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Trade Openness, Industrialization, Urbanization and Pollution Emissions in GCC Countries: A Way towards Green and Circular Economies

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ABSTRACT

The GCC countries are moving toward circular and green economies in their long-run visions. This transformation is accelerating the industrialization, urbanization, economic growth, and Trade Openness (TO) in the region. This present study examines the effects of these economic indicators on pollution emissions in the GCC panel from 1980 to 2019 using panel techniques. We found the environmental Kuznets curve. Moreover, TO is helping reduce CO_2 emissions. Hence, economic growth and TO are helping the GCC region to follow the track of green and circular economies. In short run, TO also reduces emissions. Industrialization and urbanization accelerate emissions in long run. Thus, both indicators have environmental consequences in the GCC region in the long run. However, these indicators could not harm the in short run. To follow the track of green and circular economies, the study recommends increasing trade openness in the region and imposing carbon taxes on industrialization and urbanization to reduce their environmental consequences.

Keywords: Trade Openness, Industrialization, Urbanization, CO_2 Emissions
JEL Classifications: F18, L16, P25

1. INTRODUCTION

While framing the determinants of pollution emissions, after trade agreements of North America, Grossman's and Krueger (1991) study is among the pioneers in working on determinants of pollution emissions, which hightligted the role of economic growth. Because the increasing economic activities with rising economic growth and trade would boost energy usage and pollution emissions, termed as scale effect. Conversely, these variables would help transfer cleaner technologies in the economies and shift the production from dirty to cleaner processes, which are termed as technique and composition effects. Hence, growth and trade could help the economies follow the track of green and circular economies. Claessens and Feijen (2007) claimed that the financial sector could play an influential role in supporting government policies to promote cleaner technologies. But, fossil fuels are significant sources of energy demand in GCC countries. Hence, it is vital to test the role of growth and trade policies on pollution emissions in the GCC region to test whether both have scale or technique effects at large in the region. Another stream of literature focused on the population's role in pollution emissions and economic growth. For instance, Raskin (1995) suggested methods of estimating the contribution that pollution has on environmental change. Using the specification of I = PAT, the model indicated that impact (I) is equal to the production of the population (P), affluence (A), and technology (T), based on theoretical concepts of Ehrlich and Holdren (1971). York et al. (2002; 2003) used this framework and reported a significant role of urbanization in emissions. The same is the case with industrialization, and more focus on the industry can result in higher CO_2 emissions. It is mentioned that even when a country is able to achieve a certain level of development, there are still possibilities that the environmentally degrading impacts will keep on increasing. Hence, both urbanization and industrialization could have environmental consequences in the economies.

Due to intensive urbanization and other factors, climate change is an alarming issue in today's life. The fossil fuels is pouring oil on the fire, so a need to avoid using fossil fuels arises but whether we can afford to abandon it or not is a question, especially when we see that energy consumption is still heavily based on coal, gas, and oil in the world. There is a need to balance energy use to spur economic growth and avoid environmental damage. Finding a balance between environment and growth is very difficult to address, but we can avoid this situation if we shift the debate to energy origins. Renewable energy is supposed to impact the environment positively, and it may contribute to economic growth as well. However, the energy production in GCC countries is rising and causing economic growth with carbon emission. Global emissions from the energy sector hit a new high, but cleaner energy may help tackle climate change and pollution. Decarbonized power can also reduce CO_2 emissions in other sectors using energy-based liquids, including hydrogen or synthetic liquid fuels. As the atmosphere shifts, we need to be more aware of how we use it. It would be exacerbated if industrialized countries settled on a method to price carbon, allowing us to be more conscious of a basic need we have largely taken for granted due to oil costs and shift our perspective on a fundamental need we have primarily embraced as natural.

As the selected GCC sample, economic growth seemed to increase environmental degradation due to excessive reliance on fossil fuels. With time, the contribution of this environmentally degrading energy is declining, but these GCC countries still rely on them primarily. The region needs to develop efficient ways of sustainable energy consumption further so that the economy and environment can go hand in hand. Excessive reliance on nonrenewable energy can ruin the environment and not be sustainable for the energy and power market. For instance, how much trade a country has, how much energy, including renewable and nonrenewable, is being consumed in the country, how much urbanization is accelerating over time, how the industrial sector is structured, and many more aspects can help determine the CO_2 emissions profile of an economy. As per these discussions, some research has been conducted to test the effect of urbanization, industrialization, oil sector, financial sector, and foreign investment on emissions in some GCC nations (Alsamara et al., 2018; Al-Mulali and Lee, 2013; Mahmood et al., 2020; Rafindadi et al., 2018). In this domain, we cannot ignore the role of economic growth, which may have a deep impact on the environment. The environemt is also greatly affected by urbanization, trade, and industrialization, which eventually increase energy demand and would pollute the economy. The testing of the effects of economic growth, urbanization, trade, and industrialization on CO_2 emissions is well motivated in GCC region. Hence, there is a still need to conduct comprehensive research to have deep inside of these variables in a panel analysis of the whole GCC region, which is targeted by this present research.

2. LITERATURE REVIEW

Wang et al. (2019) talked about how urbanization can lead to CO_2 emissions and indicated that many sectors, including agriculture, forestry, fishery, water conservancy, animal husbandry, and many more, get influenced by these higher CO_2 emissions. Industrial areas and urbanization usually have to depend on fuel consumption, which primarily has to be oil in the Middle Eastern region. Therefore, the more significant effect of urbanization is on the oil segment, which eventually worsens the environment because of resource depletion. The same findings are reported in the case of Vietnam (Fan et al., 2019), in Pakistan (Ali et al., 2019), and China (Liang and Yang, 2019). 2018 et al. (2019) found that urbanization and development of the cities are responsible for increasing temperature during heatwaves. Mahmood et al. (2019) considered and validated the Environmental Kuznets Curve (EKC) in Egypt during 1990-2014. Moreover, foreign investments reduce CO_2 emissions, and energy usage increases emissions. However, trade could not affect the emissions in Egypt.

Plakolb et al. (2019) argued that traffic in an urban area is responsible for increasing CO_2 emissions and NOx emissions, which may contribute to global warming. Talking about environmental technologies and how they can reduce CO_2 emissions, Alatas (2021) mentioned that environmental technologies do not affect the transport industry. However, energy consumption can help determine the emissions of a country while the effect of urbanization is insignificant. The results are contradictory to a few studies that argue that environmental technologies help to control emissions (Alvarez-Herranz et al., 2017a; Li et al., 2021; Alvarez-Herranz et al., 2017b). Some literature also focuses an impact of Financial Development (FD) in determining emissions (Jalil and Feridun, 2011; Dasgupta et al., 2001; Chousa et al., 2009; Zhang, 2011; Sadorsky, 2010). Chousa et al. (2009) investigated the US and Japan and found that economin growth and FD helped reduce emissions. Dasgupta et al. (2001) argued that capital markets re-act for any environmental regulations and could perform well to support the environment if a proper financial incentive is provided. Sadorsky (2010) investigated some emerging economies from 1990-2006 and found that capital markets have strong ties with energy usage and, hence, affect emissions in economies. In China, Zhang (2011) described an effect of FD on emissions, and the capital market has a greater impact on emissions than that of the banking sector. Moreover, foreign investments reduced the emissions in China. Conversely, Jalil and Feridun (2011) reported a negative effect of FD. However, trade, income, and energy usage have contributed to emissions in China.

In the trade and emissions relationship, Jiang et al. (2019) argued that developing countries could reduce their emissions by involving sustainable trade deals. But, the effect of trade was found positive on carbon emissions in the empirical exercise. Moreover, Aller et al. (2015) displayed the same results in the case of developing countries. Alam and Murad (2020) argued that trade openness promoted technological development in countries, which fostered the use of renewable energy mix and could reduce pollution emissions. Mutascu (2018) investigated and found a positive link between Trade Openness (TO) and emissions. Moreover, bi-directional association between both has also been reported. Hence, increasing pollution also fosters more trading activities. Shahbaz et al. (2017) found that TO increased pollution emissions through scale effects.

Le and Ozturk (2020) tested the cross-dependence in a panel of 47 economies to test the EKC from 1990-2014 and confirmed a positive effect of globalization, and FD also accelerated the emissions in the target economies. Moreover, energy use also contributed to emissions significantly. Sarkodie and Ozturk (2020) tested the EKC for Kenya during 1971-2013 and validated this hypothesis. Moreover, urbanization accelerated pollution emissions in Kenya. Al-Mulali et al. (2016) provided confirmation of the EKC with higher use of renewables in the economies. Hence, renewable use helped reduce emissions. Al-Mulali et al. (2015) inquired Vietnam from 1981-2011. The authors reported that imports and fossil fuels accelerated the emissions. However, exports and renewables could not affect the emissions in Vietnam. Solarin et al. (2017) explored the EKC from 1965 to 2013 in China and India and validated the hypothesis. The authors also reported the positive impact of urbanization and hydropower reduced emissions in the economies.

Alsamara et al. (2018) explored the GCC region and corroborated the positive impacts of income and exports. However, FD was found helpful in reducing emissions. On the other hand, Al-Mulali and Lee (2013) corroborated the positive effect of FD and economic growth on emissions in GCC region. Rafindadi et al. (2018) also probed the GCC region and a negative impact of foreign investment on emissions was reported. In Saudi Arabia, Mahmood et al. (2020) investigated and observed positive effects of oil price and urban population on CO_2. Mahmood and Alanzi (2020) scrutinized and corroborated the positive role of the rule of law in Saudi Arabia to reduce CO_2 emissions. However, the effect of income growth could not be validated. In GCC, Al-Mulali and Ozturk (2014) investigated and corroborated electricity and growth relationship, which may also have environmental consequences because of the heavy reliance of electricity on fossil fuels in GCC economies.

Literature has highlighted the role of urbanization, industry, trade, and economic growth on pollution emissions. However, the GCC region is still under-investigated in this context, and this present research motivates this issue in deep panel data analyses.

3. METHODS

Increasing trade would have a scale effect on pollution emissions. On the other hand, it may also have technique and composition effects and create pleasant environmental effects. The net impact of trade in any economy or group is an empirical question. The same description may be provided for economic growth and to test the EKC. Moreover, urbanization and industrialization would also accelerate due to economic growth. Hence, we test the effect of all these variables on emissions in GCC economies in the following way:

$$LCO_{it} = f(LY_{it}, LY_{it}^2, LTO_{it}, LUP_{it}, LI_{it}) \quad (1)$$

LCO_{it} is CO_2 emissions per capita. LY_{it} and LY_{it}^2 are economic growth and its square and are regressed to test the EKC in 6 GCC economies. t is the period of 1980-2019. LTO_{it} is trade openness and is a share of trade in total income. LUP_{it} is urban population share of aggregate population. LI_{it} is industrialization and measured by industry's share in income. All series are transformed in a natural log. Data on emissions is from Global Carbon Atlas (2021), and rest is from World Bank (2021).

After hypothesizing the model, the integration level will be tested by Im-Pesaran-Shin (IPS) of Im et al. (2003) and Fisher-Augmented Dickey Fuller (ADF) and Fisher-Phillip and Perron (PP) tests of Maddala and Wu (1999). Then, Johansen (1988) cointegration will be tested using Maddala and Wu (1999) aggregation procedure:

$$y = -2\sum_{(i=1)}^{N} ln(p_i) \quad (2)$$

Afterward, the robustness of cointegration can be verified using the residual base procedure of Kao (1999) and seven statistics of Pedroni (2004). Then, we may proceed to Pesaran et al. (1999) for long and short-run analyses in the following way:

$$\Delta LCO_{it} = \alpha_{1i} + \sum_{j=1}^{p-1} \gamma_j \Delta LCO_{i,t-1} + \sum_{j=0}^{q-1} \beta_{1j} \Delta LY_{i,t-1} + \sum_{j=0}^{q-1} \beta_{2j} \Delta LY_{i,t-1}^2 + \sum_{j=0}^{q-1} \beta_{3j} \Delta LTO_{i,t-1} + \sum_{j=0}^{q-1} \beta_{4j} \Delta LUP_{i,t-1} + \sum_{j=0}^{q-1} \beta_{5j} \Delta LI_{i,t-1} + \mu_1 LCO_{i,t-1} + \mu_{21} LY_{i,t-1} + \mu_{22} LY_{i,t-1}^2 + \mu_{23} LTO_{i,t-1} + \mu_{24} LUP_{i,t-1} + \mu_{25} I_{i,t-1} + \epsilon_{1it} \quad (3)$$

$$\Delta LCO_{it} = \alpha_{2i} + \sum_{j=1}^{p-1} \gamma_j \Delta LCO_{i,t-1} + \sum_{j=0}^{q-1} \beta_{1j} \Delta LY_{i,t-1} + \sum_{j=0}^{q-1} \beta_{2j} \Delta LY_{i,t-1}^2 + \sum_{j=0}^{q-1} \beta_{3j} \Delta LTO_{i,t-1} + \sum_{j=0}^{q-1} \beta_{4j} \Delta LUP_{i,t-1} + \sum_{j=0}^{q-1} \beta_{5j} \Delta LI_{i,t-1} + \mu_3 ECT_{i,t-1} + \epsilon_{2it} \quad (4)$$

Above equations are Pooled Mean Group (PMG). A statistically negative may be verified the convergence. Long and short runs results can be produced from equations 3 and 4. Afterward, we use Pedroni's (2000) Fully Modified Ordinary Least Square (FMOLS) and Kao and Chiang's (2000) Dynamic Ordinary Least Square (DOLS), which may modify the estimated parameters in the following way:

$$\hat{\beta}_{FMOLS} = \left(\Sigma_{n=1}^{N}\left(\Sigma_{t=1}^{T}\left(y_{it} - \overline{y}_i\right)\hat{\chi}_{it}^{+} + T\hat{\Delta}_{\varepsilon\mu}^{+}\right)\right) / \left(\Sigma_{i=1}^{N}\Sigma_{t=1}^{T}\left(y_{it} - \overline{y}_i\right)'\right) \quad (5)$$

$$\hat{\beta}_{DOLS} = \left(\sum_{t=1}^{T} x_{it} x_{it}^{+}\right) . \sum_{i=t}^{N} 1 / \sum_{t=1}^{T} x_{it} x_{it}^{'} \quad (6)$$

The results from Equations 5 and 6 can be utilized to check the robustness of PMG results.

4. DATA ANALYSES

At first, we test the unit root and find that LCO_{it} and LY_{it} are non-stationary and ΔLCO_{it} and ΔLY_{it} are stationary. Moreover, most results support stationarity in the level and first differences of the rest of the variables. Hence, mixed order is confirmed in the analyses Table 1.

In Table 2, cointegration is confirmed with Fisher-Johansen test. Moreover, the Pedroni test also validates it with 2 statistics and 1 weighted statistics. Hence, we may claim cointegration in the model and proceed with further analyses.

Table 3 reflects long and short-run results from 3 techniques to test the robustness of findings. LY_{it} has, and LY_{it}^2 has negative parameters and corroborate the EKC in all estimations of GCC economies. The effect of LTO_{it} is negative in 3 estimates. It affirms that the trade openness of the whole GCC region is helping reduce CO_2 emissions. It may be because high-income GCC economies are importing cleaner technologies, which help clean the environment in the economies to support the concept of green economies. Moreover, the openness of economies helps to transfer cleaner technologies. It would help transform from oil to other relatively cleaner sectors in GCC economies, which reduce the CO_2 emissions and promote the green economies in the GCC region. Hence, trade openness has greater composition and technique effects, which are larger than scale effects of trade. Contrarily, literature corroborated positive impact of TO on pollution (Alam and Murad, 2020; Aller et al., 2015; Jiang et al., 2019; Mutascu, 2018; Shahbaz et al., 2017). The parameter of LUP_{it} is positive in

Table 1: Unit Root Tests

Series	IPS		Fisher-ADF		Fisher-PP	
	Constant	Constant and Trend	Constant	Constant and Trend	Constant	Constant and Trend
LCO_{it}	−0.6604	−0.8871	13.9498	15.7985	16.4233	19.2199
	(0.2057)	(0.1875)	(0.3039)	(0.2006)	(0.1726)	(0.0834)
LY_{it}	1.5538	−0.3881	4.3099	15.8655	3.5852	13.4388
	(0.9399)	(0.2985)	(0.9772)	(0.1912)	(0.9898)	(0.3380)
LTO_{it}	−2.1080	−2.1993	25.3165	23.2635	21.3963	14.9533
	(0.0175)	(0.0139)	(0.0134)	(0.0256)	(0.0449)	(0.2440)
LUP_{it}	−0.2492	−3.7995	11.9507	38.2207	72.1514	103.6020
	(0.4016)	(0.0001)	(0.4496)	(0.0001)	(0.0000)	(0.0000)
LI_{it}	−2.7001	−1.7062	28.7905	19.9373	22.7920	12.1716
	(0.0035)	(0.0440)	(0.0042)	(0.0683)	(0.0295)	(0.4320)
ΔLCO_{it}	−10.1545	−9.1399	110.3270	90.9006	168.7660	207.0790
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ΔLY_{it}	−6.9172	−5.6417	69.6576	52.2182	110.0770	93.4694
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ΔLTO_{it}	−9.9312	−8.8646	107.0890	86.8083	138.5440	345.4870
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ΔLUP_{it}	−2.5140	−0.1607	26.1117	12.4333	29.0031	10.7798
	(0.0060)	(0.4362)	(0.0103)	(0.4115)	(0.0039)	(0.5479)
ΔLI_{it}	−9.5594	−8.7243	102.8090	85.0609	121.4800	115.4350
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 2: Cointegration Analyses

	Stat.	P-value	Weighed Stat.	P-value
Pedroni (2004)				
v	−0.2825	0.6112	−0.4537	0.6750
rho	0.0631	0.5251	−0.1556	0.4382
PP	−1.3456	0.0892	−1.6398	0.0505
ADF	−0.7948	0.2134	−0.8203	0.2060
Grouped-rho	0.4547	0.6753		
Grouped-PP	−1.6423	0.0503		
Grouped-ADF	−0.8581	0.1954		
Kao (1999)				
Stat	−2.6770	0.0037		
Variance	0.0177			
		Maddala and Wu (1999)		
Cointegrating Vectors	Trace Statistics		Max-Eigen Statistics	
0	81.67	0.0000	37.58	0.0002
1	49.10	0.0000	24.57	0.0170
2	29.99	0.0028	11.64	0.4749
3	24.92	0.0152	12.53	0.4042
4	22.69	0.0305	18.92	0.0906
5	22.17	0.0356	22.17	0.0356

Table 3: Regression Results

Variable	Parameter	Standard Error	t-stat.	P-value
FMOLS				
LY_{it}	2.7140	0.9084	2.9876	0.0031
LY_{it}^2	−0.1332	0.0458	−2.9074	0.0040
LTO_{it}	−0.4773	0.1456	−3.2789	0.0012
LUP_{it}	1.5173	0.4094	3.7061	0.0003
LI_{it}	0.6360	0.2082	3.0544	0.0025
DOLS				
LY_{it}	5.2971	1.3195	4.0145	0.0001
LY_{it}^2	−0.2662	0.0670	−3.9736	0.0001
LTO_{it}	−0.4661	0.2249	−2.0726	0.0403
LUP_{it}	1.6782	0.7458	2.2502	0.0262
LI_{it}	0.6245	0.3517	1.7753	0.0784
PMG				
LY_{it}	3.2255	1.2459	2.5889	0.0105
LY_{it}^2	−0.1752	0.0636	−2.7563	0.0065
LTO_{it}	−0.6157	0.2382	−2.5848	0.0107
LUP_{it}	2.4961	0.4237	5.8910	0.0000
LI_{it}	1.2270	0.3129	3.9208	0.0001
ECT_{t-1}	−0.2797	0.0782	−3.5776	0.0005
ΔLCO_{it-1}	0.0244	0.0723	0.3370	0.7366
ΔLY_{it}	0.0985	2.1510	0.0458	0.9636
ΔLY_{it-1}	1.4686	1.7461	0.8411	0.4016
ΔLY_{it}^2	0.0147	0.1106	0.1334	0.8941
ΔLY_{it-1}^2	−0.0809	0.0908	−0.8909	0.3743
ΔLTO_{it}	−0.4102	0.3389	−1.2102	0.2280
ΔLTO_{it-1}	−0.6374	0.2148	−2.9675	0.0035
ΔLUP_{it}	−3.3750	2.5454	−1.3260	0.1868
ΔLUP_{it-1}	1.2396	1.5861	0.7816	0.4356
ΔLI_{it}	−0.2295	0.1466	−1.5651	0.1196
ΔLI_{it-1}	0.3597	0.2712	1.3262	0.1867
Intercept	−8.5059	2.3794	−3.5748	0.0005

all estimates. So, the increasing urban population is enhancing CO_2 emissions in the GCC region. Hence, urbanization is damaging the environment of the GCC region by releasing emissions. Many studies reported positive impact of urbanization on pollution (Plakolb et al., 2019; Sarkodie and Ozturk, 2020; Wang et al., 2019; Solarin et al., 2017). The coefficient of LI_{it} is also positive in all estimates. Therefore, increasing industrialization is augmenting CO_2 emissions in the GCC region. Hence, industrialization is not healthy for the environment of the GCC region and promotes CO_2 emissions.

ECT_{t-1} has negative parameter as per expectations and confirms the convergence in case of disequilibrium. Hence, equilibrium relationships are corroborated in PMG estimates. The lag of trade openness reduced emissions, and it also helps reduce CO_2 emissions. However, most of the effects are insignificant in the short run. Therefore, we conclude that trade and urbanization take a long time to affect the environment in the GCC region.

5. CONCLUSIONS

Trade, industrialization, and urbanization could have environmental consequences and affect circular economies. The effects of these variables on emissions in GCC region from 1980-2019 were investigated. We substantiated EKC hypothesis in whole region and income growth would help support green economies in the GCC region. Moreover, TO has a negative effect. So, trade openness is also helping in clean technology transfers in the GCC region. Moreover, it also promotes cleaner production processes in the region and is changing the composition of production in the region. Hence, trade openness fosters the concept of green and circular economies in the GCC region. Increasing urbanization augmenting CO_2 emissions. Thus, the urban population is destructive for the environment in the GCC region by releasing CO_2 emissions. Further, industrialization puts fuel on the fire and increases CO_2 emissions in the region. Hence, industrialization and urbanization have an environmental hazard in the GCC region and de-tracking the GCC region from green economies. Most short-run effects are found insignificant. Hence, urbanization and industrialization require a long time to have adverse environmental effects. Moreover, TO is also promoting the green economies in the GCC region.

Based on the results, we recommend further enhancing trade openness in GCC economies to enjoy its pleasant environmental effects in the region. Conversely, the urban population and industries should be penalized with carbon taxes to reduce their environmental effects, and the carbon revenue could invest in clean technologies to follow the track of circular and green economies in the GCC region.

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