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THE ROLE OF INSTITUTIONAL QUALITY IN REDUCING ENVIRONMENTAL DEGRADATION IN CANADA

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ABSTRACT. This paper uses the Fully Modified Ordinary Least Squares (FMOLS) technique to explore the influence of institutional quality, income, consumption of renewable energy, trade openness, and total factor productivity on consumption-based CO2 emissions in Canada from 1996 to 2021. Estimation findings showed that institutional quality, renewable energy use, and total factor productivity exert a statistically significant and negative influence on CO2 emissions. Moreover, our findings indicated that there is a statistically significant and positive impact of income on CO2 emissions, while trade openness exhibits an insignificant impact on CO2 emissions. The study discusses alternative policies, emphasizing the role of institutional quality in reducing CO2 emissions.

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Introduction

Recently, many countries have focused on developing their economies in terms of higher production, advanced infrastructure, and other similar aspects. However, while concentrating on these factors, rising environmental degradation remains a neglected matter to be dealt with. Consequently, the climate change issue has become more severe, leading to a pressing and alarming threat to humanity's well-being and continued existence.

Nowadays, some detrimental footprints of climate change are food shortages, the loss of various species, and the significant rise in extreme weather events, all of which have far-reaching implications for our future. According to Ahmed & Wang (2019), if the world's nations continue their activities at the current pace, it would take 1.73 Earths to sustain the human impact on the environment. Also, currently, a 1% reduction in the global GDP is needed to tackle the costs associated with climate change (Acheampong et al., 2021). Nevertheless, such a reduction in GDP may have adverse effects on the current state of the worldwide economy and could impede its future growth (Hadj, 2023; Mukhtarov et al., 2023a).

Rising global warming and degradation are directly linked with rapid economic growth and industrialization. This is because higher production comes at the cost of ejecting greenhouse gas emissions, especially CO2, into the atmosphere. Eventually, these emissions are translated into environmental pollution. Considering the alarming environmental damage due to greenhouse gas emissions, many international organizations, as well as policymakers, have gradually started to tackle or mitigate issues regarding environmental deterioration. In this sense, Sustainable Development Goal 13 (SDG 13) of the UNDP was set to take quick action to address the concerns associated with climate change and its repercussions. Considering the significant environmental deterioration, studying and addressing environmental issues from different perspectives becomes extremely crucial. In this regard, studies on global warming have gained popularity, and remarkable interest has emerged in them from researchers and policymakers.

Furthermore, developing countries that lack access to advanced technologies have become significant contributors to high carbon emissions and face worsening environmental conditions (Mishchuk et al., 2023; Sansyzbayeva et al., 2020; Sarkodie, 2018). Conversely, in advanced economies, sustainable environmental policies, technological advancements, and the quality of institutions can contribute to a reduction in environmental degradation. On the other hand, several studies showed that oil and gas-exporting countries are reluctant to utilize alternative and clean energy sources (Sadorsky, 2009; Troster et al., 2018). The same is typical for economies with high military spending (Tarczyński et al., 2023). This is because the cost of energy production from oil and gas is relatively more affordable for them. Eventually, this leads to a higher level of CO2 emissions, which raises environmental degradation. To deal with environmental degradation issues, strong institutional quality is highly important. This is because better institutional quality can ensure effective enforcement of environmental laws, influence policy implementation, and promote transparency and accountability (Gasimov et al. 2023). All of these will be remarkable support for long-term planning for sustainable development (Danish & Ulucak, 2020). Appropriate justifications are developed, particularly, based on a concept of Environmental Kuznets curve (Ojaghlou and Uğurlu, 2023). Moreover, better institutional quality could combat corruption, reduce military involvement in politics, and enhance international cooperation (Sarkodie & Adams, 2018). Overall, strong institutions could provide the key support for successful environmental management. Considering both confronting views, it could be interesting to study the impact of institutional quality on the reduction of CO2 ejections in the example of an oil-rich developed country, Canada, which is the tenth-largest economy in terms of GDP (UNCTAD, 2020) and third regarding its oil reserves (Worldometer, 2016). Regarding clean energy, the country is ranked in the top 12th place based on the Renewable Energy Country Attractiveness Index (RECAI) (Ernst & Young, 2023). The economic freedom score of the country is 73.7, which makes it the 16th freest economy in 2023 (Economic Freedom Index, 2023). Recently, the country placed a strong emphasis on environmental programs and sustainability initiatives. It has pledged to tackle climate change through diverse initiatives and measures, including the Pan-Canadian Framework on Clean Growth and Climate Change (Thompson, 2022). The government has established ambitious goals to decrease greenhouse gas emissions and enhance the utilization of renewable energy in the nation's energy portfolio (IRENA, 2021). Considering all of these, the main aim of this study is to evaluate the effect of institutional quality on environmental degradation in the case of Canada.

This study makes several notable contributions. Firstly, to our knowledge, this study is one of the few time-series studies examining the impact of institutional quality on CO2 emissions in Canada. Secondly, we adopt a model specification that considers consumption-based CO2 emissions for Canada. The advantage of using consumption-based CO2 lies in its incorporation of both final consumption and foreign trade. With adjustments to accommodate global commerce, this approach facilitates the identification of carbon emissions generated in one economy but consumed in another. Lastly, the study's outcomes provide a roadmap for other oil-rich developed economies.

The remainder of this paper is structured as follows: Section 2 shows the results of a concise review of the relevant literature. Section 3 comprehensively provides model construction and data description. The methodology is given in Section 4. The empirical results are discussed in Section 5. Lastly, Section 6 presents the conclusion and policy implications.

1. Literature review

Numerous studies have been undertaken to explore the factors that affect CO2 emissions. In this context, recent investigations focusing on the influence of institutional quality on environmental degradation across various countries have been examined.

Hussain & Dogan (2021) examined the influence of institutional quality on environmental degradation proxied by ecological footprints in the case of BRICS countries, utilizing the CS-ARDL method on the data period from 1992 to 2016. The estimation results revealed that institutional quality has a negative and significant effect on ecological footprints. Moreover, Warsame et al. (2022) utilized the ARDL technique to analyze institutional quality-environmental degradation nexus for the data period 1990-2017. They found that institutional quality reduces environmental degradation.

Furthermore, many studies used CO2 emissions as a proxy for environmental degradation in their analysis. Ahmed et al. (2019) evaluated the impact of institutional quality on CO2 emissions in the case of Pakistan, employing the ARDL method for the data period from 1996 to 2018. The estimation findings indicated that institutional quality has a negative and significant effect on CO2 emissions. In addition, Tamazian & Bhaskara Rao (2010) revealed that there is a negative impact of institutional quality on CO2 emissions in 24 transition economies using random effect. Khan et al. (2021) studied the impact of institutional quality on CO2 emissions in the case of 188 countries. They concluded the negative impact of control of corruption as a proxy of institutional quality on CO2 emissions by utilizing the GMM model. Besides, Ali et al. (2019) in the case of 47 developing countries, Danish & Ulucak (2020) in the case of 18 Asia-Pacific Economic Cooperation countries, Anwar & Malik (2022) in the case of G-7 countries, Abd Razak et al. (2021) in the case of Malaysia, Mehmood (2022) in the case of 11 countries, Xaisongkham & Liu (2022) in the case of developing countries, Bakhsh et al. (2021) in the case of Asian countries, Karim et al. (2022) in the case of 30 Sub-Saharan African, Li et al. (2022) in the case of Canada, Fatima et al. (2022) in the case of OECD countries, Khan et al. (2022) in the case of G-7 countries revealed a negative effect of institutional quality.

On the other hand, several studies found a positive effect of institutional quality on CO2 emissions in the cases of different countries. For example, Obobisa et al. (2022) analyzed the relationship between CO2 emissions and institutional quality for 25 African countries using the common correlated effects mean group (CCEMG) and the augmented mean group (AMG) estimators and found a positive effect of institutional quality on CO2 emissions. Also, Yang et al. (2022) for 42 developing countries, Godil et al. (2020) for Pakistan, Hassan et al. (2020) for Pakistan, Cao et al. (2022) for thirty-six OECD countries, and Teng et al. (2021) for 10 economies found a positive effect of institutional quality on CO2 emissions.

Additionally, Abid (2016) analyzed the effect of institutional quality on CO2 emissions using the GMM dynamic panel method in 25 SSA countries. The findings approve that democracy, government effectiveness, political stability, and control of corruption negatively affect CO2 emissions, while rule of law, and regulatory quality have a positive impact on CO2 emissions. Haldar & Sethi (2021) investigated the effects of institutional quality on CO2 emission in the case of 39 developing countries using data spanning from 1995 to 2017. The impact of institutional quality is revealed to be insignificant utilizing the common correlated effects mean group (CCEMG) and the augmented mean group (AMG) estimators. In addition, Bletsas et al. (2022) revealed that the impact of institutional quality is not statistically significant for developed countries (including Canada).

The examination of the aforementioned studies yields two valuable findings for the purpose of this investigation. Firstly, many studies indicate a negative impact of institutional quality on CO2 emissions across different countries. Secondly, it is noteworthy that none of these studies have taken into account the influence of institutional quality, along with factors such as income, renewable energy consumption, total factor productivity, and international trade on the consumption-based CO2 emissions in Canada, employing time-series analysis.

2. Model specification and data

2.1. Model specification

Numerous studies address CO2 emissions, often using frameworks like the Environmental Kuznets Curve (EKC) or STIRPAT. These frameworks primarily focus on income and population, but their limitations are acknowledged by scholars like Brock & Taylor (2010), and Berk et al. (2022). Scholars, including Criado et al. (2011), Berk et al. (2022), and Brock & Taylor (2010), advocate for more comprehensive and theoretically grounded frameworks. Recent studies such as Knight & Schor (2014), Liddle (2018a), Liddle (2018b), Mikayilov et al. (2020), and Mukhtarov et al. (2023b) explore international trade measures, such as exports and imports, to enhance the analysis of CO2 emissions. Hasanov et al. (2021), Hasanov et al. (2023), and Mukhtarov (2023) used a novel functional specification introducing income, exports, and imports in addition to total factor productivity (TFP) and renewable energy consumption (RE) as influencers of consumption-based CO2 emissions. In addition, Obobisa et al. (2022) used a model specification in which CO2 emission is a function of institutional quality, economic growth, fossil fuel energy, renewable energy, and green technological innovation. Anwar & Malik (2022) analyzed the impact of institutional quality, population, economic growth, technological innovation, and renewable energy consumption on CO2 emissions. Furthermore, the impact of institutional quality on CO2 emissions in the case of different countries was considered by several studies, such as Tamazian & Bhaskara Rao (2010), Ahmed et al. (2020), Udemba (2021), Abd Razak (2021), Khan et al. (2022), Khan & Rana (2021), Yang et al. (2022), inter alia.

Considering the aforementioned studies, the functional specifications outlined in this article can be presented as follows:

$$lnCO_{2,t_t} = \beta_0 + \beta_1 lnIQ_t + \beta_2 lnY_t + \beta_3 lnRE_t + \beta_4 lnTFP_t + \beta_5 lnTO_t + \varepsilon_t \qquad (1)$$

where, CO2t is consumption-based carbon dioxide emissions, IQt is institutional quality proxied by corruption perception index, Yt is real GDP per capita as measure of income, REt is renewable energy consumption, TFPt is total factor productivity, TOt is trade openness and εt is an error term.

2.2. Data

This research employs annual time series data spanning from 1996 to 2021 for Canada to conduct empirical estimations. The choice of the data period is based on data availability, and all variables are utilized in their logarithmic forms.

Consumption-based Carbon Dioxide Emissions (CO2) are presented in per capita terms, measured in million tons of carbon per year. Institutional quality (IQ) is represented by the Corruption Perception Index (CPI). The CPI is a metric that allocates scores to nations according to the perceived extent of governmental corruption in each country. The scores range from zero to 100, with zero indicating higher levels of corruption and 100 indicating lower levels of corruption. Income (Y) is expressed by GDP per capita in US dollars at 2015 prices. Renewable energy consumption (RE) refers to the utilization of energy derived from renewable sources, expressed as the proportion of total final energy consumption. Total Factor Productivity (TFP) represents the total factor productivity index. Trade Openness (TO) represents the total trade as a percentage of GDP, calculated by combining exports and imports, with both variables expressed as percentages of the GDP. The data of IQ was sourced from Transparency International (2023), while CO2 emissions were collected from the Global Carbon Atlas (2023). The RE data was retrieved from Our World in Data (Our World in Data, 2023). In addition, the data of Y and TO were obtained from the World Development Indicators (2023), whereas TFP was taken from the Penn World Table 10.0 database.

3. Econometric methodology

Before assessing the long-term connection, it is essential to examine whether the variables exhibit non-stationarity. The Phillips–Perron (PP) test by Phillips & Perron (1988) is employed for this purpose. Following the declaration of variable integration in the same order, the subsequent step involves testing the variables for a long-term co-integration relationship. The Park's Variable Addition test (Park, 1992) is applied to evaluate the presence of a cointegration relationship. The Fully Modified Ordinary Least Squares (FMOLS) method, as proposed by Phillips & Hansen (1990), is then used to estimate the long-term impact of independent variables on CO2 emissions.

The mentioned estimation methods are widely used in time-series applications, and thus, an explanation of these techniques is not provided in this context. Phillips & Perron (1988), Phillips & Hansen (1990), and Park (1992) furnish detailed information for them.

4. Empirical results and discussions

As detailed in the methodology section, our first step was to scrutinize the variables for non-stationarity characteristics. The results of the PP unit root test are displayed in Table 1.

Table 1. The Findings of Unit root test

Variable	Panel A: Level	Panel B: 1st difference	Findings
	Actual value	Actual value	
CO2	-2.2322	-5.8950***	I(1)
IQ	0.1637	-3.1951**	I(1)
Y	-2.5628	-3.4092**	I(1)
RE	-2.5557	-8.2508***	I(1)
TFP	-1.6747	-3.7934***	I(1)
TO	-1.2567	-4.1427***	I(1)

Notes: ** and *** accordingly signify to rejection of null hypothesis at 5% and 1% significance levels.

As shown in Table 1, each variable demonstrates first-order integration, implying they are non-stationary at their level and stationary at their first difference. Consequently, we can progress to the next phase, which entails evaluating the long-term co-movement of the used variables. The results of the cointegration tests are presented in Table 2.

Table 2. The findings of Park's Variable Addition cointegration test

	Value	df	Probability
Chi-Square	2.4008	1	0.121

Notes: Presence of cointegration is the null hypothesis for test.

According to Park's Variable Addition test, the null hypothesis of "existence of cointegration" is not rejected. Therefore, the findings of the used test confirm the presence of a long-run cointegration relationship between variables.

In the subsequent stage, we assessed the long-term influence of institutional quality, income, TFP, renewable energy consumption, and trade openness on consumption-based CO2 emissions. To achieve this, we employed the FMOLS method, and the results are presented in Table 3.

Table 3. Long-run estimation results

Variables	coefficients	*Std. Error*	t-Statistics	p-values
IQ	-0.146	0.057	-2.553	0.022
Y	1.958	0.091	21.365	0.000
RE	-0.867	0.112	-7.689	0.000
TFP	-0.566	0.164	-3.434	0.003
TO	0.025	0.031	0.836	0.415
Intercept	-10.91	1.161	-9.398	0.000
Trend	-0.023	0.001	-16.488	0.000

Note: CO2 is dependent variable. The dummy variables of I1999 (pulse dummies getting unity in 1999 and zero otherwise), and SI2009 (shift dummies getting unity until 2009 and zero otherwise) were held in the estimations as deterministic regressors.

The results of the analysis indicated that the corruption perception index exhibits a negative and statistically significant impact on CO2 emissions. Specifically, a 1% increase in the corruption perception index causes a 0.146% decrease in CO2 emissions. With higher institutional quality, measured by the corruption perception index (lower levels of corruption), regulatory bodies and institutions can implement and enforce environmental policies more efficiently. This indicates that regulations intended to reduce CO2 emissions have a higher chance of being applied consistently and transparently. Transparent decision-making in the context of environmental policy guarantees that laws are created and carried out with environmental concerns in mind rather than being susceptible to the effects of corrupt activities. The use of transparency may enhance the efficacy of identifying and mitigating possible sources of emissions. In addition, decreased corruption boosts investor trust, which draws more capital to clean and environmentally friendly technology. When investors have confidence in the security of their funds and the uniform enforcement of rules, they are more inclined to back projects that adhere to environmentally beneficial methods. The average value of control of corruption for Canada between 1996 and 2021 was 1.91 points. The latest value was 1.65 points in 2021. In terms of comparison, the average worldwide score for the year 2021, including 192 nations, is -0.04 points (The GlobalEconomy, 2023a). Canada exhibits a notable position above the global mean, as it attains the 16th rank out of a total of 192 countries in 2021 (The GlobalEconomy, 2023b). The evidence presented indicates that Canada has made notable advancements in combating corruption and has attained substantial levels of political and economic stability during the studied period. Consequently, this leads to the implementation of environmentally friendly policies. The findings of the research align with results of previous studies devoting developed countries, such as Anwar & Malik (2022) in the case of G-7 countries, Li et al. (2022) in the case of Canada, Fatima et al. (2022) in the case of OECD countries, Khan et al. (2022) in the case of G-7 countries, which found a negative influence of institutional quality.

Furthermore, we observed a positive impact of income, as measured by real GDP per capita on CO2 emissions in Canada. In theory, an increase in income, as suggested by the

Environmental Kuznets Curve and STIRPAT, can lead to greater pollution. In practice, for Canada as an oil-rich country, it is expected that pollution will rise with increasing income. This is primarily because historically, the mining, oil and gas, manufacturing, and resource extraction sectors have been the main drivers of Canada's economy. These sectors often generate a large amount of CO2 emissions. These industries may develop as the economy does, which would raise emissions. Additionally, increased industrial activity is typically associated with economic development, which can lead to higher energy consumption and emissions. Canada has a sizable industrial sector, and economic expansion may increase production and emissions. Our research results align with the conclusions of earlier studies focused on different nations, such as Khoshnevis Yazdi & Shakouri (2017), Shuai et al. (2017), Pata (2018), Danish (2019), Mukhtarov et al. (2021), Mukhtarov (2023). These studies have demonstrated a positive influence of GDP on CO2 emissions.

It was observed that RE negatively affects CO2 emissions in the long run. Numerically, a 1% increase in RE results in a 0.867% decline in CO2 emissions. Theoretically, the negative effect of renewable energy on CO2 emissions is quite plausible. Thus, a rise in the utilization of renewable energy, generated from non-fossil fuel sources, would lead to a decline in CO2 emissions. Our results are consistent with the results of several studies in the case of different countries, such as Waheed et al. (2018), Khoshnevis Yazdi & Shakouri (2017), Hasanov et al. (2021), Raihan & Tuspekova (2022), and Mukhtarov (2023), which revealed a negative effect of renewable energy consumption on CO2 emissions.

Moreover, at the 1% level, the effect of TFP on CO2 emissions is negative and statistically significant. Based on the findings, a 1% rise in TFP leads to a 0.566% decrease in CO2 emissions. From an economic standpoint, the negative effects of TFP on carbon dioxide emissions can be clarified through its two primary elements: advancements in technology and improvements in efficiency. Higher TFP is frequently connected with progress in technology. Technological progress can result in the creation and acceptance of cleaner and more energy-efficient technologies. For instance, industries can reduce their carbon emissions by investing in ecologically friendly technology and procedures. The efficiency with which inputs are transformed into outputs is measured by TFP. A rise in productivity often indicates that companies are using resources—including energy—more effectively. Enhancing efficiency may result in a decrease in waste generation and energy consumption, leading to a reduction in carbon dioxide (CO2) emissions per unit of production. Additionally, our findings are in line with some studies like Mukhtarov (2023), Huang et al. (2020), Mensah et al. (2018), Alvarez-Herranz et al. (2017), Li et al., (2017) concluded that technological progress (or TFP) reduces CO2 emissions.

According to the findings, the impact of trade openness on CO2 emissions is positive and statistically insignificant. Our results are consistent with the research findings of several studies, such as Ohlan (2015), Mahmood et al. (2019), and Haldar & Sethi (2021). These studies all observed a positive and insignificant impact of trade openness on CO2 emissions. In addition, Shahbaz et al. (2017) found an insignificant influence of trade openness on CO2 emissions in the case of Canada.

5. Conclusion and policy implications

To address the adverse effects of human activities on the climate, nations globally are actively seeking methods to reduce their impact. To achieve this goal, it is essential to conduct research that explores the factors influencing CO2 emissions. Considering the importance of environmental sustainability, the primary objective of this study is to assess the impact of institutional quality, income, renewable energy consumption, total factor productivity, and trade openness on consumption-based CO2 emissions in Canada. After confirming the stationarity of the variables are stationary at their first difference, their potential long-run cointegration relationship was examined. The Cointegration test, namely Park's Variable Addition test, was employed to investigate the association among the variables. The results support the existence of a cointegrating relationship among them. Employing the FMOLS method to assess the long-term impact of independent variables on CO2 emissions, it was found that institutional quality, renewable energy consumption, and TFP have a negative and statistically significant influence on CO2 emissions. On the other hand, income positively affects CO2 emissions. However, trade openness was determined to have an insignificant positive impact on CO2 emissions.

The following section outlines the policy implications derived from the findings of this research:

The policy implications arising from the findings of this study are presented below: (1) In order to uphold environmental policies effectively, it is imperative to establish governance structures that are transparent and accountable. (2) It is imperative to institute systems that facilitate public engagement and input in order to ensure that institutions fulfill their environmental obligations. (3) Robust monitoring and reporting mechanisms should be implemented to oversee the advancement of emission reduction efforts. It should be consistently evaluated the efficacy of policies and adapt them accordingly in light of the gathered data. (4) Bureaucratic procedures should be efficiently optimized to facilitate the acquisition of licenses for renewable energy initiatives. (5) To mitigate the total energy usage, it is essential to enact energy efficiency regulations for buildings, appliances, and cars. (6) Enterprises, non-governmental organizations, and government agencies should be encouraged to collaborate to share knowledge and best practices regarding emissions reduction.

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