

Article

The Fiscal and Monetary Policies and Environment in GCC Countries: Analysis of Territory and Consumption-Based CO₂ Emissions

Haider Mahmood ^{1,*} , Anass Hamadelneel Adow ², Muzafar Abbas ³ , Asim Iqbal ⁴ , Muntasir Murshed ⁵  and Maham Furqan ⁶

- ¹ Department of Finance, College of Business Administration, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia
 - ² Department of Accounting, College of Business Administration, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia; a.adow@psau.edu.sa
 - ³ Department of Business Administration, Community College, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia; mm.abbas@psau.edu.sa
 - ⁴ Department of Economics, University of Education, Lahore 54000, Pakistan; asim.iqbal@ue.edu.pk
 - ⁵ School of Business and Economics, North South University, Dhaka 1229, Bangladesh; muntasir.murshed@northsouth.edu
 - ⁶ School of Public Policy, Oregon State University, Corvallis, OR 97331, USA; furqanm@oregonstate.edu
- * Correspondence: h.farooqi@psau.edu.sa; Tel.: +966-115887037



Citation: Mahmood, H.; Adow, A.H.; Abbas, M.; Iqbal, A.; Murshed, M.; Furqan, M. The Fiscal and Monetary Policies and Environment in GCC Countries: Analysis of Territory and Consumption-Based CO₂ Emissions. *Sustainability* **2022**, *14*, 1225. <https://doi.org/10.3390/su14031225>

Academic Editors: Antonio Boggia and Syed Abdul Rehman Khan

Received: 27 December 2021

Accepted: 19 January 2022

Published: 21 January 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Expansionary monetary and fiscal policies are necessary for economic and environmental development. The present research studies the impact of monetary policy and fiscal policy on Territory-Based CO₂ (TBC) and Consumption-Based CO₂ (CBC) emissions in Gulf Cooperation Council (GCC) economies from 1990–2019. The cointegration is corroborated through various tests, and long-term relationships are found in both TBC and CBC models. Government expenditures have long-term positive effects on both TBC and CBC emissions and short-term positive effects on TBC emissions in the region. Money supply negatively affects the TBC and CBC emissions in the long run and positively affects TBC and CBC emissions in the short run. Hence, monetary policy needs a long time to have positive ecological effects in the GCC region. Moreover, fiscal policy in both the long and short run and monetary policy in the short run have scale effects in GCC economies. Therefore, we recommend reducing fiscal measures and encouraging monetary policy in the long run to have positive environmental outcomes in the region.

Keywords: fiscal policy; monetary policy; territory-based CO₂ emissions; consumption-based CO₂ emissions

1. Introduction

Grossman and Krueger [1] have initiated the idea of linking economic growth and pollution emissions. The economy may be tracked into pollution emissions activities at the first phase of growth [2], which is a scale effect. Onwards, an economy may improve environmental health due to demand for a cleaner environment and technical and composition changes using renewable sources [3,4]. In both stages, the macroeconomic policies would play their role in greening the economy. On the other hand, macroeconomic policies would also adversely affect the environment if the primary object were just economic growth. For example, expansionary monetary policies in terms of increasing money supply and decreasing bank rate would increase the investment, industrialization, and aggregate demand in the economy [5], which would increase energy demand and pollute the economy if the energy mix is relying primarily on the fossil fuels [6]. Alternatively, literature suggests using a green monetary policy to reduce the environmental effects of the expansionary policy. Wang and Zhi [7] argued that green finance with adequate policies and market

mechanisms would be helpful for ecological balance. He et al. [8] explored this issue in China and found that green finance improved the investment in renewable projects to some extent but has a negative effect on the overall loan market. Hence, there is a need for intensive government regulations to achieve the optimum results from green financing in the economy. On the other hand, Schoenmaker [9] claimed that any monetary policy effort to promote a green economy might be nullified with the environmental consequences of usual expansionary policies. In the presence of both positive and negative ecological consequences in the literature, it seems pertinent to test the exact linkages between monetary policy and pollution emissions to conclude the precise effect of monetary policy on the environment in any economy or region.

In addition to monetary policy, the literature has suggested that globalization and oil prices could asymmetrically affect pollution emissions [10,11]. Moreover, Weimin et al. [12] found that innovation and globalization helped to improve the environmental quality. Further, Leal and Marques [13] provided evidence that higher globalization helped to shape the Environmental Kuznets Curve (EKC). On the other hand, Pata and Caglar [14] reported that globalization accelerated pollution, and the EKC could not be found in China. In another dimension, Rehman et al. [15] investigated and found that the agriculture sector and rainfall positively affected CO₂ emissions. Janjua et al. [16] reported that foreign direct investment (FDI) and the industry sector were responsible for pollution. On the other hand, the literature found a mix of the negative and statistically insignificant effects of FDI on CO₂ emissions [17,18]. Khan et al. [19] found that fossil fuels reduced and renewable energy improved the environmental quality in Europe. Moreover, bulk literature has suggested that the concept of a circular economy and green business practices would serve to promote eco-environmental performance [20–26].

In terms of fiscal policy, fiscal instruments also significantly affect the aggregate demand in the economy, directly and indirectly [27], which impacts the environment through industrialization, economy size, and energy usage. Moreover, environmental policies could discourage investment and other aggregate demand components [28]. Furthermore, environmental taxes can reduce the environmental side effects [29]. Ulucak et al. [30] narrated that environmental tax with high globalization could help in mitigating CO₂ emissions. In the same way, technology and patents supported by government policies would also help in reducing CO₂ emissions. Gaspar et al. [31] argued that pollution is a threat to the whole world, which may be reduced by carbon taxation on coal and other fossil fuel consumption. It would help the economies to shift towards cleaner energies. Further, the authors explained that USD 75 should be imposed on every ton of CO₂ emissions to achieve the target to reduce global warming by 2 °C in 2030. Contrarily, government spending could increase the dimension and causes of pollution emissions [32]. For example, government spending may increase economic activities and emissions through the scale effect. On the other hand, government spending in health and education may increase the income, human capital, and awareness that individuals have of a cleaner environment. It can also enhance the administrative and institutional ability of the government for environmental protection [33]. In this regard, empirical evidence has been provided showing that government expenditure has been found helpful in controlling consumption and production-based emissions [34]. Moreover, Ullah et al. [35] investigated the asymmetrical effects of fiscal variables on environmental quality and found mixed evidence. For instance, increasing government expenditures reduced the environmental quality in some investigated countries and improved it in others. The inverse effects were reported for decreasing government expenditures.

Following Halkos and Paizanos's [34] arguments about the role of fiscal policy on Territory-Based CO₂ (TBC) and Consumption-Based CO₂ (CBC) emissions, we are highly motivated to estimate the effect of macroeconomic policies on such emissions. The literature has suggested the analysis of TBC and CBC emissions to differentiate the emissions in consumption and production activities [36]. CBC emissions are adjusted from TBC emissions by adding import emissions and subtracting export emissions. Hence, exports would

reduce and imports would increase CBC emissions [37]. Following this idea, Mahmood [38] did an analysis and found exports reduced and imports increased CBC emissions. Hence, the impact of exports was negative, and the effect of imports was positive on CBC emissions. Khan et al. [39] and Hasanov et al. [36] also did the same analysis and found the same conclusions. Moreover, the industrial sector contributed to CBC emissions. In this context, no study focuses on the role of macroeconomic policy on TBC and CBC emissions. Furthermore, the testing of combined fiscal and monetary policies on CO₂ emissions is rare in global literature [40–43] and missing in the Gulf Cooperation Council (GCC) region. The analysis of the GCC region is critical as emissions are rising at a higher projected pace [44]. It may be due to the expansionary fiscal policy of GCC countries. This is because GCC economies' government revenues largely depend on the oil sector and increasing the oil sector has both direct and indirect effects on pollution emissions. By direct impact, the oil sector emits a lot of pollution due to oil production activities. By indirect impact, the oil sector supports the economic growth in GCC economies. Resultantly, the booming oil sector enables the GCC governments to spend more in the economies, increasing the pollution emissions due to the scale effect of expansionary fiscal policy and increasing overall economic activities due to increasing income and aggregate demand. Moreover, expansionary monetary policy would also have a scale effect on energy consumption and pollution emissions. Therefore, it is pertinent to analyze which fiscal or monetary policy has more significant environmental consequences to suggest the right policy choice for demanding a better environment for sustainable development goals in GCC countries. Hence, the present research estimates the effect of money supply and government expenditures on the CBC and TBC emissions to ensure an empirical contribution in global and GCC literature and proposes the right policy for economic and environmental sustainability in GCC economies.

The research is distributed into four major sections. The first section provides a detailed literature review. The second section delivers a theory to draw a contextual picture of the scenarios and model being discussed and also covers the data and methodology. The third section provides an analysis. Lastly, the fourth section delivers concluding remarks with policy implications and future directions.

2. Literature Review

Fiscal policy could directly affect the environment, and literature has investigated this issue in past studies. For instance, Neves et al. [45] examined 17 European Union (EU) economies from 1995–2017 and found that environmental regulations, renewable energy policies, and Foreign Direct Investment (FDI) reduced emissions. Emissions taxes and FDI have promoted the environmental profile of the EU. Moreover, the pollution halo hypothesis has been corroborated in the EU. Le and Ozturk [46] argued that expansionary fiscal policy would be helpful to increase the capacity to buy renewable technology and green products. The authors worked on 47 emerging economies from 1990–2014. The authors found that the financial sector and globalization accelerated CO₂ emissions and recommended the role of financing and governing economic sectors for sustainable development. Ahmed et al. [47] explained that government spending towards clean energy infrastructure might reduce CO₂ emissions. The authors worked investigated Japan from 1974–2017 and found that government spending towards clean energy infrastructure and nuclear energy reduced CO₂ emissions. Zhang et al. [48] argued that public support for green projects might promote green technologies and reduce emissions. They found that public spending on clean technology research promoted sustainable development. Moreover, this type of policy would accelerate renewable consumption through green technology innovation, which facilitates a reduction in pollution emissions.

Yilanci and Pata [49] investigated G7 economies from 1875–2016 by bootstrap causality test and found that public spending helped reduce emissions. However, they could not validate the EKC with a long-term analysis. The same finding has been shared by Katircioglu and Katircioglu [50] in the case of Turkey from 1960–2013 where public spending as a share

of income reduced the emissions. Moreover, the EKC was confirmed in Turkey. Hashmi and Alam [51] found that environmental taxes reduced CO₂ emissions. Moreover, green patents also reduce CO₂ emissions, which have a more significant effect than environmental taxes. Aydin and Esen [52] investigated a nonlinear effect of energy, transport, and pollution taxes in the EU from 1995–2013. They reported a significant positive impact of transport tax on emissions in the first phase of EKC and then a negative effect in the second phase. However, an insignificant impact in the first phase and a negative impact in the second phase of EKC was found in the rest of taxes. Mardones and Flores [53] reported that carbon taxes helped accelerate a cleaner industrial use of energy in Chile and reduced emissions. However, low tax rates showed insignificant effects. Yuelan et al. [54] explored the impact of public revenues and spendings in China from 1980–2016. In the long run, they found that expansionary policy was responsible for increasing CO₂ emissions. Nevertheless, its short-term effects were environmentally pleasant. Solaymani [55] investigated the role of taxes on emissions in Malaysia and found that carbon and energy taxes helped reduce emissions. Moreover, a carbon tax is more efficient than an energy tax in reducing fossil fuel consumption and CO₂ emissions. Khan et al. [56] investigated and reported that carbon taxes, renewable energy, and innovations helped reduce carbon emissions.

Literature has investigated the environmental effects of monetary policy. Qingquan et al. [5] examined Asian economies from 1990–2014 and found that increasing money supply raised CO₂ emissions and decreasing money supply reduced emissions. Hence, expansionary measures increased emissions and vice versa for contractionary monetary policy. However, contractionary monetary policy would reduce the investments in technical innovation and may reduce the chance to produce cleaner technologies, which may have adverse environmental effects in the long run. Moreover, empirical findings show that human capital helped reduce emissions, and remittance and fossil fuel accelerated CO₂ emissions. Qingquan et al. [57] investigated quarterly data of Australia from 1972–2014. Expansionary commercial measures accelerated CO₂ emissions, and contractionary commercial and monetary efforts helped reduce CO₂ emissions. Moreover, remittances and fossil energy usage increased CO₂ emissions in Australia. Vo and Zaman [58] investigated 101 economies from 1995–2018 and found the EKC between income and emissions variables. Most economies were found on the first stage of EKC and had environmental consequences of growth. FDI and energy use accelerated CO₂ emissions. Moreover, the rising money supply increased the CO₂ emissions in a large sample of the world's economies with a causal feedback effect. Furthermore, the money supply also caused FDI and increased income.

Limited studies probed the simultaneous effects of fiscal and monetary policies. For instance, Ullah et al. [40] argued that expansionary policy could accelerate energy demand and pollution in the short run. In their empirical exercise, the authors found that fiscal and monetary shocks showed adverse environmental effects in the short run and showed pleasant environmental impact in Pakistan in the long run. Therefore, monetary and fiscal policies need a long time to have a positive environmental effect. Chan [41] narrated that contractionary monetary policy, for example, by increasing bank rates, would reduce economic activities and aggregate demand. Hence, it would help mitigate CO₂ emissions but would reduce the general welfare of society as well. The author suggested that fiscal policy through carbon taxes can only achieve environmental targets and higher household welfare levels. Hence, carbon taxes should be complemented by a monetary policy.

Chishti et al. [59] investigated and found that expansionary (contractionary) fiscal measures increased (decreased) CO₂ emissions, while expansionary and contractionary monetary measures increased CO₂ emissions. Moreover, fossil use and consumption expenditure increased CO₂ emissions, and renewable usage reduced CO₂ emissions. Using the period from 1990–2019, Mughal et al. [42] found that increasing (decreasing) bank rates reduced (raised) CO₂ emissions. Moreover, rising public spending reduced CO₂ emissions. The same finding of both expansionary policies was reported in the short run, but contractionary policies carry an insignificant impact. Bhowmik et al. [43] investigated the US and found that monetary policy uncertainty accelerated CO₂ emissions and fiscal

policy uncertainty reduced CO₂ emissions. However, trade policy uncertainty did not affect CO₂ emissions. Ahmed et al. [60] investigated G7 from 1985–2017 and found that environmental regulations and democracy helped reduce ecological footprints. However, income accelerated ecological footprints. Mahmood et al. [61] probed the effect of Financial Development (FD) on emissions and reported an insignificant effect of FD and a positive effect of income.

In the GCC context, Mahmood and Furqan [62] examined the impact of oil rents and other determinants on greenhouse gas emissions. Oil rents showed a significant effect on most of the investigated emissions. Moreover, FD increased and FDI decreased most of the emissions. Moreover, Mahmood et al. [63] corroborated the positive and asymmetrical impact of urbanization and industrialization on CO₂ emission in Saudi Arabia. Furthermore, oil price, stock market, and trade nexus have been investigated in the GCC context [64,65]. However, the existing GCC literature did not work on the macroeconomic policy and emissions relationship. Hence, this present research attempts to test the effects of monetary and fiscal policies on CBC and TBC emissions to fill this gap.

3. Methods

The economic policies play an influential role in determining the pollution emission in any country because any expansionary policy can increase the economic activities through a scale effect. The fiscal policy can have an immediate impact because government spending is a direct component of aggregate demand in an economy. Increasing government spending increases production and consumption activities and aggregate demand. Therefore, it would increase investment and production, which would increase the energy demand and pollution emissions if renewable sources are ignored in the energy mix of an economy. Moreover, expansionary monetary policy may also increase aggregate demand through rising consumption and investment activities. Hence, the expansionary monetary policy could also pollute the environment. Overall, any expansionary fiscal or monetary policy could have environmental consequences if the energy sector does not transition into cleaner sources in the process of expansionary policy. Literature has probed the combined environmental impact of both fiscal and monetary measures. Moreover, Halkos and Paizanos [27] suggested that macroeconomic policies would influence production and consumption-based emissions. Hence, we hypothesize the impact of both fiscal and monetary policies on TBC and CBC emissions in the following way:

$$LCBC_{it} = f(LGE_{it}, LMS_{it}) \quad (1)$$

$$LTBC_{it} = f(LGE_{it}, LMS_{it}) \quad (2)$$

LCBC_{it} is consumption-based and LTBC_{it} is tertiary-based CO₂ emissions. LGE_{it} is government expenditure, which is a proxy for fiscal policy. LMS_{it} is money supply, which is a proxy of monetary policy. *i* shows 6 GCC economies, and *t* shows a period of 1990–2019. All series are used in natural log form. CO₂ emissions are taken from Global Carbon Atlas [66], and policy variables are taken from the World Bank [67]. LGE_{it} could positively affect CO₂ emissions through the scale effect and might have a negative impact if government spending is encouraging cleaner technologies in an economy. In the same way, LMS_{it} could positively impact CO₂ emissions through the scale effect and might negatively impact if the monetary policy encourages the consumption of cleaner sources. For example, financial sector loans are facilitated in cleaner technology projects. The exact relationship would be found after a thorough empirical investigation. The relationship would be confirmed by applying panel cointegration. Literature suggests checking the integration level to verify the suitability of cointegration analyses [68,69]. For this purpose, three tests are used, which are Im-Pesaran-Shin (IPS), Levin-Lin-Shin (LLS), and Fisher-Augmented Dickey Fuller (ADF). These verify the robustness of each other, which are provided by Im et al. [70], Levin et al. [71], and Maddala and Wu [72]. Afterward, cointegration is used. Kao [73] provided the residual-based test and cointegration can be claimed if the Ordinary

Least Square (OLS) residual proves to be at a stationary level. To test robustness, we applied Maddala and Wu's [72] procedure to find the aggregate probability of the Johansen [74] statistics, which may confirm the cointegration through investigating the vectors using the following aggregating formulae:

$$y = -2 \sum_{i=1}^N \ln(\text{probability}_i) \quad (3)$$

After testing cointegration through the above equation, the robustness may again be verified through the Pedroni [75] test with the following statistics:

$$T^2 N^{1.5} Z_{\hat{\rho} N, T} = T^2 N^{1.5} \left(\sum_{i=1}^N \sum_{t=1}^T 1 / \hat{L}_{11i}^2 \hat{e}_{i,t-1}^2 \right)^{-1} \quad (4)$$

$$TN^{0.5} Z_{\hat{\rho} N, T-1} = T^2 N^{0.5} \left(\sum_{i=1}^N \sum_{t=1}^T \frac{1}{\hat{L}_{11i}^2 \hat{e}_{i,t-1} \Delta} \hat{e}_{i,t} - \hat{\lambda}_i \right) \left(\sum_{i=1}^N \sum_{t=1}^T 1 / \hat{L}_{11i}^2 \hat{e}_{i,t-1}^2 \right)^{-1} \quad (5)$$

$$Z_{t N, T} = \left(\sum_{i=1}^N \sum_{t=1}^T 1 / \hat{L}_{11i}^2 \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) (\tilde{\sigma}_{N, T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2)^{-0.5} \quad (6)$$

$$Z_{t N, T}^* = \left(\sum_{i=1}^N \sum_{t=1}^T \frac{1}{\hat{L}_{11i}^2 \hat{e}_{i,t-1}^*} \Delta \hat{e}_{i,t}^* \right) (\tilde{s}_{N, T}^{*2} \sum_{i=1}^N \sum_{t=1}^T 1 / \hat{L}_{11i}^2 \hat{e}_{i,t-1}^{*2})^{-0.5} \quad (7)$$

$$TN^{0.5} \tilde{Z}_{\hat{\rho} N, T-1} = T \cdot N^{-0.5} \left(\sum_{t=1}^T \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \left(\sum_{i=1}^N \sum_{t=1}^T \hat{e}_{i,t-1}^2 \right)^{-1} \quad (8)$$

$$N^{-0.5} \tilde{Z}_{t N, T} = N^{0.5} \left(\sum_{t=1}^T \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right)^{-1} \sum_{i=1}^N \left(\hat{\sigma}_i^2 \sum_{t=1}^T \hat{e}_{i,t-1}^2 \right)^{-1} \quad (9)$$

$$N^{-0.5} \tilde{Z}_{t N, T}^* = N^{0.5} \left(\sum_{t=1}^T \hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^* \right)^{-1} \sum_{i=1}^N \left(\sum_{t=1}^T \hat{s}_i^{*2} \hat{e}_{i,t-1}^{*2} \right)^{-0.5} \quad (10)$$

Considering heterogeneous country effects, the above equations would suggest cointegration. Afterward, we applied the Pesaran et al. [76] method to find the effects of our policy variables on CO₂ emissions. This method was chosen as it is a Pooled Mean Group (PMG) and provides robust results in a mixed order of integration.

$$\Delta z_{it} = \alpha_i + \sum_{j=1}^{p-1} \gamma_j \Delta z_{i,t-1} + \sum_{j=0}^{q-1} \beta_j \Delta w_{i,t-1} + \mu_1 z_{i,t-1} + \mu_2 w_{i,t-1} + e_{1it} \quad (11)$$

$$\Delta z_{it} = \alpha_i + \sum_{j=1}^{p-1} \gamma_j \Delta z_{i,t-1} + \sum_{j=0}^{q-1} \beta_j \Delta w_{i,t-1} + \varphi_j u_{i,t-1} + e_{2it} \quad (12)$$

Equations (11) and (12) test the long- and short-term effects. Afterward, the robustness of PMG was tested by the Fully Modified OLS (FMOLS) of Pedroni [77] and Dynamic OLS (DOLS) of Kao and Chiang [78] in the following way:

$$\hat{\beta}_{FMOLS} = \left(\sum_{n=1}^N \left(\sum_{t=1}^T (w_{it} - \bar{w}_i) \hat{z}_{it}^+ + T \hat{\Delta}_{\varepsilon\mu}^+ \right) \right) / \left(\sum_{t=1}^N \sum_{t=1}^T (w_{it} - \bar{w}_i)' \right) \quad (13)$$

$$\hat{\beta}_{DOLS} = \left(\sum_{t=1}^T z_{it} \hat{z}_{it}^+ \right) \cdot \sum_{i=1}^N 1 / \sum_{t=1}^T z_{it} z_{it}' \quad (14)$$

Equations (13) and (14) are the modified and dynamic versions of OLS and provide robust results by removing many econometric problems.

4. Data Analyses and Discussions

In Table 1, panel unit root results are shown. Leveled LCBC_{it} and LTBC_{it} have unit roots. However, LGE_{it} and LMS_{it} are stationary in most tests. Moreover, all differenced variables are stationary. Hence, the results corroborate a mixed integration order.

Table 1. Unit root analyses.

Series	IPS		LLC		Fisher-ADF	
	Constant	Constant and Trend	Constant	Constant and Trend	Constant	Constant and Trend
Level						
LCBC _{it}	0.5759 (0.7176)	−1.0772 (0.1407)	−0.5565 (0.2889)	−3.0406 (0.0012)	12.0614 (0.4408)	15.9109 (0.1953)
LTBC _{it}	−1.2107 (0.1130)	1.4581 (0.9276)	−0.9775 (0.1742)	0.4942 (0.6894)	17.2302 (0.1411)	4.8899 (0.9616)
LGE _{it}	−0.9902 (0.1611)	−1.6428 (0.0502)	−1.7228 (0.0425)	−1.8842 (0.0298)	23.3242 (0.0245)	23.9536 (0.0206)
LMS _{it}	−3.6069 (0.0002)	−4.9801 (0.0000)	−4.5227 (0.0000)	−8.2021 (0.0000)	42.6335 (0.0000)	82.3455 (0.0000)
First Difference						
ΔLCBC _{it}	−6.1309 (0.0000)	−5.0956 (0.0000)	−4.2631 (0.0000)	−3.0304 (0.0012)	59.4586 (0.0000)	47.0703 (0.0000)
ΔLTBC _{it}	−8.2643 (0.0000)	−6.9252 (0.0000)	−6.3976 (0.0000)	−4.6417 (0.0000)	82.3608 (0.0000)	63.2934 (0.0000)
ΔLGE _{it}	−7.4991 (0.0000)	−6.2432 (0.0000)	−6.8013 (0.0000)	−4.8588 (0.0000)	74.7894 (0.0000)	57.9564 (0.0000)
ΔLMS _{it}	−9.1672 (0.000)	−8.1078 (0.0000)	−6.7832 (0.0000)	−5.1972 (0.0000)	93.0122 (0.0000)	75.8042 (0.0000)

Note: (*p*-value).

Tables 2 and 3 show that Kao's [73] test confirmed long-run association in the LTBC_{it} model but not in the LCBC_{it} model. On the other hand, Fisher-Johansen's test found two cointegrating vectors in both LTBC_{it} and LCBC_{it} models. Further, Pedroni's [75] test confirmed the cointegration in four out of seven statistics and two out of four weighted statistics. Hence, cointegration tests provided sufficient evidence of long-run relationships in the LCBC_{it} and LTBC_{it} models. Furthermore, coefficients of ECT_{t-1} were negative in both LTBC_{it} and LCBC_{it} models in Table 4, which confirms the cointegration in the models. Hence, we may proceed with long- and short-run analyses.

Table 2. Cointegration in LTBC_{it} model.

	Statistic	<i>p</i> -Value	Weighed Statistic	<i>p</i> -Value
Pedroni test				
v	0.6546	0.2563	0.9626	0.1679
rho	−0.9851	0.1623	−1.1746	0.1201
PP	−2.6972	0.0035	−2.3859	0.0085
ADF	−3.2080	0.0007	−3.2468	0.0006
Grouped-rho	−0.3811	0.3516		
Grouped-PP	−2.4324	0.0075		
Grouped-ADF	−3.3281	0.0004		
Kao test				
Statistic	−2.5958	0.0047		
Variance	0.0184			
Fisher-Johansen by Maddala and Wu test				
Cointegrating Vectors	Trace Statistic		Max-Eigen Statistic	
0	44.24	0.0000	40.36	0.0001
1	14.47	0.2716	10.65	0.5592
2	22.14	0.0360	22.14	0.0360

Table 3. Cointegration in LCBC_{it} model.

	Statistic	<i>p</i> -Value	Weighed Statistic	<i>p</i> -Value
Pedroni test				
<i>v</i>	0.7477	0.2273	0.5906	0.2774
<i>rho</i>	−0.9262	0.1772	−1.0806	0.1399
PP	−2.0042	0.0225	−1.7877	0.0369
ADF	−2.1793	0.0147	−2.0728	0.0191
Grouped- <i>rho</i>	−0.3088	0.3787		
Grouped-PP	−1.7434	0.0406		
Grouped-ADF	−1.6471	0.0498		
Kao test				
Stat	−1.0621	0.1441		
Variance	0.0212			
Fisher-Johansen by Maddala and Wu test				
Cointegrating Vectors	Trace test		Max-Eigen test	
0	23.79	0.0218	19.76	0.0717
1	12.13	0.4353	8.902	0.7113
2	20.16	0.0642	20.16	0.0642

Table 4. Regression results.

Variable	LTBC _{it} Parameters	S.E.	<i>t</i> -Statistic	<i>p</i> -Value	LCBC _{it} Parameters	S.E.	<i>t</i> -Statistic	<i>p</i> -Value
FMOLS								
LGE _{it}	0.1281	0.0496	2.5848	0.0106	0.1664	0.0496	3.3584	0.0010
LMS _{it}	−0.2091	0.0260	−8.0564	0.0000	−0.1765	0.0260	−6.8002	0.0000
DOLS								
LGE _{it}	0.0826	0.0849	0.9729	0.3326	0.2269	0.1204	1.8845	0.0620
LMS _{it}	−0.3694	0.0743	−4.9737	0.0000	−0.2811	0.0727	−3.8664	0.0002
PMG								
LGE _{it}	0.2690	0.0823	3.2677	0.0013	0.3549	0.1308	2.7141	0.0074
LMS _{it}	−0.4136	0.0783	−5.2789	0.0000	−0.3695	0.1217	−3.0371	0.0028
ECT _{t-1}	−0.3512	0.1001	−3.5078	0.0006	−0.2584	0.0921	−2.8064	0.0057
ΔLTBC _{it-1}	0.1264	0.0541	2.3373	0.0208				
ΔLCBC _{it-1}					0.0466	0.1203	0.3876	0.6988
ΔLGE _{it}	0.3455	0.1127	3.0642	0.0026	0.1406	0.1050	1.3386	0.1828
ΔLMS _{it}	0.2158	0.0973	2.2171	0.0281	0.3348	0.1449	2.3101	0.0223
Intercept	1.3669	0.3977	3.4371	0.0008	0.8291	0.3160	2.6242	0.0096
Pesaran cross-section dependence test	0.2184			0.8271	0.6853			0.4932

Table 4 demonstrates the long-term positive impact of government spending on TBC_{it} and CBC_{it} in GCC countries in PMG, FMOLS, and DOLS results. The government expenditure is a direct component of aggregate demand, demonstrating a scale effect of fiscal policy in GCC economies in terms of both territory- and consumption-based CO₂ emissions. For example, increasing government spending increases energy demand and both TBC and CBC emissions, which shows that most of the energy demand is sourced from fossil fuel. The consumption-based emissions are adjusted by international trade. Our results show that fiscal policy discourages both production and consumption-based pollution-oriented economic activities. Another possible reason for this result is that oil is a major source of income and exports in GCC countries, which is pollution-oriented and accelerates CO₂ emissions in production and consumption activities. Our finding is also corroborated by literature investigating the impact of government aggregate expenditures on emissions [54,59]. However, the literature has also reported the positive

environmental effect, through reducing emissions, of public spending in clean energy and green projects [47,48]. Moreover, some literature also found the negative long-term effect of aggregate public spending on emissions [40,48,49].

The effect of LMS_{it} was found to be negative in all estimates. Monetary policy is proxied by broad money, including cash outside the banks and all types of bank deposits, securities, and travelers' cheques. Hence, money supply represents both liquid cash and financial sector deposits, which has a pleasant effect on the environment in GCC economies. This result corroborates that monetary policy in GCC countries is promoting cleaner technologies in the long run. This result is in line with Ullah's et al. [40] findings, which elaborate that the monetary shocks need a long run to have positive environmental effects. Contrarily, the literature has found a positive impact of money supply on emissions [5,37,38].

In the short run, parameters of ECT_{t-1} are negative and show divergence to a long-term equilibrium. The lagged term $\Delta LTBC_{it-1}$ shows that TBC in any year is promoting TBC in the subsequent year. However, $\Delta LCBC_{it-1}$ does not have any effect on subsequent years' CBC emissions. Government spending in promoting TBC emissions does not affect CBC emissions. Past literature also verified our finding of the positive short-run effect of public expenditure on TBC emissions [40,42]. Moreover, Yuelan et al. [54] reported the opposite finding of the negative short-term effect of public spending on emissions. Monetary policy positively impacts both CBC and TBC emissions. However, this effect was negative in the long term, demonstrating that monetary policy needs a long time to have a positive environmental impact by reducing emissions. Ullah et al. [40] also reported the same positive and negative environmental effects of monetary policy in the long and short terms.

5. Conclusions

Macroeconomic policies can have profound effects on the environment of any economy or region. We investigated the role of monetary and fiscal policies on the TBC and CBC emissions in six GCC countries. We found the long-term relationships in cointegration analyses of TBC and CBC emissions models. Moreover, we applied various panel techniques to confirm the robustness of the research findings. In the long run, government expenditures have positive effects on both TBC and CBC and have a scale effect on GCC economies through increasing CO₂ emissions. Theoretically, government expenditure is one of the components of aggregate demand. Hence, increasing aggregate demand through fiscal policy has environmental consequences in releasing CO₂ emissions because fossil fuel is a major chunk of GCC economies' energy mix. Moreover, government spending is also majorly sourced from oil production and revenues in the GCC economies. The positive effect of fiscal policy on both TBC and CBC corroborates that fiscal policy has a uniform impact on TBC and CBC emissions in the GCC region. Government spending shows a positive effect on TBC emissions in the short run, but it has an insignificant impact on CBC emissions. Money supply has a negative long-term effect on both TBC and CBC emissions and has a positive short-term effect on both TBC and CBC emissions. Hence, monetary policy has short-term environmental consequences in terms of TBC and CBC emissions in GCC countries. However, in the long run, monetary policy is helpful for reducing both TBC and CBC emissions in the GCC region.

5.1. Policy Recommendations

Based on the results, we recommend that the GCC economies care about the environmental consequences of government spending by encouraging renewable energy consumption in government projects to save the environment from CO₂ emissions. The monetary policy would reduce CO₂ emissions as per the findings of this research. Hence, the monetary policy should be encouraged further to promote a clean environment. Additionally, expansionary monetary policy should be encouraged to provide loans for green projects to promote renewable and energy-efficient technologies.

5.2. Limitations and Future Directions

The present research utilized a limited period of 1990–2019 due to the unavailability of CBC emissions data before 1990. Moreover, the analysis was restricted to GCC countries. To improve the generalization of the results, future research may extend the time range by generating CBC emissions data for an extensive range of time periods and might consider utilizing a panel of Middle East and North Africa countries to promote the scope of the present research.

Author Contributions: Conceptualization, H.M. and A.H.A.; methodology, M.A. and A.I.; software, M.A. and A.I.; validation, A.H.A., H.M. and M.M.; formal analysis, M.A., M.M. and A.I.; investigation, H.M.; resources, H.M.; data curation, A.H.A.; writing—original draft preparation, M.F. and H.M.; writing—review and editing, M.F. and H.M.; visualization, H.M. and A.H.A.; supervision, H.M.; project administration, H.M.; funding acquisition, H.M. All authors have read and agreed to the published version of the manuscript.

Funding: This project was supported by the Deanship of Scientific Research at Prince Sattam bin Abdulaziz University under the research project #2021/02/18338.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: All data are publicly available from [66,67].

Acknowledgments: We thank the editor and anonymous referees for their useful comments.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Grossman, G.; Krueger, A. *Environmental Impacts of a North American Free Trade Agreement*; Working Paper 3914; National Bureau of Economic Research: Cambridge, MA, USA, 1991. [\[CrossRef\]](#)
2. Stern, D.I. The rise and fall of the environmental Kuznets curve. *World Dev.* **2004**, *32*, 1419–1439. [\[CrossRef\]](#)
3. Xue, L.; Haseeb, M.; Mahmood, H.; Alkhateeb, T.T.Y.; Murshed, M. Renewable Energy Use and Ecological Footprints Mitigation: Evidence from Selected South Asian Economies. *Sustainability* **2021**, *13*, 1613. [\[CrossRef\]](#)
4. Murshed, M.; Mahmood, H.; Alkhateeb, T.T.Y.; Banerjee, S. Calibrating the Impacts of Regional Trade Integration and Renewable Energy Transition on the Sustainability of International Inbound Tourism Demand in South Asia. *Sustainability* **2020**, *12*, 8341. [\[CrossRef\]](#)
5. Qingquan, J.; Khattak, S.I.; Ahmad, M.; Ping, L. A new approach to environmental sustainability: Assessing the impact of monetary policy on CO₂ emissions in Asian economies. *Sustain. Dev.* **2020**, *28*, 1331–1346. [\[CrossRef\]](#)
6. Jalil, A.; Feridun, M. The impact of growth, energy and financial development on the environment in China: A cointegration analysis. *Energy Econ.* **2011**, *33*, 284–291. [\[CrossRef\]](#)
7. Wang, Y.; Zhi, Q. The role of green finance in environmental protection: Two aspects of market mechanism and policies. *Energy Procedia* **2016**, *104*, 311–316. [\[CrossRef\]](#)
8. He, L.; Liu, R.; Zhong, Z.; Wang, D.; Xia, Y. Can green financial development promote renewable energy investment efficiency? A consideration of bank credit. *Renew Energy* **2019**, *143*, 974–984. [\[CrossRef\]](#)
9. Schoenmaker, D. Greening monetary policy. *Clim. Policy* **2021**, *21*, 581–592. [\[CrossRef\]](#)
10. Chishti, M.Z.; Ullah, S.; Ozturk, I.; Usman, A. Examining the asymmetric effects of globalization and tourism on pollution emissions in South Asia. *Environ. Sci. Pollut. Res.* **2020**, *27*, 27721–27737. [\[CrossRef\]](#)
11. Ullah, S.; Chishti, M.Z.; Majeed, M.T. The asymmetric effects of oil price changes on environmental pollution: Evidence from the top ten carbon emitters. *Environ. Sci. Pollut. Res.* **2020**, *27*, 29623–29635. [\[CrossRef\]](#)
12. Weimin, Z.; Chishti, M.Z.; Rehman, A.; Ahmad, M. A pathway toward future sustainability: Assessing the influence of innovation shocks on CO₂ emissions in developing economies. *Environ. Dev. Sustain.* **2021**, 1–24. [\[CrossRef\]](#)
13. Leal, P.H.; Marques, A.C. Rediscovering the EKC hypothesis for the 20 highest CO₂ emitters among OECD countries by level of globalization. *Int. Econ.* **2020**, *164*, 36–47. [\[CrossRef\]](#)
14. Pata, U.K.; Caglar, A.E. Investigating the EKC hypothesis with renewable energy consumption, human capital, globalization and trade openness for China: Evidence from augmented ARDL approach with a structural break. *Energy* **2021**, *216*, 119220. [\[CrossRef\]](#)
15. Rehman, A.; Ma, H.; Ahmad, M.; Ozturk, I.; Chishti, M.Z. How do climatic change, cereal crops and livestock production interact with carbon emissions? Updated evidence from China. *Environ. Sci. Pollut. Res.* **2021**, *28*, 30702–30713. [\[CrossRef\]](#)
16. Janjua, L.; Razzak, A.; Razzak, A. Lack of Environmental Policy and Water Governance: An Alarming Situation in Pakistan. *Int. J. Circ. Econ. Waste Manag.* **2021**, *1*, 4. [\[CrossRef\]](#)

17. Mahmood, H.; Alkhateeb, T.T.Y.; Furqan, M. Exports, Imports, Foreign Direct Investment and CO₂ Emissions in North Africa: Spatial Analysis. *Energy Rep.* **2020**, *6*, 2403–2409. [\[CrossRef\]](#)
18. Mahmood, H. CO₂ emissions, financial development, foreign direct investment, trade and income in North America: A spatial panel data approach. *SAGE Open* **2020**, *10*, 2158244020968085. [\[CrossRef\]](#)
19. Khan, S.A.R.; Godil, D.I.; Quddoos, M.U.; Yu, Z.; Akhtar, M.H.; Liang, Z. Investigating the nexus between energy, economic growth, and environmental quality: A road map for the sustainable development. *Sustain. Dev.* **2021**, *29*, 835–846. [\[CrossRef\]](#)
20. Khan, S.A.R.; Razaq, A.; Yu, Z.; Miller, S. Industry 4.0 and circular economy practices: A new era business strategies for environmental sustainability. *Bus. Strategy Environ.* **2021**, *30*, 4001–4014. [\[CrossRef\]](#)
21. Yu, Z.; Khan, S.A.R.; Umar, M. Circular economy practices and industry 4.0 technologies: A strategic move of automobile industry. *Bus. Strategy Environ.* **2021**. [\[CrossRef\]](#)
22. Khan, S.A.R.; Ponce, P.; Thomas, G.; Yu, Z.; Al-Ahmadi, M.S.; Tanveer, M. Digital Technologies, Circular Economy Practices and Environmental Policies in the Era of COVID-19. *Sustainability* **2021**, *13*, 12790. [\[CrossRef\]](#)
23. Jones, P.; Wynn, M.G. The Circular Economy, Resilience, and Digital Technology Deployment in the Mining and Mineral Industry. *Int. J. Circ. Econ. Waste Manag.* **2021**, *1*, 2. [\[CrossRef\]](#)
24. Khan, S.A.R.; Ponce, P.; Tanveer, M.; Aguirre-Padilla, N.; Mahmood, H.; Shah, S.A.A. Technological Innovation and Circular Economy Practices: Business Strategies to Mitigate the Effects of COVID-19. *Sustainability* **2021**, *13*, 8479. [\[CrossRef\]](#)
25. Khan, S.A.R.; Yu, Z.; Sharif, A. No Silver Bullet for De-carbonization: Preparing for Tomorrow, today. *Resour. Policy* **2021**, *71*, 101942. [\[CrossRef\]](#)
26. Khan, S.A.R.; Godil, D.I.; Yu, Z.; Abbas, F.; Shamim, M.A. Adoption of renewable energy sources, low-carbon initiatives, and advanced logistical infrastructure—An step toward integrated global progress. *Sustain. Dev.* **2021**. [\[CrossRef\]](#)
27. Halkos, G.E.; Paizanos, E.A. The effect of government expenditure on the environment: An empirical investigation. *Ecol. Econ.* **2013**, *91*, 48–56. [\[CrossRef\]](#)
28. Heutel, G. How should environmental policy respond to business cycles? Optimal policy under persistent productivity shocks. *Rev. Econ. Dyn.* **2012**, *15*, 244–264. [\[CrossRef\]](#)
29. Liu, Y.; Han, L.; Yin, Z.; Luo, K. A competitive carbon emissions scheme with hybrid fiscal incentives: The evidence from a taxi industry. *Energy Policy* **2017**, *102*, 414–422. [\[CrossRef\]](#)
30. Ulucak, R.; Kassouri, Y. An assessment of the environmental sustainability corridor: Investigating the nonlinear effects of environmental taxation on CO₂ emissions. *Sustain. Dev.* **2020**, *28*, 1010–1018. [\[CrossRef\]](#)
31. Gaspar, V.; Mauro, P.; Parry, I.; Pattillo, C. Fiscal Policies to Curb Climate Change. 2019. Available online: <https://blogs.imf.org/2019/10/10/fiscal-policies-to-curb-climate-change/> (accessed on 15 November 2021).
32. McAusland, C. Trade, politics, and the environment: Tailpipe vs. smokestack. *J. Environ. Econ. Manag.* **2008**, *55*, 52–71. [\[CrossRef\]](#)
33. Lopez, R.; Galinato, G.I.; Islam, A. Fiscal spending and the environment: Theory and empirics. *J. Environ. Econ. Manag.* **2011**, *62*, 180–198. [\[CrossRef\]](#)
34. Halkos, G.E.; Paizanos, E.A. The effects of fiscal policy on CO₂ emissions: Evidence from the USA. *Energy Policy* **2016**, *88*, 317–328. [\[CrossRef\]](#)
35. Ullah, S.; Majeed, M.T.; Chishti, M.Z. Examining the asymmetric effects of fiscal policy instruments on environmental quality in Asian economies. *Environ. Sci. Pollut. Res.* **2020**, *27*, 38287–38299. [\[CrossRef\]](#)
36. Hasanov, F.; Liddle, B.; Mikayolov, J. The Impact of International Trade on CO₂ Emissions in Oil Exporting Countries: Territory vs. Consumption Emissions Accounting. *Energy Econ.* **2018**, *74*, 343–350. [\[CrossRef\]](#)
37. Weimin, Z.; Chishti, M.Z. Toward Sustainable Development: Assessing the Effects of Commercial Policies on Consumption and Production-Based Carbon Emissions in Developing Economies. *SAGE Open* **2021**. [\[CrossRef\]](#)
38. Mahmood, H. Consumption and Territory based CO₂ Emissions, Renewable Energy Consumption, and Trade Nexus in South America: Spatial Analyses. *Pol. J. Environ. Stud.* **2022**. [\[CrossRef\]](#)
39. Khan, Z.; Ali, M.; Jinyu, L.; Shahbaz, M.; Siqun, Y. Consumption-based Carbon Emissions and Trade Nexus: Evidence from Nine Oil Exporting Countries. *Energy Econ.* **2020**, *89*, 104806. [\[CrossRef\]](#)
40. Ullah, S.; Ozturk, I.; Sohail, S. The asymmetric effects of fiscal and monetary policy instruments on Pakistan's environmental pollution. *Environ. Sci. Pollut. Res.* **2021**, *28*, 7450–7461. [\[CrossRef\]](#)
41. Chan, Y.T. Are macroeconomic policies better in curbing air pollution than environmental policies? A DSGE approach with carbon dependent fiscal and monetary policies. *Energy Policy* **2020**, *141*, 111454. [\[CrossRef\]](#)
42. Mughal, N.; Kashif, M.; Arif, A.; Guerrero, J.W.G.; Nabua, W.C.; Niedbala, G. Dynamic effects of fiscal and monetary policy instruments on environmental pollution in ASEAN. *Environ. Sci. Pollut. Res.* **2021**, *28*, 65116–65126. [\[CrossRef\]](#)
43. Bhowmik, R.; Syed, Q.R.; Apergis, N.; Alola, A.A.; Gai, Z. Applying a dynamic ARDL approach to the Environmental Phillips Curve (EPC) hypothesis amid monetary, fiscal, and trade policy uncertainty in the USA. *Environ. Sci. Pollut. Res.* **2021**, 1–15. [\[CrossRef\]](#)
44. Olabemiwo, F.A.; Danmaliki, G.I.; Oyehan, T.A.; Tawabini, B.S. Forecasting CO₂ emissions in the Persian Gulf States. *Glob. J. Environ. Sci. Manag.* **2017**, *3*, 1–10.
45. Neves, S.A.; Marques, A.C.; Patricio, M. Determinants of CO₂ emissions in European Union countries: Does environmental regulation reduce environmental pollution? *Econ. Anal. Policy* **2020**, *68*, 114–125. [\[CrossRef\]](#)

46. Le, H.P.; Ozturk, I. The impacts of globalization, financial development, government expenditures, and institutional quality on CO₂ emissions in the presence of environmental Kuznets curve. *Environ. Sci. Pollut. Res.* **2020**, *27*, 22680–22697. [\[CrossRef\]](#) [\[PubMed\]](#)
47. Ahmed, Z.; Cary, M.; Ali, S.; Murshed, M.; Ullah, H.; Mahmood, H. Moving towards a green revolution in Japan: Symmetric and asymmetric relationships among clean energy technology development investments, economic growth, and CO₂ emissions. *Energy Environ.* **2021**, 0958305X211041780. [\[CrossRef\]](#)
48. Zhang, D.; Mohsin, M.; Rasheed, A.K.; Chang, Y.; Taghizadeh-Hesary, F. Public spending and green economic growth in BRI region: Mediating role of green finance. *Energy Policy* **2021**, *153*, 112256. [\[CrossRef\]](#)
49. Yilanci, V.; Pata, U.K. On the interaction between fiscal policy and CO₂ emissions in G7 countries: 1875–2016. *J. Environ. Econ. Policy* **2021**, 1–22. [\[CrossRef\]](#)
50. Katircioglu, S.; Katircioglu, S. Testing the role of fiscal policy in the environmental degradation: The case of Turkey. *Environ. Sci. Pollut. Res.* **2018**, *25*, 5616–5630. [\[CrossRef\]](#)
51. Hashmi, R.; Alam, K. Dynamic relationship among environmental regulation, innovation, CO₂ emissions, population, and economic growth in OECD countries: A panel investigation. *J. Clean. Prod.* **2019**, *231*, 1100–1109. [\[CrossRef\]](#)
52. Aydin, C.; Esen, O. Reducing CO₂ emissions in the EU member states: Do environmental taxes work? *J. Environ. Plan. Manag.* **2018**, *61*, 2396–2420. [\[CrossRef\]](#)
53. Mardones, C.; Flores, B. Effectiveness of a CO₂ tax on industrial emissions. *Energy Econ.* **2018**, *71*, 370–382. [\[CrossRef\]](#)
54. Yuelan, P.; Akbar, M.W.; Hafeez, M.; Ahmad, M.; Zia, Z.; Ullah, S. The nexus of fiscal policy instruments and environmental degradation in China. *Environ. Sci. Pollut. Res.* **2019**, *26*, 28919–28932. [\[CrossRef\]](#) [\[PubMed\]](#)
55. Solaymani, S. Carbon and energy taxes in a small and open country. *Glob. J. Environ. Sci. Manag.* **2017**, *3*, 51–62. [\[CrossRef\]](#)
56. Khan, S.A.R.; Ponce, P.; Yu, Z. Technological innovation and environmental taxes toward a carbon-free economy: An empirical study in the context of COP-21. *J. Environ. Manag.* **2021**, *298*, 113418. [\[CrossRef\]](#) [\[PubMed\]](#)
57. Qingquan, J.; Khattak, S.I.; Ahmad, M.; Lin, P. Mitigation pathways to sustainable production and consumption: Examining the impact of commercial policy on carbon dioxide emissions in Australia. *Sustain. Prod. Consum.* **2021**, *25*, 390–403. [\[CrossRef\]](#)
58. Vo, X.V.; Zaman, K. Relationship between energy demand, financial development, and carbon emissions in a panel of 101 countries: “Go the extra mile” for sustainable development. *Environ. Sci. Pollut. Res.* **2020**, *27*, 23356–23363. [\[CrossRef\]](#)
59. Chishti, M.Z.; Ahmad, M.; Rehman, A.; Khan, M.K. Mitigations pathways towards sustainable development: Assessing the influence of fiscal and monetary policies on carbon emissions in BRICS economies. *J. Clean. Prod.* **2021**, *292*, 126035. [\[CrossRef\]](#)
60. Ahmed, Z.; Ahmad, M.; Rjoub, H.; Kalugina, O.A.; Hussain, N. Economic growth, renewable energy consumption, and ecological footprint: Exploring the role of environmental regulations and democracy in sustainable. *Sustain. Dev.* **2021**. [\[CrossRef\]](#)
61. Mahmood, H.; Furqan, M.; Bagais, O.A. Environmental accounting of financial development and foreign investment: Spatial analyses of East Asia. *Sustainability* **2019**, *11*, 13. [\[CrossRef\]](#)
62. Mahmood, H.; Furqan, M. Oil Rents and Greenhouse Gas Emissions: Spatial Analysis of Gulf Cooperation Council Countries. *Environ. Dev. Sustain.* **2021**, *23*, 6215–6233. [\[CrossRef\]](#)
63. Mahmood, H.; Alkhateeb, T.T.Y.; Furqan, M. Industrialization, urbanization and CO₂ emissions in Saudi Arabia: Asymmetry analysis. *Energy Rep.* **2020**, *6*, 1553–1560. [\[CrossRef\]](#)
64. Alkhateeb, T.T.Y.; Mahmood, H. The oil price and trade nexus in the Gulf Co-operation Council countries. *Resources* **2020**, *9*, 139. [\[CrossRef\]](#)
65. Siddiqui, A.; Mahmood, H.; Margaritis, D. Oil Prices and Stock Markets during the 2014–16 Oil Price Slump: Asymmetries and Speed of Adjustment in GCC and Oil Importing Countries. *Emerg. Mark. Financ. Trade* **2020**, *56*, 3678–3708. [\[CrossRef\]](#)
66. Global Carbon Atlas. 2021. Available online: <http://www.globalcarbonatlas.org/en/CO2-emissions> (accessed on 19 September 2021).
67. World Bank. *World Development Indicators*; The World Bank: Washington, DC, USA, 2021.
68. Chishti, M.Z.; Iqbal, J.; Mahmood, F.; Azeem, H.S.M. The implication of the oscillations in exchange rate for the commodity-wise trade flows between Pakistan and China: An evidence from ARDL approach. *Rev. Pac. Basin Financ. Mark. Policies* **2020**, *23*, 2050030. [\[CrossRef\]](#)
69. Chishti, M.Z.; Sinha, A. Do the shocks in technological and financial innovation influence the environmental quality? Evidence from BRICS economies. *Technol. Soc.* **2022**, *68*, 101828. [\[CrossRef\]](#)
70. Im, K.S.; Pesaran, M.H.; Shin, Y. Testing for Unit Roots in Heterogeneous Panels. *J. Econ.* **2003**, *115*, 53–74. [\[CrossRef\]](#)
71. Levin, A.; Lin, C.-F.; Chu, C.-S.J. Unit root tests in panel data: Asymptotic and finite-sample properties. *J. Econ.* **2002**, *108*, 1–24. [\[CrossRef\]](#)
72. Maddala, G.S.; Wu, S. A comparative study of unit root tests with panel data and a new simple test. *Oxf. Bull. Econ. Stat.* **1999**, *61*, 631–652. [\[CrossRef\]](#)
73. Kao, C. Spurious regression and residual-based tests for cointegration in panel data. *J. Econ.* **1999**, *90*, 1–44. [\[CrossRef\]](#)
74. Johansen, S. Statistical analysis of Cointegration Vectors. *J. Econ. Dyn. Control.* **1988**, *12*, 231–254. [\[CrossRef\]](#)
75. Pedroni, P. Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econ. Theory* **2004**, *20*, 579–625. [\[CrossRef\]](#)
76. Pesaran, M.H.; Shin, Y.; Smith, R. Pooled mean group estimator of dynamic heterogeneous panels. *J. Am. Stat. Assoc.* **1999**, *94*, 621–634. [\[CrossRef\]](#)

-
77. Pedroni, P. Fully modified OLS for heterogeneous cointegrated panels. *Adv. Econ.* **2000**, *15*, 93–130. [[CrossRef](#)]
 78. Kao, C.; Chiang, M.H. On the estimation and inference of a cointegrated regression in panel data. *Adv. Econ.* **2000**, *15*, 179–222. [[CrossRef](#)]