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The Impact of Multiple Dimensions of Globalization on CO_2 Emissions in Egypt (1970-2020)

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أثر الأبعاد المتعددة للعولمة على انبعاثات ثاني أكسيد الكربون في مصر (1970-2020)

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Abstract

Carbon emissions associated with increased globalization have emerged as a focal point of concern, particularly in countries highly vulnerable to climate change, such as Egypt. This paper investigates the impact of globalization on territorial CO_2 emissions in Egypt during the period (1970–2020). Since globalization is a multidimensional process, the paper considers four dimensions of globalization: trade, financial, informational, and political globalization. The globalization indices covered in this study are based on the KOF Globalization sub-indices. Using an Autoregressive Distributed Lag (ARDL) model, the results of this paper show that only financial globalization leads to mitigation of carbon emissions in Egypt in the long run. In contrast, both informational and political globalization are not environmentally friendly and contribute to higher CO_2 emissions. In addition, trade globalization raises emission levels in the short run. Besides, both economic growth and primary energy consumption raise CO_2 emissions in Egypt, whereas gross capital formation reduces emission levels. The paper's findings suggest that policies to enhance financial globalization should be encouraged. However, activities associated with informational and political globalization should be reshaped to consider environmental aspects and to help mitigate carbon emissions.

Keywords: CO_2 emissions, financial globalization, informational globalization, political globalization, Egypt

Introduction

One of the most pressing environmental challenges facing the world nowadays is climate change, with its consequences already being felt around the world such as extreme weather events, floods, and rising sea levels. According to the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC), CO_2 emissions, the main driver of climate change, have continued to increase since the pre-industrial era. The global average temperature is on track to exceed 1.5 degrees Celsius of warming above pre-industrial levels by the middle of the 21st century. As mentioned in the report, human activities such as burning fossil fuels, deforestation, and industrial production, are the main causes for rising the temperature by 1.1 since 1900 (Masson-Delmotte et al., 2021).

Egypt is highly vulnerable to the impact of climate change, which is considered a significant environmental threat to the country's development progress (Jungudo, 2023). The country's location in the arid and semi-arid regions of North Africa makes it particularly vulnerable to water scarcity, droughts, and desertification. According to Climate Risk Profile: Egypt (2020), projections indicate that Egypt will suffer from sea-level rise, which could potentially submerge sizable areas of the Nile Delta, causing significant damage to the country's agricultural sector and infrastructure. Moreover, water scarcity is expected to worsen due to the decrease in water availability. Although its share in global emissions is relatively low, around 0.6% (World Bank, 2022), Egypt's territorial carbon emissions increased remarkably, by 989%, during the period 1970-2020 (Global Carbon Atlas). Heavy reliance on fossil fuels is one of the main factors contributing to CO_2 emissions. In Egypt, oil and natural gas are currently dominating primary energy consumption with a share of 93% in 2020 (EIA, 2022). Therefore, for Egypt to follow a development path with low carbon emissions, it is crucial to investigate the other factors that could affect its CO_2 emissions.

One of the factors that is always linked to carbon emissions and has been a subject of intense debate is globalization. Since 1970, the trend of globalization has been increasing, and countries are becoming highly interdependent and integrated in many aspects such as trade, investment, and information. Most of the studies exploring the relationship between globalization and environmental degradation focus on the impact of trade openness and investment liberalization as the main forms of globalization (Al-mulali, 2012; Alkhateeb & Mahmood, 2019; Antweiler et al., 2001; Apergis et al., 2023; Cole, 2004; Copeland, 2008; Demena & Afesorgbor, 2020; Ederington et al., 2004; Eskeland & Harrison, 2003). However, characterized by being a multifaceted concept, globalization goes beyond just trade openness and FDI (Gygli et al., 2019). It is a process that includes various dimensions, such as trade in goods and services, technology spillovers and the movement of people across borders. Apart from these economic aspects, globalization also involves social and cultural interactions between the people of different countries. It facilitates the sharing of ideas, information, and knowledge. Additionally, globalization also involves political cooperation of governments to address issues of common concern, such as climate change, terrorism, and global health crises. Therefore, using a globalization index that comprises multiple indicators, such as the

Maastricht Globalization Index and the KOF Globalization Index, is a better measure of globalization (Dreher et al., 2008; Martens & Raza, 2009).[1]

The KOF globalization index comprises three dimensions, namely: economic, social and political globalization index (Dreher, 2006; Dreher et al., 2008). The economic globalization index includes two sub-indices: the trade index and the financial index. The social globalization index includes three sub-indices: interpersonal index, informational index, and cultural index. Egypt's overall globalization score has risen from 35.04 in 1970 to 66 in 2020, indicating a growing connection with the global economy. In recent decades, Egypt has benefited from its involvement in the global economy by gaining access to new technologies, creating jobs, and increasing trade and investment. However, different dimensions of globalization might have positive or negative consequences on the environment, in particular CO_2 emissions.

This paper aims to examine the impact of multiple dimensions of globalization on CO_2 emissions in Egypt. The present paper is closely related to the literature examining the impact of globalization on CO_2 emissions using the KOF globalization index (Bu et al., 2016; Gaies et al., 2022; Hipólito Leal & Cardoso Marques, 2019; Rudolph & Figge, 2017; Shahbaz et al., 2015). The results of this literature reveal that the impact of globalization on CO_2 emissions is inconclusive and might vary according to the dimension of globalization and the country in question. Therefore, this paper asks whether globalization has a positive or negative impact on carbon emissions in Egypt and whether the effect differs across dimensions of globalization. To gain a better understanding of the effects of globalization on carbon emissions in Egypt, this paper considers four dimensions, namely: trade, financial, informational, and political globalization.

The contribution of this paper is twofold. First, to the best of the author's knowledge, this is the first attempt to investigate the impact of different dimensions of globalization on carbon emissions in Egypt during the period (1970–2020).[2] Second, due to the increasing role played by information and communication technologies in the economies, more research is needed to explore the impact of informational globalization on emissions, particularly, in developing countries such as Egypt. Therefore, this paper does not use the overall social globalization index but considers the informational globalization sub-index, separately. This gives more insights into whether increased informational globalization enhances environmental sustainability or exacerbates carbon-intensive activities. Through empirical evidence, the results of this study are important to shape and develop policies that promote the benefits of globalization while mitigating its negative impacts, and hence aligning globalization to mitigate climate change.

This paper estimates the long-run and short-run impact of four dimensions of globalization on carbon emissions in Egypt during the period (1970–2020) using the (ARDL) model. The results of the paper show that only financial globalization helps in mitigating carbon emissions,

[1] Maastricht globalization index comprises five domains (i.e., dimensions): political, economic, social & cultural, technological, and ecological domain. The technological domain is reflected in the social globalization dimension in the KOF index; however, the ecological domain is not reflected in the KOF index.

[2] There is one study on the impact of globalization on ecological footprint in Egypt by Ibrahiem and Hanafy (2020). However, their paper uses only the overall globalization index.

whereas all other forms of globalization contribute to raising the country's CO_2 emissions. Trade globalization has a positive impact on carbon emissions only in the short run, but has an insignificant impact on emissions in the long run. However, both informational and political globalization lead to an increase in CO_2 emissions in Egypt in the long run. This suggests that Egypt should encourage financial globalization and direct its political cooperation to agreements that establish environmental regulations. In addition, new policies should be adopted to benefit from informational globalization without undermining the environmental quality.

Following the Introduction in Section 1, the rest of the paper is organized as follows. Section 2 presents the literature review. Section 3 includes data and methodology. Results and discussion are reported in Section 4. Finally, Section 5 concludes and provides policy implications.

Literature Review

This section first embarks on the theoretical framework which explains the impacts of various dimensions of globalization on environmental quality and CO_2 emissions. Then, the empirical literature examining the impact of globalization on emissions is presented.

Theoretical Framework

The debate on the environmental impact of globalization traces back to trade and investment liberalization as forms of economic globalization. In their seminal paper, Grossman and Krueger (1991) showed that the effect of trade liberalization on the environment can be decomposed into three effects. First, the scale effect, where opening to trade leads to an increase in production and consumption, ultimately resulting in higher energy demand and increased pollution levels. Second, the composition effect, where countries specialize in sectors with comparative advantage, and, hence, this effect depends on whether there is an increase in the production of pollution-intensive industries or clean industries. Third, the technique effect, where trade with foreign countries would help developing countries bring in more clean technologies. By assessing the relative magnitudes of these three effects in Mexico in the context of joining NAFTA, Grossman and Krueger (1991) found that the scale effect is likely dominant, but the composition and technique effects could also be important.

A key aspect of the relationship between trade and the environment is economic growth, where it has been argued that trade openness leads to higher national incomes, which in turn affect the environment (Copeland & Taylor, 2004). The relationship between per capita income and environmental quality is described by the Environmental Kuznets Curve (EKC) which postulates an inverse-U relationship between the two variables (Grossman & Krueger, 1995). According to the EKC, low-income countries suffer from environmental degradation as their per capita income increases. However, after reaching a certain turning point in income level, countries experience less pollution with an increase in their per capita income. Thus, achieving higher income levels, due to trade openness, would contribute positively to the environment, given that countries are operating beyond the turning point of the EKC.

Similarly, foreign direct investment (FDI) and capital mobility, as forms of financial globalization, could also have a positive or negative effect on the environment. On the one

hand, two effects suggest a negative impact of FDI on carbon emissions. First, FDI contributes to rising emissions, in particular in developing countries, where countries compete by setting lax environmental regulations to attract foreign investment, which is known in the literature as a "race to the bottom" (Copeland, 2008). Second, one of the most important phenomena that has been tested in the FDI-environment literature is called the Pollution Heaven Hypothesis (Copeland, 2008; Taylor, 2005). This hypothesis predicts that facing relatively stringent environmental regulations, emission-intensive industries might relocate from developed to developing countries.[3] On the other hand, investments could affect the environment positively and reduce carbon emissions, if it is accompanied by the transfer of new efficient technologies and the use of clean sources of energy. For instance, Eskeland and Harrison (2003) found weak evidence that foreign investment are concentrated in polluting industries and that foreign investors are less polluting than domestic firms in these countries.

However, globalization is not limited to trade and investment openness. Generally, globalization refers to the interdependence of governments and countries across the globe through the flow of people, capital, goods, ideas and information (Dreher et al., 2008). Therefore, in addition to the economic dimension of globalization, other aspects such as interpersonal, cultural, informational, and political globalization (Dreher, 2006; Dreher et al., 2008) could also affect the environmental quality.

The impact of informational globalization, as a relatively recent aspect of globalization, on the environment has been the subject of intense debate among scholars. As information flows across borders, leading to rapid technological advancements and the exchange of knowledge, it influences energy use and the patterns of production and consumption. Information and communication technology (ICT) can affect CO_2 emissions through three effects (Charfeddine & Kahia, 2021; Danish, 2019; Dehghan Shabani & Shahnazi, 2019). First, the use effect, where the production and processing of ICT equipment and high-tech products alongside the wastes released from the installation of these equipment cause an increase in CO_2 emissions, due to the intensive energy requirements of these processes. Second, is the substitution effect, where physical products can be replaced with e-products. In addition, the need for physical presence and mobility can be replaced by electronic activities such as e-banking, e-commerce, and e-learning. In such cases, informational globalization could lead to an improvement in energy efficiency and the design of smart applications, which could help mitigate carbon emissions. Third, is the cost effect, where ICT leads to an increase in demand for goods and services, which in turn raises energy consumption and CO_2 emissions.

Political globalization is considered one of the dimensions that might also affect the environment positively or negatively. Joining international agreements and bilateral treaties as well as participation in international organizations could facilitate the development of a global environmental regime (Sørensen et al., 2021). However, it has been postulated that the political dimension of globalization can mitigate climate change, if countries join international treaties that promote environmental standards and monitor their implementation. For instance, the incorporation of environmental provisions in preferential trade agreements has witnessed a

[3] See Brunnermeier and Levinson (2004) for a survey of empirical literature on the effect of environmental regulations on the relocation of firms.

significant increase in recent years. Certain provisions have been established to facilitate the reduction of trade barriers for environmental goods, which is a step towards promoting sustainable trade practices. Conversely, other provisions aim to justify the imposition of trade barriers for hazardous waste, which is necessary to protect the environment (Brandi et al., 2020). Similarly, many countries in recent years, particularly developed countries and emerging economies, have placed increasing emphasis on the importance of promoting sustainable development during the negotiation of investment agreements (UN.ESCAP, 2018). Although developed countries have been the primary proponents of the inclusion of environmental provisions in trade agreements, developing countries have generally been engaged in separate side agreements to address environmental issues (Baghdadi et al., 2013).

Empirical Studies

Over the past two decades, a large body of empirical literature has examined the connection between globalization and the environment. The impact of economic globalization on the environment has received great attention since Grossman and Krueger (1991). Most of the early literature focused on trade and foreign investments, as they are widely recognized as the key drivers of economic globalization. These studies consider only trade openness, measured by the sum of exports and imports as a ratio of GDP, as an indicator of trade globalization, and foreign direct investment (FDI) as a measure of financial globalization (Al-mulali, 2012; Alkhateeb & Mahmood, 2019; Antweiler et al., 2001; Apergis et al., 2023; Demena & Afesorgbor, 2020; Ibrahiem, 2016).

On the one hand, some studies concluded that trade and financial globalization improve environmental quality. For instance, Antweiler et al. (2001) found that the net effect of trade on the environment is positive, and the benefits outweigh the costs. Similarly, Frankel and Rose (2005) found that trade reduces air pollution, in particular SO_2. Also, in their meta-analysis using 65 studies, Demena and Afesorgbor (2020) concluded that FDI has a significant negative effect on emissions and helps in reducing environmental degradation.

On the other hand, Managi et al. (2009) showed that the effect of trade on the environment differs from one country to the other. In their study, they found that although trade has a positive effect on the environment in OECD countries, it affects the environment of non-OECD countries negatively. Similarly, Le et al. (2016) examined the impact of trade openness on the environment in 98 countries during the period 1990–2013 and found the effect to be positive in high-income countries, while negative in both middle and low-income countries. Nemati et al. (2019) also found that joining free trade agreements either between developed countries (e.g., Australia-US FTA) or between developing countries (e.g., Mercosur) improve environmental quality by reducing emissions. However, trade agreements between developed and developing countries, such as NAFTA, raise emissions in developing countries. By assessing the effect of FDI inflows on carbon emissions in BRICS, Apergis et al. (2023) found that although flows from Denmark and the UK raised emissions, investment flows from France, Germany and Italy reduced emissions.

In the Middle East North Africa (MENA) region, Al-mulali (2012) showed that both FDI inflows and trade cause an increase in emissions in the MENA region over both the short and long term. Similarly in a comparative study applied on Tunisia and Morocco, Hakimi and

Hamdi (2016) found that both trade liberalization and FDI inflows affect the environmental quality negatively by raising CO_2 emissions. In contrast, Ibrahiem (2016) found that trade openness reduces CO_2 emissions in Egypt. Also for the GCC countries, Al-mulali and Foon Tang (2013) found that FDI has a negative impact on carbon emissions in the long run. They showed that the main sources of carbon emissions in GCC countries are economic growth and energy consumption, not FDI.

Some other studies consider broader measures of economic globalization by using the KOF globalization index, which includes multiple indicators for both trade and financial globalization. On the one hand, the positive impact of economic globalization on environmental degradation (measured either by CO_2 emissions or ecological footprint) was confirmed by Rudolph and Figge (2017), for a sample of 146 countries, and by Bu et al. (2016) for a sample of 166 countries. On the other hand, Aluko et al. (2021) showed that the economic globalization index reduces ecological footprint in a sample of 27 industrialized countries. Both Ulucak et al. (2020) and Kihombo et al. (2022) focused on financial globalization and found that it reduces ecological footprint. Focusing only on the de facto measures of globalization, Acheampong (2022) found that, using the symmetric ARDL model, economic globalization raises CO_2 emissions in Ghana. However, the asymmetric ARDL model results show the effect of economic globalization is neutral on emissions. Similarly, Gaies et al. (2022) found an asymmetric effect of globalization on CO_2 emissions in MENA countries, where an increase in economic globalization drives carbon emissions up, while a decrease in globalization has no effect. By decomposing economic globalization into trade and financial globalization, they found that trade globalization raises CO_2 emissions in their whole sample of MENA countries, while financial globalization reduces CO_2 emissions only in oil-exporting countries.

Restricting globalization to the economic dimension undermines the other aspects of globalization that could also have a direct or indirect effect on the environmental quality of countries. Therefore, some studies consider both social and political globalization alongside economic globalization. By using the KOF social globalization index, which includes indicators for interpersonal, informational, and cultural globalization, Bu et al. (2016) found that social globalization raises carbon emissions in a sample of 166 countries. In contrast, Rudolph and Figge (2017) found that social globalization affects the environment positively by reducing ecological footprint in a sample of 146 countries. Acheampong (2022) used de facto measures of globalization and found that social globalization in Ghana leads to higher (lower) CO_2 emissions under the symmetric (asymmetric) ARDL model.

Few recent studies have started to consider the impact of the informational globalization index, a sub-index of social globalization on the environment. Haq et al. (2022) showed that informational globalization in Pakistan reduces CO_2 emissions in the long run, while it has insignificant effects in the short run. In a different context, Ramzan et al. (2023) found that informational globalization is significant in predicting environmental sustainability in the ten greenest economies. Apart from the KOF informational globalization index, some studies used separate indicators of ICT, such as the number of mobile subscriptions and internet usage. For instance, both Charfeddine and Kahia (2021), applying on the MENA region, and Danish et al.

(2018), applying to the N-11 countries, found that ICT raises emissions and leads to environmental deterioration.

Exploring the influence of political globalization on environmental quality is still emerging. Applying on a sample of 166 countries, Bu et al. (2016) found that political globalization leads to higher emission levels. In contrast, it was shown by Chen et al. (2020) that for advanced economies, such as OECD countries, political globalization mitigates carbon emissions. However, Aluko et al. (2021) showed that political globalization has no significant impact on the environment in a sample of 27 industrialized countries. By classifying 25 countries in the European Union as high- and low-globalized countries, Hipólito Leal and Marques (2019) found that de jure political globalization, which is a proxy of political cooperation, reduces CO_2 emissions in highly globalized countries, while raising emissions in low-globalized countries. This suggests that highly globalized countries in the European Union benefit more from joining international agreements. In developing countries, there is little evidence about the impact of political globalization on emissions. Applying on Ghana, for example, Acheampong (2022) found that de facto political globalization causes an increase in CO_2 emissions.

For Egypt, which is the country of focus in this paper, it is noted that there exists a limited amount of research that has explored the effect of globalization on carbon emissions in Egypt. For instance, Egypt was included in a sample of 11 developing countries by Sultana et al. (2023), who found that globalization contributes to environmental degradation by raising carbon emissions.[4] In contrast, Awan et al. (2020) showed that globalization reduces carbon emissions in the MENA countries, including Egypt. Similarly, Ibrahiem and Hanafy (2020) examined the long-run relationship between globalization and carbon footprint in Egypt using fully modified ordinary least square and dynamic ordinary least squares methods for the period 1971–2014 and found that globalization reduces environmental degradation. However, these studies used the overall KOF globalization index, whereas the present study investigates the effect of four dimensions of globalization (trade, financial, informational, and political) on CO_2 emissions in Egypt.

From the above studies, one can conclude that the impact of globalization on carbon emissions is inconclusive and differs across different dimensions of globalization and the country in concern. This study extends the aforementioned studies by examining the impact of multiple dimensions of globalization on carbon emissions in Egypt during the period (1970–2020). Therefore, the following sections aim to test the hypothesis that trade, financial, informational, and political globalization affect CO_2 emissions positively in Egypt.

Data and Methodology

This section comprises two parts. The first part provides a descriptive analysis of CO_2 emissions and the four dimensions of globalization used in this paper in Egypt during the

[4] The selected countries in this study are Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, and Vietnam.

period (1970-2020). The second part presents the model specification and the methodological steps that will be followed.

Data and Descriptive Analysis

This paper uses different dimensions of globalization by employing the 2022 KOF globalization index (Dreher, 2006; Dreher et al., 2008; Gygli et al., 2019) outsourced from the KOF Swiss Economic Institute. This index is calculated on a yearly basis from 1970 to 2020 on a scale of 1(minimum level) to 100 (maximum level). The index covers the economic, social, and political dimensions of globalization. Gygli et al. (2019) introduced a revised index by separating de facto and de jure globalization for the overall index and its dimensions and sub-dimensions. De facto globalization indicates the actual international flows and activities, while de jure index indicates the policies and regulations used that can affect those activities. In this paper, we use four dimensions of globalization: trade and financial globalization, which are the two dimensions of economic globalization, informational, which is one of the dimensions of social globalization, and political globalization. Regarding the political dimension of globalization, this paper considers the political globalization de jure index as a proxy of political cooperation. The indicators of the four dimensions of globalization used in the paper are provided in Table (1).

Figure (1) depicts the development of territorial CO_2 emissions (measured in million tonnes) and the globalization index of the four dimensions used in this paper during the period (1970–2020) in Egypt. The four dimensions of globalization showed an increasing trend during the period of study. However, the increasing trend of both trade and financial globalization index is not stable over time. The average score of trade globalization was 32 during the years (1970–1973). Since the adoption of liberalization policies in 1974, the average score of trade globalization increased to 42 during the period (1974–1990) and continued to have an average score of 49.7 during the period (1991–2010). However, the trade globalization index showed a decreasing trend since 2011 and reached a score of 39 in 2020. Thus, for the whole period of the study (1970–2020), we find that the trade globalization index increased by 27%, with an annual growth rate of 0.88% on average.

Similarly, the financial globalization index started to witness an increasing trend during the period (1974–1989) with an average score of 48.6 and continued to increase during the period (1990–2010) with an average score of 61 and reached its maximum score in 1996. However, the score of the financial globalization index decreased to 45 on average from 2011 to 2020.

The most significant increase is observed in informational globalization, where its index increased by 426.5% during the whole period with an average of 3.6% annual growth rate. In the 1970s, the informational globalization index increased by negligible rates, while it showed a moderate increase in the 1990s and continued to increase at rapid rates from a score of 52 in 2005 to a score of 78 in 2020. Most of the indicators of informational globalization have been rising rapidly in Egypt, in particular internet and television access. In addition, high-tech exports, as a percentage of manufactured exports, have recently increased from 1% in 2016 to 3% in 2020, according to the World Bank data.

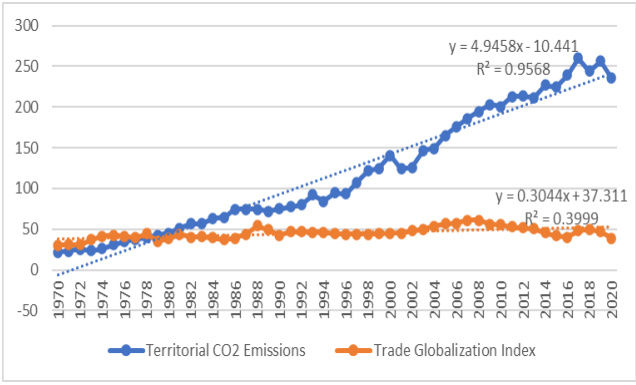
The second largest increase in globalization is in the political dimension, where the index increased by 158% with an annual growth rate of 2% during the period (1970–2020). The political globalization (de jure) index showed an increasing trend since 1970, where it increased from a score of 36 in 1970 to a score of 81 in 1986. However, the score decreased relatively to an average of 74 during the period (1978–1992), after which it continued to increase and reached its maximum level (94) in 2019.

The figure also shows a consistent increase in carbon emissions during the period (1970–2020), where emissions increased substantially from 21.6 $MTCO_2$ in 1970 to 235.8 $MTCO_2$ in 2020, i.e., by 989% during that period. The general trend line equation depicts a positive slope, signifying an average increase of approximately 5% annually. However, CO_2 emissions reached the maximum level in 2017, after which it started to decrease till year 2020. This was mainly due to the drop in the electricity and heat producers sector, which is responsible for the largest share of CO_2 emissions in Egypt, from 2017 to 2020 (IEA, 2021). As observed in Figure (1), most of the years in which CO_2 emissions increased also witnessed an increase in the score of both the informational and political globalization index. However, this was not the case for both trade and financial globalization.

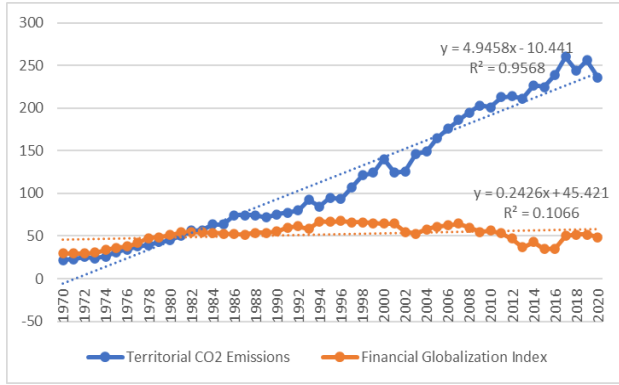
Figure 1.

CO_2 Emissions and Globalization in Egypt During Period (1970–2020)

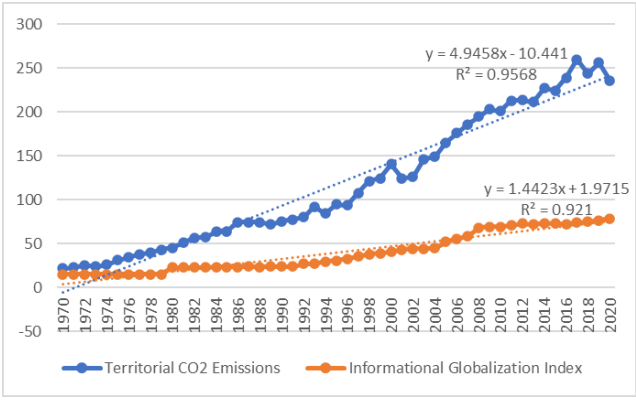
(A) Trade Globalization



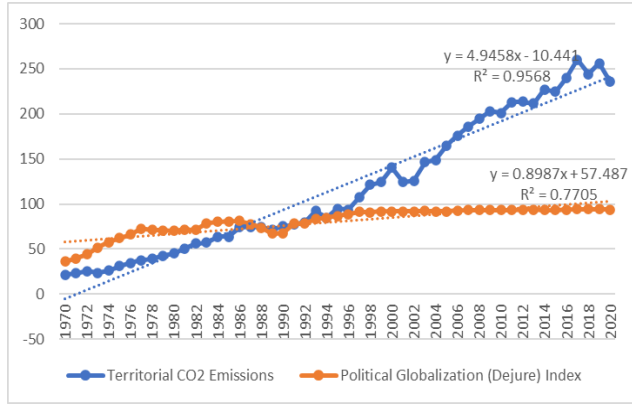
(B) Financial Globalization



(C) Informational Globalization



(D) Political Globalization



Source: Prepared by the author based on data from the Swiss KOF Globalization Index and Global Carbon Atlas.

Model Specification

The following functional form is used to estimate the impact of the four dimensions of globalization, along with some control variables, on CO_2 emissions in Egypt:

$$CO_{2t} = f\left(TrG_t, FnG_t, INfG_t, PolG_t, GDP_t, EC_t, GCF_t\right)$$

where the CO_{2_t} is territorial CO_2 emissions. Our main variable of interest in this paper is globalization. The four indices of globalization used in this model are as follows: TrG_t denotes trade globalization index, FnG_t denotes financial globalization index, $INfG_t$ denotes informational globalization index, which is a proxy of digitalization and innovation, and $PolG_t$ denotes political globalization (de jure) index, which is taken as a proxy for political cooperation. In addition, based on the literature (Adebayo & Beton Kalmaz, 2021; Al-mulali & Foon Tang, 2013; Arouri et al., 2012; Ibrahiem, 2016; Ibrahiem & Hanafy, 2020), three control variables are used in this model: GDP_t denotes real GDP per capita, EC_t is primary energy consumption, GCF_t is gross capital formation. All definitions and sources of data are provided in Table 1.

Table 1.

Description and Sources of Variables

Variable Symbol	Description	Source
CO_2	Territorial CO_2 Emissions measured in Million Tons of CO_2 ($MTCO_2$)	Global Carbon Atlas
TrG	**Trade globalization index** - Trade globalization index, de facto Includes: trade in goods, trade in services, and trade partner diversity. - Trade globalization index, de jure Includes: Trade regulations, Trade taxes, Tariffs and Trade agreements	KOF Swiss Economics Institute [5]
FnG	**Financial globalization index** - Financial globalization index, de facto Includes: foreign direct investment, portfolio investment, international debt, international reserve, international income payments. - Financial globalization index, de jure Includes: Investment restrictions, capital account openness, and international investments agreements	
INfG	**Informational Globalization index** Includes: internet bandwidth, international patents and high-tech exports, internet access, television access and press freedom	

[5] The detailed description of the variables according to the KOF Swiss Economic Institute is available here https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

PolG	**Political globalization index, de jure** International organizations, international treaties, treaty partner diversity	
GDP	GDP per capita (constant 2015 US$)	WDI World Bank
EC	Primary energy consumption per capita measured in KWH	BP Statistical Review 2021
GCF	Gross capital formation (constant 2015 US$)	WDI World Bank

Source: Prepared by the author

After transforming all variables to natural logarithm, the above functional form can be re-written as follows:

$$ln\ CO_{2t} = \beta_0 + \beta_1\ ln\ TrG_t + \beta_2\ lnFnG_t + \beta_3\ ln\ INfG_t + \beta_4\ lnPolG_t + \beta_5\ lnGDP_t + \beta_6\ lnEC_t + \beta_7 GCF_t + U_t \quad (1)$$

where U_t is the error term, and the variables as defined above.

Table (2) presents the summary statistics of the variables used in the study. Across the four dimensions of globalization, political globalization has the largest mean value and the largest maximum value. The standard deviation is small indicating low variability of the data. Based on the results of the Jarque-Bera test, it is noteworthy that the data for all variables, except for financial globalization, political globalization, and energy consumption, follows a normal distribution.

Table 2.

Descriptive Statistics of Variables

Variable	$LnCO_2$	LnTrG	LnFnG	LnINfG	LnPolG	LnGDP	LnEC	LnGCF
Mean	4.531	3.799	3.920	3.511	4.370	7.647	8.833	23.517
Median	4.538	3.800	3.980	3.428	4.465	7.660	8.857	23.500
Maximum	5.561	4.109	4.216	4.361	4.545	8.252	9.331	24.983
Minimum	3.075	3.414	3.382	2.689	3.594	6.861	7.881	21.253
Std. Dev.	0.746	0.160	0.237	0.586	0.226	0.413	0.430	0.988
Skewness	-0.3578	-0.2916	-0.9326	0.0558	-1.7954	-0.4340	-0.8853	-0.7172
Kurtosis	2.0112	3.1145	2.8614	1.6327	5.9762	2.1485	2.7944	2.8571
Jarque-Bera	3.1657	0.7508	7.4342	3.9987	46.225	3.1420	6.7524	4.41634
Probability	0.2053	0.6870	0.0243	0.1354	0.0000	0.2078	0.03417	0.1099
Sum	231.0980	193.7575	199.934	179.074	222.899	390.018	450.492	1199.418
Sum Sq. Dev.	27.872	1.294	2.832	17.215	2.5638	8.5477	9.2664	48.8174
Observations	51	51	51	51	51	51	51	51

Source: Compiled by the author using EViews.

This paper employs the ARDL model to estimate the long-run and short-run impact of the four dimensions of globalization on carbon emissions. Eq. (1) can be written within the ARDL framework as follows:

$$\begin{aligned}\Delta \ln CO_{2t} &= \alpha_0 + \sum_{i=1}^{p}\alpha_{1i}\Delta \ln CO_{2t-i} + \sum_{i=1}^{q_1}\alpha_{2i}\Delta \ln TrG_{t-i} + \sum_{i=1}^{q_2}\alpha_{3i}\Delta \ln FnG_{t-i} + \sum_{i=1}^{q_3}\alpha_{4i}\Delta \ln INfG_{t-i} \\ &+ \sum_{i=1}^{q_4}\alpha_{5i}\Delta \ln PolG_{t-i} + \sum_{i=1}^{q_5}\alpha_{6i}\Delta \ln GDP_{t-i} + \sum_{i=1}^{q_6}\alpha_{7i}\Delta \ln EC_{t-i} + \sum_{i=1}^{q_7}\alpha_{8i}\Delta \ln GCF_{t-i} + \\ &\delta_1 \ln CO_{2t-1} + \delta_2 lnTrG_{t-i} + \delta_3 lnFnG_{t-i} + \delta_4 lnINfG_{t-i} + \delta_5 lnPolG_{t-i} \\ &+ \delta_6 lnGDP_{t-i} + \delta_7 lnEC_{t-i} + \delta_8 lnGCF_{t-i} + \varepsilon_t\end{aligned} \quad (2)$$

where Δ is the first difference operator, $\alpha_{1i}, .., \alpha_{8i}$ are short run coefficients and $q_1, \dots, q_7$ are the optimal lag order selected based on the Akaike Information Criterion (AIC). The long run coefficients are $\delta_1, \dots, \delta_8$, and ε_t is the error term.

The methodological steps proceed as follows. First, unit root tests are applied to examine the stationarity of all variables to avoid spurious estimation (Granger & Newbold, 1974). The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test are used to check that all variables are stationary, either at level, I (0), or at first difference, I (1), or a mix of both orders. That is, to ensure that none of the variables is integrated of order 2 to be able to conduct the ARDL model (Pesaran et al., 2001).

Second, cointegration is tested to check whether a long run relationship between variables exists. The ARDL bound test developed by Pesaran et al. (2001) is applied. This involves conducting an F-test on the lagged levels of the variables. The null hypothesis of the F-test is that the lagged levels are jointly insignificant, which implies no cointegration. That is, $H_0 = \delta_1 = \ ... = \delta_8 = 0$. The calculated F-statistic is compared to two critical values provided by Pesaran et al. (2001). A lower bound critical value assuming variables are I (0) and an upper bound critical value assuming variables are I (1). If the F-statistic is greater than the upper critical value, then the null hypothesis is rejected, and the variables are considered to be cointegrated.

Third, upon the existence of a long run relationship between variables, the long run coefficients will be estimated as follows:

$$\begin{aligned}ln\ CO_{2t} &= \delta_0 + \sum_{i=1}^{p}\delta_{1i} \ln CO_{2t-i} + \sum_{i=1}^{q_1}\delta_{2i} \ln TrG_{t-i} + \sum_{i=1}^{q_2}\delta_{3i} \ln FnG_{t-i} + \sum_{i=1}^{q_3}\delta_{4i} \ln INfG_{t-i} \\ &+ \sum_{i=1}^{q_4}\alpha\delta_{5i} \ln PolG_{t-i} + \sum_{i=1}^{q_5}\delta_{6i} \ln GDP_{t-i} + \sum_{i=1}^{q_6}\delta_{7i} \ln EC_{t-i} + \sum_{i=1}^{q_7}\delta_{8i} \ln GCF_{t-i} + u_t\end{aligned} \quad (3)$$

Fourth, the Error Correction Model (ECM) is used to analyze the short-run dynamics of a cointegrated system. The ECM captures how the variables in the system adjust towards their long-run equilibrium in response to any short-run deviations.

$$\Delta \ln CO_{2t} = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln CO_{2t-i} + \sum_{i=1}^{q_1} \alpha_{2i} \Delta \ln TrG_{t-i} + \sum_{i=1}^{q_2} \alpha_{3i} \Delta \ln FnG_{t-i} + \sum_{i=1}^{q_3} \alpha_{4i} \Delta \ln INfG_{t-i} + \sum_{i=1}^{q_4} \alpha_{5i} \Delta \ln PolG_{t-i} + \sum_{i=1}^{q_5} \alpha_{6i} \Delta \ln GDP_{t-i} + \sum_{i=1}^{q_6} \alpha_{7i} \Delta \ln EC_{t-i} + \sum_{i=1}^{q_7} \alpha_{8i} \Delta \ln GCF_{t-i} + \varphi ECT_{t-1} + u_t \quad (4)$$

where φ denotes the Error Correction Term (ECT) coefficient, which represents the speed of adjustment towards the long-run equilibrium. A negative and statistically significant coefficient suggests that the system is converging towards its long-run relationship.

Fifth, the diagnostic tests will be conducted to verify the presence of serial correlation (using Breusch–Godfrey Serial Correlation LM test), heteroscedasticity (using Breusch-Pagan-Godfrey Heteroscedasticity Test), and normality of residuals to ensure that the model is valid. In addition, the cumulative sum of recursive (CUSUM) and CUSUM-squared residuals introduced by Brown et al. (1975) will be employed to test the long-run stability of the ARDL model.

Results and Discussion

This section presents and discusses the results of the ARDL model and the diagnostic tests.

Stationarity and Cointegration Tests

The analysis starts by checking the order of integration of variables. Table (3) shows the results of the ADF test and the PP test. All variables are stationary at the first difference, i.e. integrated at I (1), for both constant and constant & trend, except the political globalization index is stationary at the level at 1% significance level. Given that none of the variables is integrated of a higher order than 1, we proceed with the cointegration bound test.

Table 3.
Unit Root Tests

	Level				**First difference**				**I (D)**
	ADF		**PP**		**ADF**		**PP**		
Variable	Constant	Constant &Trend	Constant	Constant &Trend	Constant	Constant &Trend	Constant	Constant &Trend	
LnCO2	-3.826 (0.0051)	-1.953 (0.6103)	-2.937 (0.0482)	-1.193 (0.9010)	-3.557 (0.0107)	-5.235 (0.0005)	-8.427 (0.0000)	-9.744 (0.0000)	I (1)
lnTrG	-2.965 (0.0455)	-1.867 (0.6540)	-2.673 (0.0858)	-2.159 (0.5009)	-5.566 (0.0000)	-5.938 (0.0001)	-6.335 (0.0000)	-6.737 (0.0000)	I (1)
lnFnG	-2.353 (0.1599)	-1.290 (0.8764)	-2.367 (0.1567)	-1.870 (0.6546)	-6.597 (0.0000)	-4.661 (0.0029) -	-6.6127 (0.0000)	-6.886 (0.0000)	I (1)

	Level				First difference				I (D)
	ADF		PP		ADF		PP		
Variable	Constant	Constant &Trend	Constant	Constant &Trend	Constant	Constant &Trend	Constant	Constant &Trend	
lnINfG	-0.286 (0.9193)	-2.562 (0.2986)	-0.286 (0.9193)	-2.685 (0.2467)	-6.990 (0.0000)	-6.914 (0.0000)	-6.990 (0.0000)	-6.914 (0.0000)	I (1)
lnPolG	-4.203 (0.0017)	-4.542 (0.0035)	-5.540 (0.0000)	-4.695 (0.0022)	-3.826 (0.0050)	-4.252 (0.0077)	-3.738 (0.0063)	-4.252 (0.0077)	I (0)
lnGDP	-2.698 (0.0818)	-2.706 (0.2389)	-1.835 (0.3593)	-1.470 (0.8266)	-3.648 (0.0083)	-4.399 (0.0053)	-4.165 (0.0019)	-4.198 (0.0090)	I (1)
lnEC	-3.299 (0.0203)	-1.096 (0.9193)	-3.424 (0.0146)	-0.563 (0.9769)	-3.992 (0.0031)	-5.244 (0.0004)	-3.992 (0.0031)	-5.250 (0.0004)	I (1)
lnGCF	-3.190 (0.0267)	-3.359 (0.0692)	-2.058 (0.2619)	-1.679 (0.7458)	-4.932 (0.0002)	-5.240 (0.0004)	-4.932 (0.0002)	-5.168 (0.0005)	I (1)

Source: Compiled by the author using EViews.

*Lag length is selected based on the Akaike Information Criterion (AIC). P-values are in parenthesis.

Table (4) reports the outcomes of the cointegration analysis conducted using the ARDL bounds testing technique developed by Pesaran et al. (2001). The ARDL model's lag structure was chosen based on the AIC to be (1,3,3,2,2,1,0,2), with a maximum lag set at 3 for all variables. By comparing the F-statistic calculated from the model to the upper and lower bounds critical values based on Pesaran et al. (2001), it is evident that the F-statistics value (8.4) is larger than the upper bound critical value at a 1% significant level. This outcome suggests the presence of strong cointegration among the variables and the variables have a long-run equilibrium relationship, and changes in the independent variable have a lasting impact on the dependent variable.

Table 4.

Co-integration Bound Test

F-Bound Test	Null Hypothesis: No levels relationship			
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	8.404030	10%	1.92	2.89
K	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

Source: Compiled by the author using EViews.

Results of The ARDL Model

The estimated long run and short run coefficients are reported in Table (5). Except for trade globalization, all dimensions of globalization examined in this paper affect CO_2 emissions in Egypt significantly in the long run. On the one hand, both informational and political globalization affect CO_2 emissions positively. That is, informational globalization results in an increase in carbon emissions by 0.19% (at a 5% significance level), whereas political globalization raises CO_2 emissions by 0.78% (at a 1% significance level). On the other hand, financial globalization has a positive effect on the environment by reducing CO_2 emissions, where a 1% increase in the financial globalization index reduces emissions by 0.25% (at a 1% significance level). In the short run, trade globalization has a positive significant effect on CO_2 emissions, where an increase in the trade globalization index by 1% raises CO_2 emissions by 0.186% in the same period (at a 5% significance level) and 0.4% with a lag of one period at (1% significant level). Similar to the results in the long run, political globalization affects CO_2 emissions positively in the same period. Informational globalization doesn't affect CO_2 in the short run, and the impact of financial globalization is not significant in the short run.

Political globalization has the largest positive effect on CO_2 in Egypt compared to other dimensions of globalization. On the one hand, Egypt joined many multilateral and bilateral agreements to facilitate trade and investment activities that have been a key factor in its economic growth. However, these agreements might contribute to the nation's emission levels, if environmental standards are not considered within the framework of those treaties. On the other hand, although Egypt has ratified several agreements aiming at reducing CO_2 emissions, such as the United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, and recently the Paris Agreement, none of these treaties include binding targets to regulate emissions. For instance, all developing countries, including Egypt, were grouped under Annex II countries under the Kyoto Protocol, and, hence, were exempted from emission reduction targets. This result is similar to Acheampong (2022), who found that political globalization raises emissions in Ghana. The above results also show that informational globalization is not environmentally friendly in Egypt. This confirms that the use effect and the cost effect mentioned by Charfeddine and Kahia (2021) and Danish (2019) dominates the substitution effect in Egypt. That is, ICT contributes to raising emission levels, due to the intensive use of energy in producing ICT and high-tech products. In addition, informational globalization in Egypt leads to higher demand for goods and services, which consequently results in higher energy consumption and carbon emissions. According to the results, the only dimension of globalization that helps decarbonization in Egypt is financial globalization. This implies that financial globalization, ranging from flow activities, such as foreign direct investment to investment policies, facilitates adoption of efficient technologies and deployment of cleaner sources of energy, and, hence, should be enhanced. In contrast to the results by Gaies et al. (2022), who found that financial globalization reduces emissions in OPEC countries, while it raises emissions in non-OPEC countries, including Egypt, in the MENA region, the present paper confirms the negative impact of financial globalization on CO_2 emissions in Egypt.

The control variables have the expected signs, where GDP per capita has the largest positive effect on territorial CO_2 emissions in Egypt, where an increase in GDP per capita by 1% leads to an increase in CO_2 emissions by 1.34% (at a significant level 1%) in the long run, and by 2.47% in the short run in the same period. This is consistent with the EKC hypothesis that countries in the early stages of development, such as Egypt, are subject to higher level of pollution as per capita income level increases. Similarly, primary energy consumption leads to an increase in CO_2 emissions in the long run by 0. 4% (at significance of 5%). This result is in line with expectations, given the fact that energy consumption in Egypt relies heavily on fossil fuels (mainly petroleum products and natural gas). These findings are qualitatively similar to Adebayo and Beton Kalmaz (2021) and Ibrahiem and Hanafy (2020) who found that both GDP growth and energy consumption contribute positively to environmental degradation in Egypt. In contrast, although our results confirm the findings of Ibrahiem (2016) regarding energy consumption, Ibrahiem concluded that economic growth has a negative impact on CO_2 emissions.

On the other hand, gross capital formation reduces CO_2 emissions, whereas a 1% in gross capital formation reduces CO_2 emissions in Egypt by 0.22% in the long run. This indicates that investment in physical capital encourages and facilitates low-carbon activities in Egypt. One of the channels through which gross capital formation might reduce carbon emissions is to invest in energy efficiency and renewable energy projects. For instance, according to IEA (2021), carbon intensity on industry energy consumption in Egypt has a declining trend since 1990, and low carbon electricity generation has been increasing since 2000.

As shown in Table (5), the error correction coefficient is negative and statistically significant at 1% significance level, suggesting that the cointegration relationship between variables is strong as confirmed by the bound test. In other words, 118% of the deviation from the long run relation between variables will be corrected annually.

Table 5.
Estimated coefficients of the ARDL model

Variable	Coefficient	Std. Error	t-statistic	Prob.
Long run coefficients				
lnTrG	0.082553	0.076770	1.075333	0.2921
lnFnG	-0.258017***	0.051921	-4.969445	0.0000
lnINfG	0.193921**	0.074304	2.609837	0.0148
lnPolG	0.784152***	0.161217	4.863956	0.0000
lnGDP	1.342048***	0.242169	5.541776	0.0000
lnEC	0.416178**	0.188839	2.203879	0.0366
lnGCF	-0.220397**	0.079759	-2.763273	0.0104
c	-7.679285***	0.769361	-9.981384	0.0000
Short run coefficients				
D(LnGDP)	2.470948***	0.377773	6.540831	0.0000

Variable	Coefficient	Std. Error	t-statistic	Prob.
D(lnGDP(-1))	0.099178	0.362303	0.273743	0.7864
D(lnGDP(-2))	0.862199**	0.316753	2.721994	0.0114
D(lnEC)	0.038870	0.179641	0.216374	0.8304
D(lnEC(-1))	-0.472815**	0.179512	-2.633900	0.0140
D(lnEC(-2))	-0.544149**	0.203275	-2.676904	0.0127
D(lnGCF)	-0.106537*	0.059485	-1.790684	0.0850
D(lnGCF(-1))	0.203488***	0.061580	3.304454	0.0028
D(lnTrG)	0.186016**	0.072966	2.549363	0.0170
D(lnTrG(-1))	0.401614***	0.083373	4.817059	0.0001
D(lnFnG)	0.007754	0.063311	0.122475	0.9035
D(lnPolG)	1.221560***	0.191565	6.376726	0.0000
D(lnPolG(-1))	-0.898767***	0.187140	-4.802639	0.0001
CointEq(-1)	-1.187509***	0.119404	-9.945299	0.0000
R-squared	0.8	Adjusted R-squared	0.729	

Source: Compiled by the author using EViews.
Notes: ***, **, and * indicate the significance levels: 1%, 5%, and 10%, respectively.

Results of Diagnostic Tests

To ensure the reliability of the model and the validity of the estimated results, the following diagnostic tests are applied. First, the Breusch-Godfrey Serial Correlation LM test is used to check whether there is any remaining serial correlation in the residuals. Second, the Breusch-Pagan-Godfrey Heteroscedasticity test to assess the presence of heteroscedasticity. Third, the normality test. The results of the diagnostic tests are reported in Table (6). The F-statistic and the P-value of the first two tests indicate that residuals are not serially correlated and are homoscedastic. In addition, the normality test suggests that the data is plausible to be normally distributed.

Table 6.
Diagnostic Tests

Test		P-value
Breusch-Godfrey Serial Correlation LM Test	F – statistic 0.148445	**F (2,24) 0.8628**
Breusch-Pagan-Godfrey Heteroscedasticity Test	F – statistic 0.860477	**F (21,26) 0.6340**
Normality Test	Jarque-Bera 0.638792	**0.7265**

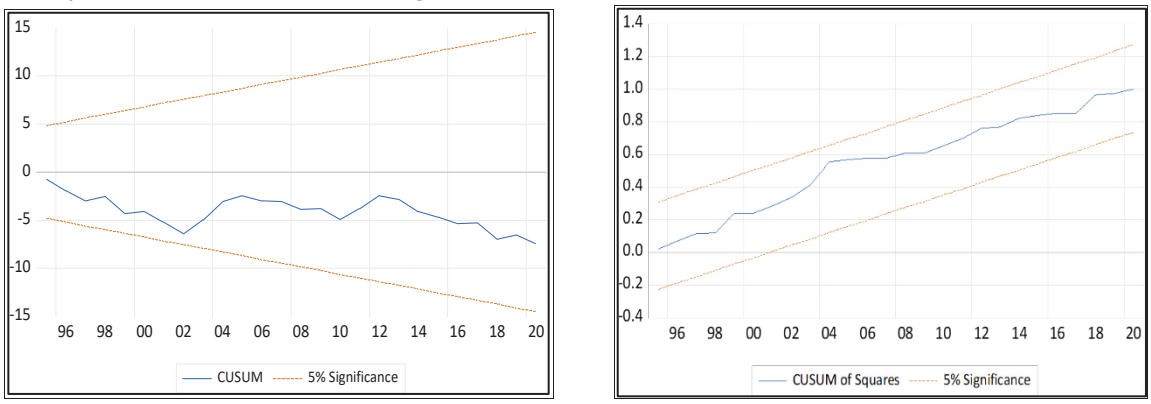
Source: Compiled by the author using EViews.

In addition, to check whether relationships captured by the model remain stable over time, CUSUM and CUSUMSQ tests are applied. Figure (2) shows the plot of the two tests, where

the plots of both tests are located within the critical bounds at a 5% significance level, indicating that the model parameters are stable.

Figure 2.

Plots of the CUSUM and CUSUMSQ tests



Source: Compiled by the author using EViews.

Conclusions and Policy Recommendations

The effect of globalization on CO_2 emissions is complex and multifaceted. While there is some empirical evidence suggesting that globalization can contribute to increased emissions, there are also factors that can mitigate this effect. To capture the multidimensional nature of globalization, this paper investigates the impact of four dimensions of globalization (trade, financial, informational, and political) on territorial CO_2 emissions in Egypt during the period (1970–2020). The paper uses the sub-indices of the KOF Globalization Index and employs the Autoregressive Distributed Lag (ARDL) model to examine the short run and long run impact of these four dimensions of globalization on carbon emissions in Egypt.

The findings of the present paper show that all dimensions of globalization cause an increase in CO_2 emission levels in Egypt, whether in the short or the long run, except financial globalization. This implies that financial globalization, ranging from flow activities such as foreign direct investment to investment policies, facilitates adoption of efficient technologies and deployment of cleaner sources of energy, and, hence, should be enhanced. The other aspect of economic globalization is trade globalization. The results of this paper show that trade globalization causes an increase in CO_2 emissions in the short run, but its impact on emissions in the long run is insignificant.

In the long run, both informational and political globalization contribute to increased emissions, and, hence, affect the environment negatively. Regarding informational globalization, the findings suggest that activities, such as using international internet bandwidth, internet usage, television access, and exporting high-tech products in Egypt are not environmentally friendly and consume energy intensively. Hence, new policies should be adopted to encourage the use of renewable energy to power the Internet, and to use smart energy-efficient applications to mitigate emissions. The results also show that political cooperation contributes to increased emissions in Egypt. Therefore, it is recommended that economic agreements should not only focus on trade or investment liberalization between

members, but also establish common environmental goals and standards to counter the negative effects that could arise from expanding production and trade on emissions. In addition, joining bilateral environmental agreements might be more effective than multilateral agreements. This helps countries to adopt and monitor their environmental regulations and facilitates financial assistance needed by developing countries, such as Egypt, to mitigate carbon emissions.

Besides, the paper highlights that the largest source of territorial CO_2 emissions in Egypt is economic growth represented by real GDP per capita. In addition, primary energy consumption in Egypt contributes to increased emissions in the long run. Hence, more policies are needed to encourage a green growth path and a transition to cleaner sources of energy. Egypt is on track to address these issues, where Egypt's National Climate Change Strategy (NCCS) emphasizes the role of the energy sector in following a sustainable development path. For instance, the strategy designs a plan to raise the share of renewable and new sources of energy to 42% of total electricity generated in 2035.

To sum up, globalization has brought about both challenges and opportunities in the context of mitigating CO_2 emissions. However, it is important to take proactive measures to address the negative environmental impacts that often accompany globalization and to capture the opportunities that could emerge from integrating into the world economy to be in favour of the environment. This study suggests several avenues for possible future research. First, one can investigate the effect of globalization on investment and production of renewable energy. Second, another aspect of globalization is the involvement of countries in global value chains. Hence, more research is needed to explore how participation in the global value chain affects carbon emissions in Egypt.

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نهي ناجي البغدادلي

أثر الأبعاد المتعددة للعولمة على انبعاثات ثاني أكسيد الكربون في مصر (1970–2020)

المستخلص

برز الاهتمام بالانبعاثات الكربونية المرتبطة بزيادة العولمة كنقطة محورية باعثةً للقلق، لا سيما في الدول شديدة التعرض لتغير المناخ مثل مصر. ويتناول هذا البحث أثر العولمة على انبعاثات ثاني أكسيد الكربون الإقليمية في مصر خلال الفترة (1970–2020). وبما أن العولمة عملية متعددة الأبعاد، فإن هذه الدراسة تتناول أربعة أبعاد للعولمة، هي: العولمة التجارية، والمالية، والمعلوماتية، والسياسية. وتستند مؤشرات العولمة التي تشملها هذه الدراسة إلى مؤشرات KOF الفرعية للعولمة. وباستخدام نموذج الانحدار الذاتي ذي الفجوات الزمنية (ARDL)، توضح نتائج هذا البحث أن العولمة المالية فقط هي التي تؤدي إلى التخفيف من انبعاثات الكربون في مصر في الأجل الطويل، في حين أن العولمة المعلوماتية والسياسية ليست صديقة للبيئة، وتُسهم في مستويات أعلى من انبعاثات ثاني أكسيد الكربون. وبالإضافة إلى ذلك، فإن العولمة التجارية ترفع مستويات الانبعاثات في الأجل القصير، كما يؤدي كل من النمو الاقتصادي واستهلاك الطاقة الأولية إلى زيادة انبعاثات ثاني أكسيد الكربون في مصر، في حين أن تكوين رأس المال الإجمالي يقلل من مستويات الانبعاثات. وتوصي نتائج الورقة بضرورة تشجيع السياسات الرامية إلى تعزيز العولمة المالية، بينما ينبغي إعادة تشكيل الأنشطة المرتبطة بالعولمة المعلوماتية والسياسية للنظر في الجوانب البيئية، والمساعدة على التخفيف من انبعاثات الكربون.

الكلمات الدالة: انبعاثات ثاني أكسيد الكربون، العولمة المالية، العولمة المعلوماتية، العولمة السياسية، مصر