. C. (2021). Central bank responses to COVID-19. *Business Economics*, 56(21). <https://doi.org/10.1057/s11369-020-00189-x>
- Mundle, S., & Sahu, A. (2021). Fiscal compression, jeopardised recovery, the humanitarian crisis and reforms. *Economic and Political Weekly*.
- Naqvi, B., Mirza, N., Rizvi, S. K. A., Porada-Rochoń, M., & Itani, R. (2021). Is there a green fund premium? Evidence from twenty seven emerging markets. *Global Finance Journal*, 50, 100656. <https://doi.org/10.1016/j.gfj.2021.100656>
- NEDA. (2020). *Addressing the social and economic impact of the COVID-19 pandemic*. National Economic and Development Authority.
- Olakojo, S. A., Onanuga, A. T., & Onanuga, O. T. (2021). Cyclical fluctuations of economic growth and monetary policy in Nigeria: Does fiscal policy also matter? *Journal of Contemporary African Studies*. <https://doi.org/10.1080/02589001.2020.1822992>
- Ozoike-Dennis, P., Spaling, H., Sinclair, A. J., & Walker, H. M. (2019). SEA, urban plans and solid waste management in Kenya: Participation and learning for sustainable cities. *Journal of Environmental Assessment Policy and Management*, 21(04), 1–22. <https://doi.org/10.1142/S1464333219500182>
- Paule-Vianez, J., Alcázar-Blanco, A., & Coca-Pérez, J. L. (2022). Effect of economic policy uncertainty on the investment in numismatic assets: Evidence for the walking liberty half dollar. *Finance Research Letters*, 46, 102412.
- Putnam, B. H. (2021). From phase transitions to Modern Monetary Theory: A framework for analyzing the pandemic of 2020. *Review of Financial Economics*, 39(1), 3–19. <https://doi.org/10.1002/rfe.1122>
- Rabbani, M. R., Bashar, A., Nawaz, N., Karim, S., Ali, M. A. M., Rahiman, H. U., & Alam, M. S. (2021). Exploring the role of islamic fintech in combating the aftershocks of Covid-19: The open social innovation of the Islamic financial system. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(2), 136. <https://doi.org/10.3390/joitmc7020136>
- Raies, A. (2020). Islamic versus conventional fiscal policy: The effect of Zakat on education and employment. *Academic Journal of Interdisciplinary Studies*, 9(1), 27. <https://doi.org/10.36941/ajis-2020-0003>
- Rizvi, S. K. A., Mirza, N., Naqvi, B., & Rahat, B. (2020). Covid-19 and asset management in EU: A preliminary assessment of performance and investment styles. *Journal of Asset Management*, 21(4), 281–291. <https://doi.org/10.1057/s41260-020-00172-3>
- Sarwar, B., Muhammad, N., & Zaman, N. U. (2020). Diversification, industry concentration, and bank margins: Empirical evidence from an emerging south Asian economy. *The Journal of Asian Finance, Economics and Business*, 7(7), 349–360. <https://doi.org/10.13106/jafeb.2020.vol7.no7.349>
- Song, L., & Zhou, Y. (2020). The COVID-19 pandemic and its impact on the global economy: What does it take to turn crisis into opportunity? *China & World Economy*, 28(4), 1–25. <https://doi.org/10.1111/cwe.12349>
- Soo Mun Peng, J. (2019). Volatile esters and sulfur compounds in durians & a suggested approach to enhancing economic value of Durians. *Malaysian Journal of Sustainable Agriculture*, 3(2), 5–15. <https://doi.org/10.26480/mjsa.02.2019.05.15>
- Steffen, B. (2018). The importance of project finance for renewable energy projects. *Energy Economics*. <https://doi.org/10.1016/j.eneco.2017.11.006>
- Stoian, A., & Iorgulescu, F. (2020). Fiscal policy and stock market efficiency: An ARDL bounds testing approach. *Economic Model*, 90, 406–416. <https://doi.org/10.1016/j.econmod.2019.12.023>
- Suescun, R. (2020). A tool for fiscal policy planning in a medium-term fiscal framework: The FMM-MTFF model. *Economic Modelling*, 88, 431–446. <https://doi.org/10.1016/j.econmod.2019.09.053>
- Sun, H. P., Tariq, G., Haris, M., Mohsin, M. (2019). Evaluating the environmental effects of economic openness: evidence from SAARC countries. *Environmental Science and Pollution Research*, 26(24), 24542–24551. <https://doi.org/10.1007/s11356-019-05750-6>

- Sun, L., Cao, X., Alharthi, M., Zhang, J., Taghizadeh-Hesary, F., & Mohsin, M. (2020). Carbon emission transfer strategies in supply chain with lag time of emission reduction technologies and low-carbon preference of consumers. *Journal of Cleaner Production*, 264, 121664. <https://doi.org/10.1016/j.jclepro.2020.121664>
- Taghizadeh-Hesary, F., Rasoulinezhad, E., Yoshino, N., Chang, Y., Taghizadeh-Hesary, F., & Morgan, P. J. (2021). The energy-pollution-health nexus: A panel data analysis of low-and middle-income asian countries. *The Singapore Economic Review*, 66(02), 435–455. <https://doi.org/10.1142/S0217590820430043>
- Taghizadeh-Hesary, F., & Taghizadeh-Hesary, F. (2020). The impacts of air pollution on health and economy in Southeast Asia. *Energies*, 13(7), 1812. <https://doi.org/10.3390/en13071812>
- Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters*. <https://doi.org/10.1016/j.frl.2019.04.016>
- Taghizadeh-Hesary, F., & Yoshino, N. (2020). Sustainable solutions for green financing and investment in renewable energy projects. *Energies*, 13(4), 788. <https://doi.org/10.3390/en13040788>
- Tian, W. (2021). How china managed the covid-19 pandemic. *Asian Economic Papers*. [https://doi.org/10.1162/asep\\_a\\_00800](https://doi.org/10.1162/asep_a_00800)
- Tiep, N. C., Wang, M., Mohsin, M., Kamran, H. W., & Yazdi, F. A. (2021). An assessment of power sector reforms and utility performance to strengthen consumer self-confidence towards private investment. *Economic Analysis and Policy*, 69, 676–689. <https://doi.org/10.1016/j.eap.2021.01.005>
- Trading Economics. (2020). China GDP annual growth rate [WWW Document]. National Bureau of Statistics of China.
- Truger, A. (2020). Reforming EU fiscal rules: More Leeway, investment orientation and democratic coordination. *Intereconomics*, 55(5), 277–281. <https://doi.org/10.1007/s10272-020-0915-z>
- Ullah, S., Zaefarian, G., Ahmed, R., & Kimani, D. (2021). How to apply the event study methodology in STATA: An overview and a step-by-step guide for authors. *Industrial Marketing Management*. <https://doi.org/10.1016/j.indmarman.2021.02.004>
- Yang, Z., Abbas, Q., Hanif, I., Alharthi, M., Taghizadeh-Hesary, F., Aziz, B., & Mohsin, M. (2021). Short- and long-run influence of energy utilization and economic growth on carbon discharge in emerging SREB economies. *Renewable Energy*, 165(P1), 43–51. <https://doi.org/10.1016/j.renene.2020.10.141>
- Yarovaya, L., Mirza, N., Abaidi, J., & Hasnaoui, A. (2021). Human capital efficiency and equity funds' performance during the COVID-19 pandemic. *International Review of Economics & Finance*, 71, 584–591. <https://doi.org/10.1016/j.iref.2020.09.017>
- Yarovaya, L., Mirza, N., Abaidi, J., & Hasnaoui, A. (2021). Human capital efficiency and equity funds' performance during the COVID-19 pandemic. *International Review of Economics & Finance*, 71, 584–591. <https://doi.org/10.1016/j.iref.2020.09.017>
- Ye, Z., Wei, H., & Ruoyu, Y. (2021). Does government behavior or enterprise investment improve regional innovation performance? - evidence from China. *International Journal of Technology Management*, 85(2–4) <https://doi.org/10.1504/IJTM.2021.115266>
- Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y., & Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: Mediating role of green finance. *Energy Policy*, 153, 112256. <https://doi.org/10.1016/j.enpol.2021.112256>