Daizy, Afia Fahmida; Anjum, Mobasshir; Arman, Md. Raied et al.

Article

Long-run impact of globalization, agriculture, industrialization and electricity consumption on the environmental quality of Bangladesh

International Journal of Energy Economics and Policy

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(6), 438-453.

Long-run Impact of Globalization, Agriculture, Industrialization and Electricity Consumption on the Environmental Quality of Bangladesh

Afia Fahmida Daizy[1]*, Mobasshir Anjum[2], Md. Raied Arman[3], Tanzina Nazia[4], Nadir Shah[5]

[1]Faculty of Economics, East West University, A/2 Jahurul Islam Avenue, Jahurul Islam City, Aftabnagar, Dhaka-1212, Bangladesh, [2]Assistant Director, Bangladesh Bank (Central Bank of Bangladesh), Motijheel C/A, Dhaka-1000, Bangladesh, [3]Senior Research Associate, BRAC Institute of Governance and Development, Mohakhali, Dhaka-1212, Bangladesh, [4]Faculty of Social Science, Comilla University, Koatbari, Cumilla-3506, Bangladesh, [5]Assistant Secretary, Ministry of Home Affairs, Bangladesh Secretariat, Abdul Gani Road, Dhaka-1000, Bangladesh. *Email: afiadaizy@ewubd.edu

Received: 13 July 2021 **Accepted:** 24 September 2021 **DOI:** https://doi.org/10.32479/ijeep.11817

ABSTRACT

This study strives to assess the long-run dynamic relationship between carbon emission, and phenomena such as globalization, industrialization, electricity consumption, and agriculture for Bangladesh by utilizing annual time series data for 1971-2014. To this end, ARDL co-integration approach is utilized in this study to investigate the particularly targeted dynamics. The findings reveal strong positive long-run relation between carbon emission, and globalization, and electricity consumption while exhibiting weak relation between emission, and industrialization. For agriculture, no significant long-run relation could be found. The current economic status of the country is liable for the relation dynamics. Improvement from the existing physical, and governance infrastructure of the country holds the key to mitigating the emission problem generating as a by-product of growth, and globalization in general.

Keywords: Climate Change, Economic Growth, Carbon Emission, Energy Consumption, Co-Integration, Environmental Economics
JEL Classifications: C32, F64, Q56

1. INTRODUCTION

The story of development over the last hundred years can be perceived into two broad divisions. On the one hand, there lies the realm of unprecedented advancement in technology, and spectacular achievement of growth across the world. On the other hand, there are stories of concern regarding our very existence in the world. The latter comprises nothing much other than the story of environmental degradation, which puts all the achievements of the former at great peril. Although the growth has brought about spectacular economic benefit, the impact it is rendering by degrading the environment has become a hot-button issue as climate change issue can be regarded to be irrevocable, posing an impending threat not only for the most natural disaster-prone countries like Bangladesh but also for the whole world. The Intergovernmental Panel on Climate Change (IPCC) forecasted that by the end of 21st Century, the global warming will rise between 1.8 and 4 degree, and at best 6.4 degree as compared to that of 20th century (Richard Alley et al., 2007; Ryan-Collins et al., 2011). The leading cause of global warming is the activity of humans that discharges greenhouse gases (GHG) into the atmosphere (Ryan-Collins et al., 2011). Currently due to COVID-19 launchings such as lockdowns, though a worldwide drop in GHG emission is noticeable, assessments suggest

COVID-19 to leave a very trivial long-run impact on the climate as (State of the Global Climate, 2020) reveals the atmospheric GHG concentration to maintain a continuous rise in the long-run (Forster et al., 2020). The predominant contributor of this global warming is carbon dioxide (CO_2), since it accounts for 58.8 percent of GHG emission (Bacon and Bhattacharya, 2007; Chandra Ghosh, 2014). Worldwide CO_2 emission has been 42% higher in 2014 as compared to that of 1990, marking a substantial increase of CO_2 concentration in the atmosphere (Aung et al., 2017).

Bangladesh, like many other countries of the world, has invariably set economic growth as one of the prime goals in the macroeconomic stabilization policy area. The country initiated large-scale trade liberalization from the early 1990s (Oh and Bhuyan, 2018). In so doing, Bangladesh got initiated into the process of globalization through trade integration. The concept of globalization is a multidimensional one with multitude of socioeconomic, political, and environmental ramifications to muse on (Haelg, 2020). As it moved ahead on the path towards globalization, the wheel of industrialization accelerated prompting the demand for energy consumption to soar greatly, and thereby causing environmental degradation by increasing per capita CO_2 emission. While the degree of globalization has increased from 18.96 in 1972 to 51.25 in 2017 (KOF Globalisation Index, n.d.), per capita CO_2 emission has also risen in the similar vein. Back in 1972, when the per capita CO_2 emission of this country was only 0.05 metric ton, it has increased to 0.51 metric ton per capita in 2018 (World Development Indicators | DataBank, n.d.). In 1972 while the share of CO_2 emission of Bangladesh in the world was 0.01%, in 2016 it became 0.21% (Global Search on Data, Maps and Indicators — European Environment Agency, n.d.). This rising trend is expected to continue due to the reliance on fossil fuel to cater to the industrial demand in this era of increasing globalization. Therefore, the country is face-to-face with a major trade-off in this regard.

As per World Bank, in 2019 among the total population of the country, almost 92.2% can avail to electricity, which was only 14.3% in 1991, and per capita electric power consumption has risen from 10.65 kWh in 1972 to 320.20 kWh in 2014. Concurrently, fossil fuel energy consumption has increased from 20.70% in 1972 to 73.76% in 2014 causing the CO2 emissions from electricity, and heat production to rise from 27.77% in 1972 to 52.80% in 2014 (World Development Indicators | DataBank, n.d.). In keeping with the energy sector, industrialization had gained momentum over the same period. Industry is a major contributor to CO_2 emissions among all economic sectors, in essence due to high energy consumption by the sector (Du et al., 2019). As per Bangladesh Economic Review 2021, the share of industrial sector to the total GDP stands at 34.99% that grew soundly, getting impetus from power, gas, water supply, mining, and quarrying subsectors (Bangladesh-Economic-Review, 2021b).

Although energy consumption, and industrialization play pivotal roles in GHG emissions, CO_2 emission from agriculture also deserves attention as a nation attempts to ensure food security (Li et al., 2016a). Agriculture, forestry, and land use remain as the second major contributing sector to GHG, after the electricity, and heat production sector (Intergovernmental Panel on Climate Change and Edenhofer, 2014). The share of the agriculture sector in the GDP of Bangladesh is only a meagre 13.47% in 2021 (Bangladesh-Economic-Review, 2021c). However, the economy is predominantly agro-based with 40.6% of total labor force still employed in this sector, and a whopping more than 40.6% of the total population linked either directly or indirectly to agricultural activities (Bangladesh-Economic-Review, 2021d).

As for the potential hazards, Bangladesh is now at the epicenter of threats originating from climate change effects like increase in sea level, draught, salinity ingress, cyclone, storms, loss of habitats, destabilization of agriculture, etc. According to the estimation of (Bangladesh-Economic-Review, 2021a), the annual average rainfall is expected to become higher by 2030, 2050, and 2070 in Bangladesh with an approximate rise of almost 4%, 2.3%, and 6.7% extra rain falling respectively. In terms of sea level of Bangladesh, a 40 cm rise by 2030 is also forecasted (Bangladesh-Economic-Review, 2021a). The rise in the sea level due to climate change can submerge up to 13% of coastal land of Bangladesh by 2080, and a rise in the sea-level by just one meter is capable of inundating about one third of the total area of Bangladesh resulting in a displacement of 25-30 million Bangladeshis (Climate Displacement in Bangladesh, 2012; Pender, 2008).

This whole scenario has motivated us to make an endeavor to see how the environmental quality of Bangladesh is going to be affected in the long-run, if the above scenario steadily gets worsening, by employing ARDL co-integration technique. That's why to keep the tenor of the above-mentioned discourses, we have equipoised our study as follows: The next section supply a brief review of relevant empirical evidence, and various theoretical arguments from the literature related to our interest, and points out the shortfalls in case of Bangladesh. Conditioned upon the previous fulfillment, the third section justifies, and introduces the objective of the study once again but in details, while the data, and methodology used by the paper for analysis would be revealed in the fourth section. Following the previous section, the fifth section deals with the findings obtained using the empirical methods. The final section sets out discussions, conclusions, and suggestions to policy makers.

2. LITERATURE REVIEW

For the last few decades, the world has seen an exponential increase in the emission of CO_2, and the same in terms of the performances of different macroeconomic indicators. As a result, there is a growing concern among the researchers, and policy makers as to the association between environmental quality, and relevant macroeconomic variables. However, existing literature in this field is not congruent with each other, and the results emerging from these studies diverge in case of one country to another, and also from one estimation technique to another. Quite an exorbitant amount of studies on the connection of CO_2 emission with it's various determinants has been undertaken in the world. All these studies can be categorized under three broad categories.

The first category entails examining the justness of Kuznet Curve (EKC) in terms of environment, where an inverted U-shaped relationship is presumed to stay between income per capita, and the pollution level (Kuznets, 1955). To be more specific, EKC maintains that the level of pollution deteriorates at first with the onset of initial development, and then improves as the development goes on. Researchers like (Öztürk, 2016; Pata, 2017) for Turkey, (Dilawar Khan and Arif Ullah, 2019) for Pakistan, (Shahbaz et al., 2015b) for China, (Shikwambana et al., 2021) for South Africa have made an endeavor to inquire into the validity of country specific EKC hypothesis. The findings from these studies, however, are not in harmony, and many studies couldn't find the existence of inverted U-shaped relationships while working with real life data for example (Zhang, 2021) found an N-shape EKC for China. At the same time, instead of relying on individual country specific data, utilizing panel database analysis, researchers like (Galeotti et al., 2006) for OECD countries, (Kalaycı and Hayaloğlu, 2019) for NAFTA, and (Selden and Song, 1994), (Suri and Chapman, 1998), and (Parajuli et al., 2019) have vindicated growth from the economists viewpoint to disturb the quality of environment at the initial stage of development, and to improve it after a threshold income level.

The second category involves a different approach from the previous category. While the first category focuses specifically on the relationship pattern of income, and pollution over time, the second category broadens the horizon by focusing on the long-term association between environmental quality, and other connected macroeconomic indicators without applying EKC hypothesis concept in the estimation model. Many researchers like (Soytas and Sarı, 2009) for Turkey, (Tiwari and Nasir, 2013) for South Africa, (Gul et al., 2015) for Malaysia, (Mohiuddin et al., 2016) for Pakistan, (Asumadu Sarkodie and Owusu, 2017) for Ghana, (Salahuddin et al., 2018) for Kuwait, (Appiah et al., 2019) for Paris, (Le et al., 2018) for Vietnam, and (Nkengfack and Fotio, 2019) for Algeria, Egypt, and South Africa have investigated in this realm.

The third category includes a mixture of the earlier two in terms of approach but covers much broader grounds in terms of perspective. Under this, some researchers bring the EKC concept like the first category entailed, and some simply ignores it as the second category said. Even though some researchers design their model incorporating the EKC hypothesis, under this third category they actually attempt to investigate the static, and dynamic relationship between quality of environment, and its determinants. It's because over time, newer challenges kept emerging, and thus, concepts such as globalization, economic growth, industrialization, urbanization, financial development etc. kept receiving more, and more attention from the eyes of environmental policymakers in their models. In the following sections, some of the broader shores of literature under this category are discussed to dig the insights of these studies if this category is selected (Section 2.1 to 2.4).

2.1. Globalization, and Environmental Degradation

Globalization removes the barriers to cross-border trade, and investments, and thus contributes to the growth of the country's economy, which subsequently accelerates the amount of pollution (Cole, 2006; Latif et al., 2018). On the other hand, pollution is assumed to decrease after reaching a certain threshold of standard of living (Shahbaz et al., 2015a). In the early 1990s, researchers streamlined the effects of globalization on environmental quality into two branches – direct effects, and indirect effects. The latter can be classified into either of three categories: Technique, composition, and scale effects.

The amount of emission made by a country during its production or consumption of a particular good hinges on the technique of production or consumption that they use. The cornucopia of channels through which globalization influences CO_2 emission by altering the production, and consumption techniques through which industry, and households emit is commonly denoted as the technique effect (McAusland, 2010). Globalization prompts many economies to adhere to international norms, and environmental quality related treaties (Bernauer et al., 2010) which in turn might reduce emission via technique effect. For example, a country can deny market access to the product of another country if it deems the product is not being procured in an environment-friendly way (Sebastiaan Princen, 1999). In light of results of technique effect like this, in 1995, Vogel put forward the concept of "California effect" delineating how emission is reduced by the positive nature of globalization. The California effect takes place when a country imposes its own standard upon one or more of its trading-partners with market access (Sebastiaan Princen, 1999). However, the success depends on the scale and adaption of technology transfer and as a result, researchers recommend to take initiatives to enhance the absorptive capacities for the countries on which the strict standards are imposed (Ryan-Collins et al., 2011).

Composition effect comes into play when the sectoral or industrial composition of a country changes, and this change in response leads to a change in emission levels due to liberalization. The composition effect captures this change in emission (McAusland, 2010). Generally, when composition of economies move from industrial sector to service or agriculture sector, emission levels decrease, and a similar pattern can be observed the other way around.

The scale effect is observed when access to increased, and efficient resources due to globalization, ends up shifting the global production possibility frontier (PPF) out (McAusland, 2010). Generally, economies with high cost of factor inputs scale up their industries through expanding in economies where expansion, and operation is cheaper. While the impact on emission is ambiguous for the former two, it is almost always negative for scale effect as the increase in production leads to at least some minimal level of emission regardless of the techniques in use.

As a result of all these different "effects" of globalization having varying repercussions on emission, in existing literature, there are contrasting opinions as to the impact of globalization on the environment. Globalization is a concept that is multi-dimensional, and incorporates different aspects such as political, economic, and social dimensions (Haelg, 2020). However, some studies rely only on trade openness as a measure of globalization. Using the data of 41 countries (Frankel, 2009) conclude that trade helps improving environmental quality, which is in line with the study of (Shahbaz et al., 2013) for Indonesia, (Shahbaz et al., 2017) for China, and (Le et al., 2018) for Vietnam. On the contrary, using country specific data, researchers like (Dean, 2002) for China, (Dilawar Khan and Arif Ullah, 2019) for Pakistan, and using panel dataset (Frankel, 2009), (Kalaycı and Hayaloğlu, 2019), (Salahuddin et al., 2019) have established trade openness as influencing the environmental quality to degrade.

On the other hand, some recent studies (Jorgenson and Givens, 2014) have incorporated other measures of globalization apart from trade openness to ascertain its relevant effect on environment quality**.** Using KOF index, (Nguyen and Hoi, 2020) for Vietnam, (Salahuddin et al., 2019) for South Africa, (Etokakpan et al., 2020) for Turkey have found environment quality is degraded by globalization. In contrast, (Antweiler et al., 2001; Liddle, 2001; Rahman et al., 2021; Shahbaz et al., 2017) have asserted that globalization tends to enhance environmental quality.

There is also a structured argument supporting the role of globalization in reducing emission named the ''pollution haven'' argument coined by (Copeland and Taylor, 1994). According to this argument, as an outcome of a higher level of integration, industries that cause high pollution in the developed economies, and have to bear high compensatory costs due to environmental laws, are relocated to developing nations in order to utilize the relatively less stringent environmental regulations existent there. Due to the nature of seeking a reduction in their production costs, these relocated industries end up emitting in high volumes in the developing countries (Jaffe, 1995). These developing economies are considered as pollution havens for the industrialists of the developed economies.

From the discussion above, it can be delineated that the impact of globalization on environmental degradation is an issue of much debate, and it is an ongoing controversy (Jorgenson and Givens, 2014).

2.2. Industrialization, and Environmental Degradation

Industrialization is a major consequence of globalization, so it is important to look into the impact of industrialization on emission separately. Majority of the authors suppose that industrialization boosts higher energy consumption as higher value added manufacturing involves usage of more energy as compared to traditional agriculture or basic manufacturing (Lin and Lei, 2015; Sadorsky, 2014). Evidence further suggests that CO_2 emissions are more responsive to industrial output rather than agricultural output (Burke et al., 2015). But, the ecological modernization theory propounds that manufacturing output increases at the beginning stages of modernization as the country enjoys economic growth which eventually increases CO_2 emissions (Begum et al., 2015; Lin and Lei, 2015). However, due to the role of different modern green technologies, generation of public awareness, and higher willingness to pay for saving the environment from degrading, CO_2 emission eventually decreases in the long-run (Samreen and Majeed, 2020). On the other hand, industry structure could lead to reduced CO_2 emissions by adversely affecting the economic growth (Chang et al., 2015). It can reduce CO_2 emission if biomass is used for low-temperature heating services (Fais et al., 2016). Due to this debate, some existing literature have attempted testing the relation of environmental degradation with industrialization and the available literature, relevant to this field can be grouped as follows:

The primary group of evidence is biased towards the environmental damaging impact of industrialization. This is backed by literature like (Asumadu-Sarkodie and Owusu, 2016) for Benin, (Li et al., 2019; Liu and Bae, 2018) for China, (Pata, 2017) for Turkey, (Appiah et al., 2019) for Paris, and also by researchers who have used panel dataset such as (Al-mulali and Ozturk, 2015) for MENA countries, (Le, 2020) for a set of 47 countries, (Samreen and Majeed, 2020) for a set of 89 countries, and (Majeed and Tauqir, 2020) for a set of 156 countries. (Wang et al., 2011) Concluded that China's heavy industries significantly contribute to its CO_2 emissions. (Al-mulali and Ozturk, 2015) Provided similar results for MENA countries. Consequently, the reduction of industrial CO_2 emissions has remained as a vital mitigation strategy for the developing countries (Chen et al., 2013).

The secondary group of evidence reports the beneficial effects of industrialization on CO_2 emissions. China can enjoy environment friendly effect from industrialization if it can upgrade and optimize the structure of this industrial sector (Zhou et al., 2013). However, by ensuring replacement of fossil fuel energy consumption by the industrial sector of USA, with renewable sources of energy, this carbon emitter can live with beneficial eco-friendly impacts of industrialization (Congregado et al., 2016). Interestingly for country like Nigeria, their industrial sector has an inverse but significant effect on CO_2 emissions (Raheem and Ogebe, 2017).

2.3. Electricity Consumption, and Environmental Degradation

While industrialization is a major contributor to CO_2 emissions, the current focus should be on improving energy efficiency (Lin and Lei, 2015). A huge amount of atmospheric GHG emission results from the consumption of traditional energy, which consequently deteriorates the environment**.** Based on panel dataset, researchers like (Sohag et al., 2017) for MENA countries, (Asif et al., 2015) for GCC countries, (Le, 2020) for a set of 47 countries, (Kalaycı and Hayaloğlu, 2019) for NAFTA have tried to examine the link between CO_2 emission, and energy consumption. At the same time, other researchers such as (Alam et al., 2011) for India, (Nguyen and Wongsurawat, 2017) for Vietnam, (Dar and Asif, 2018), (Asumadu Sarkodie and Owusu, 2017) for Ghana, (Salahuddin et al., 2018) for Kuwait, (Pata, 2017) for Turkey have relied on individual country specific dataset for the same analysis. All of these studies have observed energy consumption to significantly increase CO_2 emission. However, if the basket of energy consumption consists of renewable and nuclear sources, environmental quality improves (Majeed and Luni, 2019). Findings of (Cole and Neumayer, 2004; Parikh and Shukla, 1995; Shahbaz et al., 2016; York et al., 2003) lends support to this alternative view by concluding that clean energy consumption improves environmental quality.

2.4. Agriculture, and Environmental Degradation

CO_2 emission from agriculture has remained important as nations strive to ensure food security (Li et al., 2016b). This sector emits three main contributors of GHG, namely, CO_2, CH_4, and N_2O emanating mainly from population growth, increased demand for food, and change in land use (Cole et al., 1997). As a result, research on the link between agriculture, and CO_2 emission is gaining momentum (Gold and Library (U.S.), 1999). Agriculture could have both positive, and negative effects on climate (Pant, 2009). For example, in North African countries, higher agricultural production leads to a long-run CO_2 emissions reduction (Ben Jebli and Ben Youssef, 2017). But, many findings suggest that efficiency in agricultural production plays an important role in reducing CO_2 emissions (Clark and Tilman, 2017; van Vuuren et al., 2017; Zhang et al., 2019). Normally, agriculture helps in reducing CO_2 emissions as arable land sinks some of the emissions, and sequesters it into organic matter, and for use as biomass (Sauerbeck, 2001). Acknowledging that, (Altieri et al., 2017) suggest focusing more on traditional farming methods, mainly used by peasant farmers. However, literature points at not to be misguided by incorporating those CO_2 emissions in the agriculture sector, which results from use of fossil fuel based machineries such as tractors, irrigation pump etc. and cautiously incorporate them under the energy sector (Ceschia et al., 2010; Tubiello et al., 2013).

2.5. Context of Bangladesh

As globalization facilitates knowledge, and technological transition, it allows an economy to go through an economic transformation where industrialization grows (Jena and Grote, n.d.). According to data from UNCTAD, Bangladesh has seen unprecedented rise in FDI from USD 1.1B in 2011 to USD 3.6B in 2018, due to increased facilitation through introduction of a host of new Economic Zones, and improved infrastructure. Increased FDI influx generally leads to rise in industrialization, which tends to increase energy consumption. For Bangladesh, a country that already ranks 162[nd] out of 180 countries according to the Environmental Performance Index (Bangladesh | Environmental Performance Index, n.d.), this is a major concern from an environmental viewpoint. Hence, evidence on this context for Bangladesh has been grabbing attention to enable for well-informed policymaking. Moreover, Bangladesh being an economy historically based on agriculture, investigation incorporating agricultural context on this discourse of environment is seeking attention of researchers.

Existing evidence on Bangladesh reports mixed findings. Using data spanning from 1973-2013 (Rayhan et al., 2018) found that while significantly higher environmental degradation is resulted due to increase in energy consumption, and economic growth, insignificant result is observed from more trade openness, and more FDI inflow. On the other hand, though energy consumption degrades environment, trade openness significantly reduces CO_2 emission (Islam et al., 2017; Oh and Bhuyan, 2018). (Rabbi, 2015) concludes the existence of EKC hypothesis for Bangladesh along with a degrading impact of energy on CO_2 emission, and inverse impact coming from trade openness. However, exploiting KOF index of globalization (Ahad, 2016) concludes that globalization, industrialization, and energy consumption, all three increases CO_2 emission in the long-run. Supporting that (Mahbub et al., 2020) concludes that in long-run both globalization, and economic growth degrades environment. Bringing economic globalization in particular, (Sharmin and Tareque, 2018) indicates that energy intensity, urbanization, industrialization, economic globalization, and economic growth all have significant positive relationship with per capita CO_2 emissions while data over 1980-2014 is utilized. (Intergovernmental Panel on Climate Change and Edenhofer, 2014) has pointed at the difficulty of separating anthropogenic, and natural GHG fluxes from land. Though it's relatively hard to estimate, and report country level atmospheric GHG fluxes than that of other sectors, the study of (Craig A Meisner and Md. Yusuf Ali, 2017) has claimed that between 1990 and 2013, where emissions from energy sector has increased by almost 500%, at the same time agricultural emissions have increased by about 30% in Bangladesh. Nevertheless, agriculture, and livestock sector are the prime suppliers of GHGs. Here in Bangladesh, non-CO_2 GHG emission such as agricultural land oriented N_2O emissions, and CH_4 emissions from livestock enteric fermentation, manure management, and emissions resulting from rice paddies have dominated this agricultural GHG emission (Intergovernmental Panel on Climate Change and Edenhofer, 2014).

3. OBJECTIVE

It is discernible from the above literature review that in both theoretical, and empirical research the impact on CO_2 emissions arising from globalization, industrialization, economic growth, energy consumption, and agriculture is still under debate. As a result, the links among them are very intricate that cannot be readily traced or narrated.

However, on this topic some shortcomings are visible in the literature for Bangladesh. Researchers have studied the effect of economic growth, industrialization, energy consumption, and trade openness on environment quality. However, hardly anyone has studied the impact of globalization, and agriculture on environment. Secondly, in Bangladesh, while only a handful studies have ever focused on the influence of globalization on CO_2 emission, no study has ever been conducted to observe the impact of agriculture on CO_2 emission. Besides that, the percentage of electricity consumption by the agriculture and industry sectors of Bangladesh is increasing and from 1995 to 2010, it had been around 45% of total electricity consumption (Masuduzzaman, 2012). Though this sector now demands separate attention, almost all the studies have still focused on the energy sector as a whole. In addition to this, no concrete conclusion could been drawn on the impact of industrialization.

We can hypothesize based on the existing evidence that, being barely out of the LDC bracket, it is highly likely that the impact of globalization along with industrialization, and consequent electricity consumption will increase the emission levels significantly in Bangladesh. However, since the farmers here still follows traditional agricultural methods, a resulting significant environmental degradation generated from an agricultural production rise is highly unlikely. Rather, it might be the other way around since the alternative of agriculture for a piece of land is either industrial production or housing.

Based on the above context, approach of co-integration has been undertaken to detect how the environment quality is affected in Bangladesh by globalization, industrialization, electricity consumption, and agriculture in the long-run. In order to provide power to the model, and more empirical evidence on this topic, we added economic growth in our model.

4. MATERIALS AND METHODS

To stand on our goal, we have extracted annual time series data for Bangladesh. However, data for electricity consumption is available only till 2014, which has limited us to choose our time expanding from 1971 to 2014. Descriptions, and sources of these variables are outlined in Table 1.

As discussed in section 2, the existing literature can be categorized into three groups. The first group, which investigates the EKC argument, follows a quadratic functional form. However, our paper does not intend to test the EKC hypothesis, and our focus is more on the long-run dynamics of environmental degradation when the above mentioned determinants are present in the model– which is a notable feature of the more recent studies. To investigate long-run relationships using time series data, a linear functional form is most common, and reliable as can be found in most of the literature under the second, and third categories in section 2. So, instead of a quadratic functional form like the EKC strand, the functional form used in this paper is constructed as follows which is quite similar to the setup of (Asumadu-Sarkodie and Owusu, 2016; Sharmin and Tareque, 2018) –

$$CO_2 = f(GDP, GI, IND, ECN, AGR) \quad (1)$$

However, (Dar and Asif, 2018) concludes that, a logarithmic transformation can provide comparatively reliable estimates than a linear model, and this has motivated us to convert our model into a logarithmic form.

$$lnCO_{2t} = \alpha_0 + \alpha_1\, lnGDP_t + \alpha_2\, lnGI_t + \alpha_3\, lnIND_t + \alpha_4\, lnECN_t + \alpha_5\, lnAGR_t + u_t \quad (2)$$

Here, represents natural logarithm, and represents time. Now, our main motive is identifying how much our chosen variables need to be altered to reduce the long-run environmental degradation in Bangladesh. Previously with a goal of studying long-run relations, researchers (Alshehry and Belloumi, 2015; Ben Jebli and Ben Youssef, 2017) have usually relied on various co-integration techniques such as (Phillips and Hansen, 1988; Robert and Granger, 1987; Soren Johamen and Katarina Jtiselius, 1990). However, if the variables are integrated at their level I(0) or at their first difference, I(1) these aforementioned methods end up generating unwanted biased results. As a remedial, (Pesaran and Shin, 1995; Pesaran et al., 2001) have introduced the autoregressive distributed lag (ARDL) model which can generate unbiased estimates (Harris and Sollis, 2003), even in the presence of a mixed I(0), and I(1) series. Not just that, the following advantages announce the superiority of ARDL model over other estimation techniques such as follows-

1. It can produce statistically significant, efficient, and consistent result even if the sample size is smaller (Narayan and Smyth, 2005; Pesaran et al., 2001)
2. It requires solving a single equation rather than a set of equations in order to estimate the short-run, and long-run (Bentzen and Engsted, 2001)
3. Avoiding possible endogenity, it itself can provide unbiased long-run estimates (Harris and Sollis, 2003; Narayan, 2004)
4. ARDL technique helps in the derivation of dynamic unrestricted error correction model, which in return helps determining short-run, and long-run without losing relevant data.

Though this approach necessitates that no variable must be integrated of order two I(2) (Ohlan, 2015), due to the aforementioned advantages, we have employed ARDL model as the co-integration technique. ARDL model normally moves forward by adopting a simple test known as bounds test to show presence of any co-integration or long-run relationship among the chosen variables.

However, the entrance gate to step in the ARDL process is the most crucial aspect here. Unless or until this gate gets unlocked, no ARDL output will achieve reliability. Most of the time series model rests on the assumption of stationarity meaning that over time, the variance, and mean maintain to exhibit constant values. However, in the light of reality, it has been frequently found that over time, the mean value, and value of variance for every time series variable keeps changing, and thus they are regarded as variables with unit root. When a time series variable has, time varying mean, and variance, and thus exhibits unit roots, econometricians label the series as non-stationary.

If a time series variable suffers from exhibiting non-stationarity, the conventional OLS approach tends to provide biased, and unreliable estimates. Therefore, any regression analysis involving non-stationary data is called spurious regression. To avert spurious regression, checking unit root is recommended for every variable. The most popular, and commonly used test to check for unit root is ADF test (Dickey and Fuller, 1981) as it takes into account the problem of autocorrelation by including lag values of the variable in the intercept, and intercept-trend models. In this study, we have seek this usefulness of ADF test for our stationarity checkups. For that we have tested -

- H_0: Non-Stationarity (i.e., Z_t has unit root) against
- H_A: Stationarity (i.e., Z_t has no unit root).

Given that the H_0 has received rejection, If a series is stationary at its level, the series is an I(0) series. In contrast, taking differencing

Table 1: Details of the selected variables

Name of variable	Symbol	Description	Source
Carbon emission	CO_2	CO_2 emissions (metric tons per capita)	World Bank Database
Economic growth	GDP	GDP per capita (constant 2010 USD)	World Bank Database
Globalization	GI	Globalization index developed by (Dreher, 2006)	KOF Index
Industrialization	IND	Industry (including construction), value added (% of GDP)	World Bank Database
Electricity consumption	ECN	Electric power consumption (kWh per capita)	World Bank Database
Agriculture	AGR	land (hectares per person)	World Bank Database

is highly suggested if a series is not found to be I(0) in a hope that this transformation will end up making the series stationary. In that case if the series becomes stationary after differencing for once, it is named as I(1) series. ADF test has the following the specifications:

For intercept, and trend:

$$\Delta z_t = \mu + \delta z_{t-1} + \lambda_t + \sum_{j=1}^{q} \theta_j \Delta z_{t-j} + \Delta_t \tag{3}$$

For intercept:

$$\Delta z_t = \mu + \delta z_{t-1} + \sum_{j=1}^{q} \theta_j \Delta z_{t-j} + \Delta_t \tag{4}$$

Here z_t resembles each time series variable to be used in this paper. Δz_t stands for first difference of the variable z_t, the intercept term is denoted by μ, the residual term has been addressed by ε_t, and lastly the optimum lag length for which the lagged value of variable is significant has been indicated by q.

Conditioned upon getting satisfactory outcome in the ADF test, at first, this paper proceeds forward for ARDL bounds testing. The following ordinary least squares (OLS) equation is estimated for the ARDL bounds test approach.

$$\begin{aligned}\Delta lnCO_{2t} = {} & \alpha_0 + \sum_{i=1}^{q1} \beta_{1i} \Delta lnCO_{2t-i} + \sum_{i=0}^{q2} \beta_{2i} \Delta lnGDP_{t-i} \\ & + \sum_{i=0}^{q3} \beta_{3i} \Delta lnGI_{t-i} + \sum_{i=0}^{q4} \beta_{4i} \Delta lnIND_{t-i} + \sum_{i=0}^{q5} \beta_{5i} \Delta lnECN_{t-i} \\ & + \sum_{i=0}^{q6} \beta_{6i} \Delta lnAGR_{t-i} + \lambda_1 CO_{2t-i} + \lambda_2 lnGDP_{t-i} + \lambda_3 GI_{t-i} \\ & + \lambda_4 lnIND_{t-i} + \lambda_5 lnECN_{t-i} + \lambda_6 lnAGR_{t-i} + u_t \end{aligned} \tag{5}$$

Here, Δ operator indicates first-difference of that variable, and all the β coefficients, and λ coefficients have been written to represent the short-run dynamic relationships, and the long-run dynamic relationships respectively. α_0 has been included to represent the intercept term, and the white noise error term has been addressed by u. In addition, all the q indicates the optimum lag lengths, and the subscript (*t–i*) beside any variable, refers to ith lag of that variable.

This bounds test is standing on the base of an F-statistic, which follows an asymptotic distribution, and under a no co-integration null, this test statistics is assumed to be non-standard. During the bounds testing, presumption of no co-integration in the null (i.e., H_0: All the λ coefficients = 0) is checked against the alternative hypothesis of co-integration (i.e., H_A: Not all the λ coefficients = 0) in order to identify presence of co-integration**.** However, decision depends on the comparison between calculated F-statistics, and the critical value. Two types of asymptotic critical values are commonly used here (Pesaran et al., 2001). One is named as upper critical bound (UCB), and other one as lower critical bound (LCB**).** But these critical values are useable for sample size of 1000. However, for our case where sample size is below 50, critical values for a sample size of 30 to 80 generated by (Narayan, 2004) is suggestive. Now, if all the series of a model are found to be I(0), LCB is utilized to give decision on the presence of co-integration, and UCB is utilized for all the other cases. Now, at a predetermined level of significance:

- The null receives rejection, if the F statistic > UCB
- The null receives no rejection, if the F statistic < LCB
- Inference becomes inconclusive, if LCB < F statistic < UCB.

However, this calculated F-statistic is very much sensitive to lag order selection. Misleading results occurs if the used lag length is inappropriate. As a result, once the ADF test has been carried out, instead of jumping into the bounds test, we must proceed forward to finalize the optimum number of lags (q) by lag order selection criteria that will minimize the errors the most. To that end, this study has utilized AIC criteria (Akaike, 1969), and the lag emerging with lowest AIC value has been finalized. We have depended on AIC criteria at each stage as AIC offers better results when the objective is prediction. Apart from that, AIC makes no restrictive assumption such as the true model lies in the model space.

Secondly, given that we could find co-integration among the variables under the bounds test, we can now estimate a conditional ARDL model for capturing the long-run dynamics of the model. This model can be specified as follows:

$$\begin{aligned} lnCO_{2t} = {} & \alpha_0 + \sum_{i=1}^{q1} \lambda_{1i} lnCO_{2t-i} + \sum_{i=0}^{q2} \lambda_{2i} lnGDP_{t-i} + \sum_{i=0}^{q3} \lambda_{3i} lnGI_{t-i} \\ & + \sum_{i=0}^{q4} \lambda_{4i} lnIND_{t-i} + \sum_{i=0}^{q5} \lambda_{5i} lnECN_{t-i} + \sum_{i=0}^{q6} \lambda_{6i} lnAGR_{t-i} + u_t \end{aligned} \tag{6}$$

Here, all the symbols have been explained earlier in this paper. Now, lastly to dig the whole plot, an error correction model is estimated. It lends benefits by capturing the short-run dynamics of the long-run relationship. It does so by determining aspects such as the speed of adjustment towards equilibrium. The parameters of short-run are obtained by the estimation of an error correction model (ECM) associated with the long-run estimates. For our study the ECM can be specified as follows:

$$\begin{aligned}\Delta lnCO_{2t} = {} & \alpha_0 + \sum_{i=1}^{q1} \beta_{1i} \Delta lnCO_{2t-i} + \sum_{i=0}^{q2} \beta_{2i} \Delta lnGDP_{t-i} \\ & + \sum_{i=0}^{q3} \beta_{3i} \Delta lnGI_{t-i} + \sum_{i=0}^{q4} \beta_{4i} \Delta lnIND_{t-i} + \sum_{i=0}^{q5} \beta_{5i} \Delta lnECN_{t-i} \\ & + \sum_{i=0}^{q6} \beta_{6i} \Delta lnAGR_{t-i} + \theta ECT_{t-1} + u_t \end{aligned} \tag{7}$$

Here, θ represents the speed at which any short-run deviations in this framework adjusts to the long-run equilibrium, and ECT_{t-1}

stands for the error correction term. A significant negative ECT_{t-1} is desirable in this study, since it indicates a convergent correction mechanism from short run to the long-run equilibrium. All the other symbols have been explained earlier in this paper.

After performing the whole co-integration process, it is very important to verify the stability of this model. To prove that our parameters from the model are stable, we have exploited Cumulative Sum of Recursive Residuals (CUSUM), and Cumulative Sum of Square of Recursive Residuals (CUSUMSQ). Besides that, the stability of the ARDL model relies on the residual diagnostic tests like serial correlation, normality, model misspecification, and heteroscedasticity. Firstly, we exploit Breusch-Godfrey Lagrange multiplier to check for the presence of serial correlation in the residuals (Breusch, 1978). Secondly, the normality of the residuals is examined by the Jarque-Bera test (Gujarati and Porter, 2009). Thirdly, Ramsey's reset test has been performed to spot model misspecification (Ramsey, 1969). Fourthly, heteroskedasticity of the residuals has been detected by the Breusch, and Pagan test (Breusch and Pagan, 1979).

5. EMPIRICAL RESULTS

Table 2 provides summary statistics of our chosen variables.

The time-series plots of the underlying variables have been portrayed in Figure 1, and an increasing trend is observed for all the series apart from LAGR. The visual illustration implies the existence of a relationship among these series. However, rigorous statistical tools have been further used in this paper to check for the co-integration among the variables.

5.1. Unit Root Test

We have proceeded with our analysis by conducting unit root test to check the aforementioned requirements for the reliability of ensuing the bounds test result (Ouattara, 2004; Phong et al., 2018). In that line, we have checked each series with the help of ADF test. The test examined the underlying data with the specification given by (3), and (4). The results are delineated in Table 3. The ADF test result indicates that at 5% level of significance, all of our variables are either I(0) or I(1). In addition to that, no I(2) variables are there in our model.

5.2. Optimal Lag Selection by VAR

Our ARDL bounds test involves two steps. At first, we have selected our optimal lag order to estimate the ARDL model utilizing the unrestricted VAR model. All the criterions suggest using lag two for conducting the ARDL model. After evaluating various models with lag two (the top-20 model with lag 2 are illustrated in Figure 2, the statistical software Eviews recommends ARDL (LCO2, LGDP, LGI, LIND, LAGR, LECN) = ARDL (1, 0, 0, 0, 2, 2) as the most suitable model for our study.

5.3. Autoregressive Distributed Lag (ARDL) Estimates, and the Bounds Test

Table 4 outlines our optimal ARDL model (1, 0, 0, 2, 2). The adjusted R-square, R-square, F-statistic, and Durbin-Watson statistic for this model are excellent which reassert the fitness of our chosen model.

Secondly, after finding the optimal lag length, we have carried out the ARDL bounds test following (5). The outcome is shown in Table 5. The calculated F-statistics is 6.71, and since not all of our series are I(0), so at 1% level of significance, we have compared it with the UCB, and it has successfully exceeded that UCB value of 6.32. Therefore, statistical evidence suggests that the variables of interest in our study have a co-integrating relationship.

5.4. Long-Run, and Short Run Result

The long-run results generated by exploiting the setup of (6) are demonstrated in Table 6. CO_2 emission has a positive long-run linkage with economic growth. That implies a 1% increase in economic growth will induce the CO_2 emission to rise by 0.29% on an average. This finding is similar with (Appiah et al., 2019; Mahbub et al., 2020; Nkengfack and Fotio, 2019; Sharmin and Tareque, 2018). We have also observed a positive association between CO_2 emission, and globalization. This result suggests that, keeping other variables constant, a 1% decrease in globalization will lower CO_2 emissions by 0.5% on average and it matches with findings of (Ahad, 2016; Dilawar Khan and Arif Ullah, 2019; Sharmin and Tareque, 2018). According to this

Table 2: Summery statistics

Variable Name	Mean	Standard Deviation	Minimum	Maximum
LCO2	–1.7882	0.6108	–2.9436	–0.7472
LGDP	6.1683	0.3066	5.7755	6.8578
LGI	3.4449	0.3355	2.8975	3.9557
LIND	2.9791	0.3071	1.8023	3.2699
LECN	4.1226	1.0068	2.3661	5.7689
LAGR	-2.4821	0.3371	–2.9905	–1.9835

Source: Author's calculation

Table 3: Result of ADF stationary tests

Variables	Intercept		Trend, and Intercept		Outcome
	Level	First difference	Level	First difference	
LCO2	0.9920	–5.9077***	–2.9503	–6.0024***	I(1)
LGDP	3.2629	–0.3380	1.6095	–3.0703**	I(1)
LGI	–0.6876	–7.1864***	–4.6526***	–7.1198***	I(0)/I(1)
LIND	–3.2695***	–3.3135***	–2.4967	–3.4597**	I(0)/I(1)
LECN	0.4632	–4.9161***	–4.1362***	–4.8954***	I(0)/I(1)
LAGR	–0.0228	–4.9443***	–2.4897	–4.8750***	I(1)

1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively. Source: Author's calculation using EViews

Figure 1: Representation of time series pattern of all the variables (a) carbon emission, (b) economic growth (c) globalization (d) industrialization (e) electricity consumption (f) agriculture in their logarithmic form

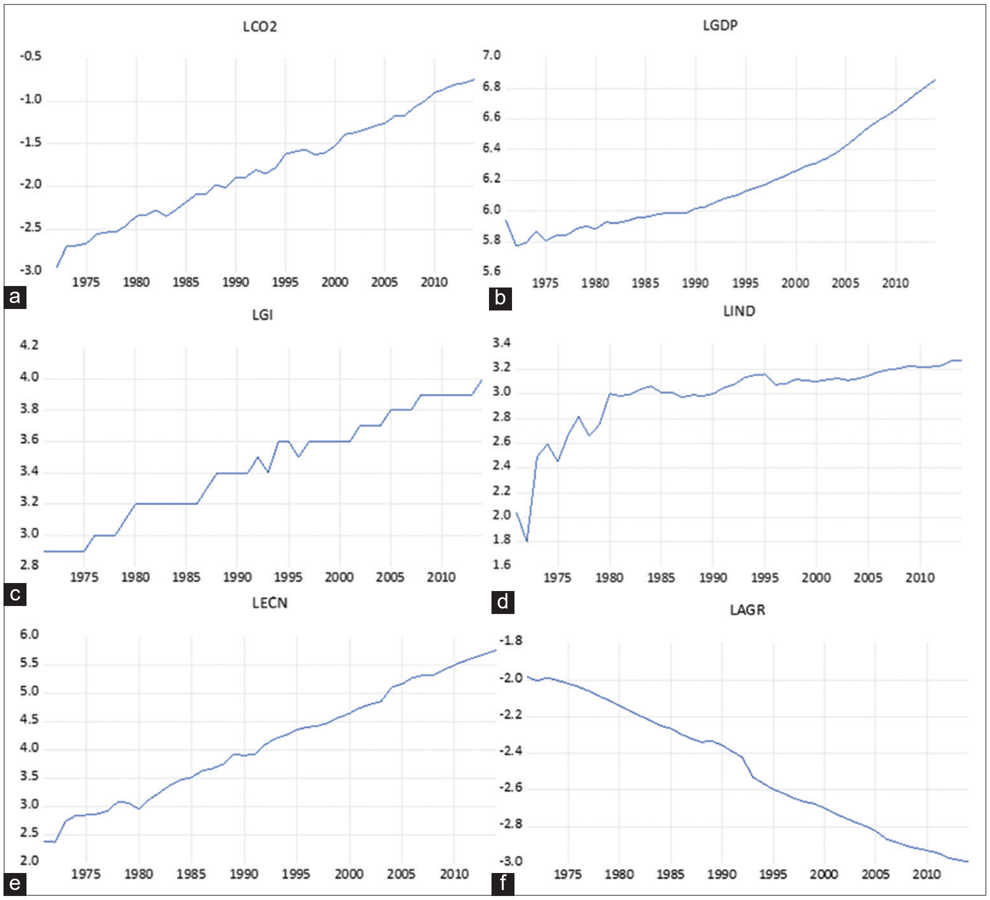
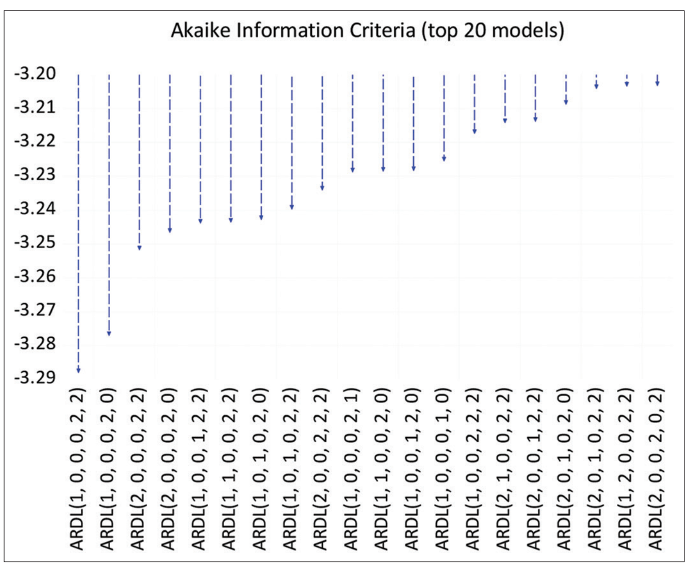


Figure 2: Optimal lag selection criteria



result, globalization is leaving the highest impact on degrading the environment of Bangladesh. Now, for the variables Electricity consumption, and Industrialization, the coefficients show 0.29%, and 0.07% increases respectively in CO_2 emission and they show similarity with findings of (Ahad, 2016; Pata, 2017; Phong et al., 2018; Rabbi, 2015; Rayhan et al., 2018; Sharmin and Tareque, 2018). All of these variables are statistically significant at 10%.

Table 4: ARDL estimation results

Variable Name	Coefficient
LCO2 (–1)	0.2293* (0.1349)
LGDP	0.2226** (0.1082)
LGI	0.3532** (0.1778)
LIND	0.0515 (0.1992)
LECN	0.1083 (0.1317)
LECN(–1)	–0.1257 (0.1548)
LECN(–2)	0.2413** (0.1041)
LAGR	–0.0984 (0.5363)
LAGR(–1)	0.8451 (0.7734)
LAGR(–2)	–0.9029* (0.4986)
C	–5.3847*** (1.1267)
Adjusted R-squared	0.9944
R-squared	0.9958
Durbin-Watson statistics	1.6820
F- Statistics	739.5644

Source: Author's calculation using EViews. Note: Values in parentheses are standard errors. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively

As per our expectation, agriculture is the only variable in this study having a benign effect on CO_2 emission reduction. It does not cause any significant degradation in the environment of Bangladesh. In fact, it may improve the quality of the environment by reducing CO_2 emission by 0.02% for a 1% increment which is contradictory to the findings of (Parajuli et al., 2019) for a panel data analysis. However, the result is not statistically significant, and thus concluding this seems illogical, and so it should be used with caution.

Table 5: Result of bounds test

Calculated	90%		95%		97.5%		99%	
F-Statistic	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
6.7112***	1.50	3.82	1.85	4.56	2.23	5.31	2.73	6.32

Note: Values in parentheses are standard errors. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively. Source: Author's calculation using EViews

Table 6: Estimates of long-run coefficients

Variable Name	Coefficient
LGDP	0.2889** (0.1339)
LGI	0.4583* (0.2391)
LIND	0.0669* (0.2251)
LECN	0.2905** (0.1406)
LAGR	–0.2028 (0.3180)

Values in parentheses are standard errors. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively. Source: Author's calculation using EViews

Table 7: Estimates of short-run coefficients

Variable Name	Coefficient
LECN	0.1083* (0.1117)
LECN(–1)	–0.2413*** (0.1248)
LAGR	–0.0984 (0.4220)
LAGR(–1)	0.9029** (0.4195)
C	–5.3847*** (0.8365)
ECT(–1)	–0.7706*** (0.1180)
Adjusted R-squared	0.5307
R-squared	0.5879
Durbin-Watson stat	1.6820

Note: Values in parentheses are standard errors. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively. Source: Author's calculation using EViews

The short run dynamics from (7) are tabulated under Table 7. Our lagged value of the error correction term is significantly negative at 1% level. This coefficient of ECT(–1) confirms that our ARDL model is dynamically stable implying if any disequilibrium is generated by a shock it will be adjusted to the equilibrium. It further suggests that for Bangladesh it will converge to its long-run equilibrium by 77% per annum due to short-run shock generated from any of our independent variables, and the adjustment period will be approximately 1 year, and 3 (1/0.770637) months.

In the short-run, it is found that electricity consumption, and the lagged value of agriculture significantly degrade our environment. Though agriculture is found to decrease CO_2 emission in the short run, it is ignorable since it is insignificant at even 10% level of significance. On the other hand, the previous year's electricity consumption acts the same but at a significantly higher magnitude. It is evident that the impact of agriculture with 1 lag, in increasing the CO_2 emission is the highest in Bangladesh. With a 1% increase in the lag 1 period of agriculture, the environment degradation will rise by 0.9029% on an average if all other things remain constant.

5.5. Diagnostic Tests

We have utilize various diagnostic tests to check the exactitudes, authenticity, and consistency of our chosen model. Results of all this previously stated tests are shown in Table 8, and Figure 3. The high p-value confirms that our model has passed all of those tests of serial correlation, heteroscedasticity, normal distribution, and correct specification.

Table 8: Diagnostic tests analysis

Types of test	Test statistics	P-value
Serial correlation	0.5969	0.5571
Normality	0.7028	0.7036
Ramsey's RESET Test	0.3481	0.7089
Heteroscedasticity	1.2606	0.2942

Source: Author's calculation

Again, Figure 4 confirms that we have successfully passed the structural stability test with zero occurrence of any structural break during our selected period. In both CUSUM, and CUSUMSQ graphical plots, our result have maintained to stay inside the 5% critical bounds, which supply the assurance of structural stability, and reliability of our ARDL parameters.

6. DISCUSSION

In the context of Bangladesh, as can be seen from the results in section 5, this study finds significant positive relation of CO_2 emission with globalization, industrialization, and electricity consumption.

Considering the scenario of Bangladesh, the high magnitude of the long-run impact of globalization on CO_2 emission cannot be attributed to a single "effect" of globalization**.** The scale effect, and "pollution haven" arguments may apparently be the prime reasons due to the availability of cheap labor, and the lack of implementation of environmental laws, but the story is not so simple. With weak industrial infrastructure, and low technological base, it is not among the cheapest countries in the world as far as investment related cost is concerned (Sharif Md Abul Hussain, 2011). As of 2020, Bangladesh ranks 168th out of 190 countries in the Ease of Doing Business indicator (World Development Indicators | DataBank, n.d.). Having low wage costs can hardly compensate for its poor investment climate, and lack of infrastructure. However, the effects of globalization such as technique effect that have the potential to decrease emission are even less prevalent here. The labor force is not imparted practical knowledge, which in return impedes technological advancement, and downplays any potential technique effect. To sum up, the aggregate relation between globalization, and emission is positive because the increase in emission due to scale effect, and the "pollution haven" scenario overpowers any potential decrease that could be brought about through technique effect.

With regard to industrial output, the results are consistent with various international studies; i.e. increased manufacturing output increases CO_2 emission (Begum et al., 2015; Li et al., 2019). However, our findings show the magnitude of the impact of industrialization to be quite low. This can be explained by the composition of Bangladesh's export basket – 81% of which consists of RMG sector (Oh and Bhuyan, 2018). However, in the value chain, our RMG sector mostly involves highly labor-intensive CMT (Cut, Make, and Trim) activities. Moreover, the industrial safety compliance rules in the RMG sector has been very strict since the Rana Plaza incident in 2013 (Report, 2021). As a result, the RMG sector of Bangladesh is a

Figure 3: Result of Jarque-Bera normality test

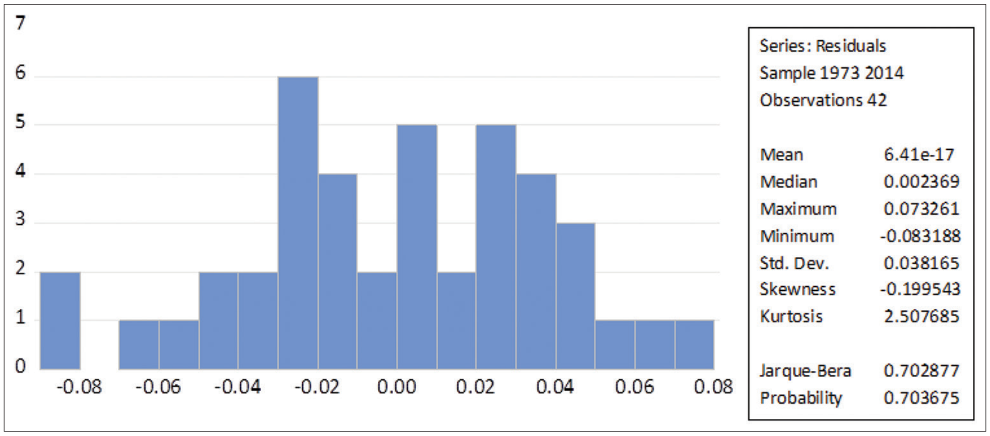
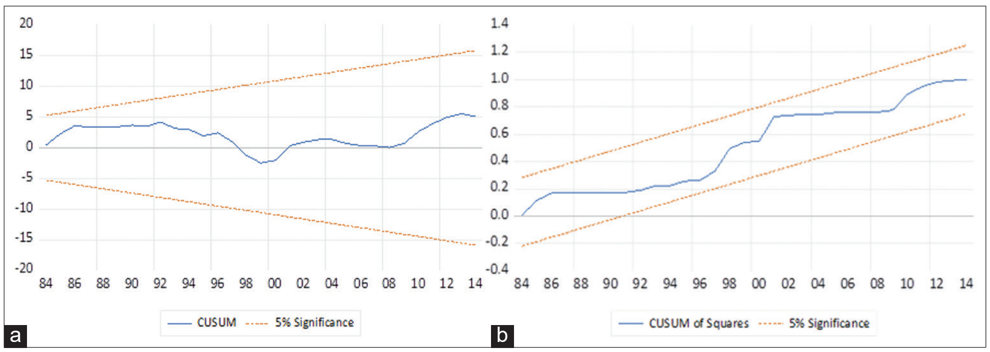


Figure 4: Representation of (a) cumulative sum of recursive residuals, and (b) cumulative sum of squares of recursive residuals



comparatively clean, and low emission industry (Oh and Bhuyan, 2018), and hence it can be concluded that the relatively low magnitude of industrialization in our findings is a consistent outcome.

Once again, in the long-run, the impact of electricity consumption on environmental degradation is found to have impact of the second highest magnitude on increasing emission. This can be attributed to the poor implementation of relevant policies, and laws in the country. Understanding the importance of electricity for acquiring the goal of higher economic growth, a good number of long-term, medium-term, short-term and immediate programs has been undertaken by Bangladesh government. It is revamping the electricity sector by undertaking projects related to installing nuclear power plants, establishing gas based power generation plants, generating renewable energy source based electricity, assuring uninterrupted power supply by undertaking massive distribution and transmission, importing electricity from neighboring countries via regional co-operation, and utilizing public-private participation to build new power plants etc. (Masuduzzaman, 2012). Besides that, Financial projects such as offering a 4 percent interest loan on environment friendly equipment, and electrical gadgets are also trying to promote energy conservation, and efficiency in both industrial and residential sector of this country (Bangladesh-Economic-Review, 2021a). It seems like Bangladesh government is dedicated to not only energy generation but also promotion of renewable, and nuclear energy, energy efficient equipment, and advanced technology (Ahad, 2016). However, the expected outcome even after implementation of such energy efficient actions and projects are far from reaching the desired level due to poor governance. Bangladesh ranked 137th out of 192 countries in terms of "Rule of Law" according to the Worldwide Governance Indicators (World Development Indicators | DataBank, n.d.). In addition, the energy sector management is of very poor quality (Mozumder and Marathe, 2007) and this sector itself run on the supply of huge government subsidies (Masuduzzaman, 2012). This lack of implementation and management hinders the conversion path onto green energy as well as gaining energy efficiency, which consequently results in significant CO_2 emission.

Interestingly, our study shows no significant long-run effect of agriculture on CO_2 emission, rather we have received a negative coefficient for agriculture. A possible reason for this might be the fact that we have focused on CO_2 emission instead of non-CO_2 GHG emissions, and the net CO_2 flux from arable land is small (Cooper et al., 2001). Before the end of this century, according to the projection of (Intergovernmental Panel on Climate Change and Edenhofer, 2014) agriculture sector will be labeled as a net CO_2 sink. Besides that, one of the main source of agricultural CO_2 emission is generated from the use of machineries by our farmers but this is separated from the agriculture sector, and is be considered under emission from energy consumption (Ceschia et al., 2010). If we investigated non-CO_2 GHG emission instead of CO_2, the findings regarding agriculture might have been different as, in terms of anthropogenic non-CO_2 GHGs emission, agriculture sector is the largest contributor. In fact, back in 2005, it alone released 56% of anthropogenic non-CO_2 GHGs in the world (Intergovernmental

Panel on Climate Change and Edenhofer, 2014; US EPA National Center for Environmental Assessment, 2011).

7. CONCLUSION AND POLICY RECOMMENDATION

Over the last few decades, Bangladesh's economy has been maintaining a steady growth path. Though this journey of high economic growth has confirmed different socioeconomic benefits, the impact it is rendering by degrading the environment has become a hot-button issue. According to this paper, all of these success stories of high economic growth can be washed away in the long run as globalization, industrialization and electricity consumption are highly responsible for degrading the environmental quality of this country. This issue as a result demands an ambitious policy response. However, a poor economy like Bangladesh, already grappling with several developmental challenges, can only seek policy mix that goes with her capacity level, yet lead it's economy onto sustainable inclusive growth path.

According to our result, industrialization, at this stage does not pose much threat to the environment in the context of Bangladesh. However, with readjustments in the export basket, the situation regarding industrialization may very well change in case the share of RMG decreases, and gets replaced by industries that emit more as they rely less on efficient energy. So, investigating on and exploiting renewable energy sources must be carried on by the Ministry of Power, Energy and Mineral Resources. Beside that the use of environment friendly technologies should be made compulsory for the whole industrial sector and the use of old technologies, which causes environmental pollution must be banned to settle down this problem. Imposing environmental taxes can also be addressed by the policymaker, if any industry does not go for inclusive technology.

In order to turn the impact of globalization on emission down, the technique effect needs to be increased. For that, policy must be undertaken to promote the dissemination of technologies. However, it should be combined with initiatives that will enhance the absorptive capacities of this country. To achieve required technology transfer and to enhance the basic capacities to acquire, adapt and use these technologies, support from the high-income countries must be ensured. To make this happen, the path of attracting foreign aid must be revised. Not only that, to ensure greater involvement of, and provision of funding by the domestic private sector, persisting weaknesses in the business environment needs to be addressed. Government should also work on bringing satisfactory reforms in the International agreements to exclude critical sectors from patenting, so that we can scale-up technology transfer at a required scale. Apart from these, the labor force needs to be mobilized effectively, so that its vast population can take advantage of the technology that is now available, and can, in the process, prepare a skilled labor force. Producing skilled labor also demands raising the standard of education, and the policy mix should also include that.

Last but not the least, a countries' ability to successfully implement any policy depends to a significant extent on their institutional structures. Even though the country has laws in place such as the Bangladesh Environment Conservation Act (1995), the governance, and implementation is of poor quality. In terms of technology transfer, absence of institutions, weak legal frameworks and low levels of technical expertise are the biggest constraints that Bangladesh faces and the energy sector is constrained by inefficiency and poor quality of governance. As a result, to attain increased global integration, and energy consumption while ensuring emission is controlled, improvement of the institutional quality must be the first policy step among all and without it other policy might fail to bring the expected outcome and Bangladesh might be established as a "pollution heaven" for the developed world.

REFERENCES

Ahad, M. (2016), Does globalization impede environmental quality in Bangladesh? The role of real economic activities and energy use. Bulletin of Energy Economics, 4, 258-279.

Akaike, H. (1969), Fitting autoregressive models for prediction. Annals of the Institute of Statistical Mathematics, 21(1), 243-247.

Alam, M.J., Begum, I.A., Buysse, J., Rahman, S., Van Huylenbroeck, G. (2011), Dynamic modeling of causal relationship between energy consumption, CO_2 emissions and economic growth in India. Renewable and Sustainable Energy Reviews, 15(6), 3243–3251.

Al-Mulali, U., Ozturk, I. (2015), The effect of energy consumption, urbanization, trade openness, industrial output, and the political stability on the environmental degradation in the MENA (Middle East and North African) region. Energy, 84, 382-389.

Alshehry, A.S., Belloumi, M. (2015), Energy consumption, carbon dioxide emissions and economic growth: The case of Saudi Arabia. Renewable and Sustainable Energy Reviews, 41, 237-247.

Altieri, M., Nicholls, C., Montalba, R. (2017), Technological approaches to sustainable agriculture at a crossroads: An agroecological perspective. Sustainability, 9(3), 349.

Antweiler, W., Copeland, B., Taylor, M.S. (2001), Is free trade good for the environment? American Economic Review, 91, 877-908.

Appiah, K., Du, J., Yeboah, M., Appiah, R. (2019), Causal correlation between energy use and carbon emissions in selected emerging economies-panel model approach. Environmental Science and Pollution Research, 26, 7896-7912.

Asif, M., Sharma, R., Adow, A. (2015), An empirical investigation of the relationship between economic growth, urbanization, energy consumption, and CO_2 emission in GCC countries: A panel data analysis. Asian Social Science, 11, 270-284.

Asumadu Sarkodie, S., Owusu, P. (2017), Recent evidence of the relationship between carbon dioxide emissions, energy use, GDP, and population in Ghana: A linear regression approach. Energy Sources Part B Economics Planning and Policy, 12, 495-503.

Asumadu-Sarkodie, S., Owusu, P.A. (2016), Carbon dioxide emission, electricity consumption, industrialization, and economic growth nexus: The Beninese case. Energy Sources, Part B: Economics, Planning, and Policy, 11(11), 1089-1096.

Aung, T., Saboori, B., Rasoulinezhad, E. (2017), Economic growth and environmental pollution in Myanmar: An analysis of environmental Kuznets curve. Environmental Science and Pollution Research International, 24, 3.

Bacon, R.W., Bhattacharya, S. (2007), Growth and CO_2 emissions: How do different countries fare? Tokyo, Japan: APO.

Bangladesh, Environmental Performance Index. (n.d.), Available from: https://www.epi.yale.edu/epi-results/2020/country/bgd. [Last accessed on 2021 Jul 13].

Bangladesh-Economic-Review. (2021a), Fifteen-environment, climate change and development. In: Finance Division, Ministry of Finance-Government of the People's Republic of Bangladesh. Bangladesh: Bangladesh-Economic-Review. p251-65. Available from: https://www.mof.portal.gov.bd/sites/default/files/files/mof.portal.gov.bd/page/f2d8fabb_29c1_423a_9d37_cdb500260002/24.%20Chapter-15%20Eng-21.pdf.

Bangladesh-Economic-Review. (2021b), One-macroeconomic situation. In: Finance Division, Ministry of Finance-Government of the People's Republic of Bangladesh. Bangladesh: Bangladesh-Economic-Review p1-10. Available from: https://www.mof.portal.gov.bd/site/page/28ba57f5-59ff-4426-970a-bf014242179e/Bangladesh-Economic-Review-2020.

Bangladesh-Economic-Review. (2021c), Seven-agriculture. In: Finance Division, Ministry of Finance-Government of the People's Republic of Bangladesh. Bangladesh: Bangladesh-Economic-Review. p91-105.

Bangladesh-Economic-Review. (2021d), Three-prices, wages and employment. Finance Division, Ministry of Finance-Government of the People's Republic of Bangladesh. Bangladesh: Bangladesh-Economic-Revie. p21-34.

Begum, R.A., Sohag, K., Abdullah, S.M.S., Jaafar, M. (2015), CO_2 emissions, energy consumption, economic and population growth in Malaysia. Renewable and Sustainable Energy Reviews, 41, 594-601.

Ben Jebli, M., Ben Youssef, S. (2017), Renewable energy consumption and agriculture: Evidence for cointegration and Granger causality for Tunisian economy. International Journal of Sustainable Development and World Ecology, 24(2), 149-158.

Bentzen, J., Engsted, T. (2001), A revival of the autoregressive distributed lag model in estimating energy demand relationships. Energy, 26(1), 45-55.

Bernauer, T., Kalbhenn, A., Koubi, V., Spilker, G. (2010), A comparison of international and domestic sources of global governance dynamics. British Journal of Political Science, 40, 1-30.

Breusch, T.S. (1978), Testing for autocorrelation in dynamic linear models. Australian Economic Papers, 17(31), 334-355.

Breusch, T.S., Pagan, A.R. (1979), A simple test for heteroscedasticity and random coefficient variation. Econometrica, 47(5), 1287-1294.

Burke, P.J., Shahiduzzaman, M., Stern, D.I. (2015), Carbon Dioxide Emissions in the Short Run: The Rate and Sources of Economic Growth Matter (SSRN Scholarly Paper ID 2597902). United States: Social Science Research Network.

Ceschia, E., Béziat, P., Dejoux, J.F., Aubinet, M., Bernhofer, C., Bodson, B., Buchmann, N., Carrara, A., Cellier, P., Tommasi, P., Elbers, J., Eugster, W., Grünwald, T., Jacobs, C., Jans, W., Jones, M., Kutsch, W.L., Lanigan, G., Magliulo, V., Wattenbach, M. (2010), Management effects on net ecosystem carbon and GHG budgets at European crop sites. Agriculture Ecosystems and Environment, 139, 363-383.

Chandra Ghosh, B. (2014), Economic growth, CO_2 emissions and energy consumption: The case of Bangladesh. International Journal of Business and Economics Research, 3(6), 220-227.

Chang, D.S., Yeh, L.T., Liu, W. (2015), Incorporating the carbon footprint to measure industry context and energy consumption effect on environmental performance of business operations. Clean Technologies and Environmental Policy, 17(2), 359-371.

Chen, Y.H.H., Timilsina, G., Landis, F. (2013), Economic implications of reducing carbon emissions from energy use and industrial processes in Brazil. Journal of Environmental Management, 130, 436-446.

Clark, M., Tilman, D. (2017), Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. Environmental Research Letters, 12(6), 064016.

Climate Displacement in Bangladesh. (2012), The Need for Urgent Housing, Land and Property (HLP) Rights Solutions. Bangladesh: Climate Displacement in Bangladesh. p1-35.

Cole, C.V., Duxbury, J., Freney, J., Heinemeyer, O., Minami, K., Mosier, A., Paustian, K., Rosenberg, N., Sampson, N., Sauerbeck, D., Zhao, Q. (1997), Global estimates of potential mitigation of greenhouse gas emissions by agriculture. Nutrient Cycling in Agroecosystems, 49(1), 221-228.

Cole, M.A. (2006), Does trade liberalization increase national energy use? Economics Letters, 92(1), 108-112.

Cole, M.A., Neumayer, E. (2004), Examining the impact of demographic factors on air pollution. Population and Environment, 26(1), 5-21.

Congregado, E., Feria-Gallardo, J., Golpe, A.A., Iglesias, J. (2016), The environmental Kuznets curve and CO_2 emissions in the USA. Environmental Science and Pollution Research, 23(18), 18407-18420.

Cooper, R.N., Houghton, J.T., McCarthy, J.J., Metz, B. (2001), Climate change 2001: The scientific basis. Foreign Affairs, 81(1), 208.

Copeland, B.R., Taylor, M.S. (1994), North-South trade and the environment. The Quarterly Journal of Economics, 109(3), 755-787.

Craig, A.M., Ali, M.Y. (2017), Climate-Smart Agriculture in Bangladesh, CSA Country Profiles for Asia Series. United States: International Center for Tropical Agriculture, World Bank. p28.

Dar, J., Asif, M. (2018), Does financial development improve environmental quality in Turkey? An application of endogenous structural breaks based cointegration approach. Management of Environmental Quality: An International Journal, 29(2), 368-384.

Dean, J.M. (2002), Does trade liberalization harm the environment? A new test. Canadian Journal of Economics, Revue Canadienne D'économique, 35(4), 819-842.

Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49(4), 1057-1072.

Dilawar, K., Ullah, A. (2019), Testing the relationship between globalization and carbon dioxide emissions in Pakistan: Does environmental Kuznets curve exist? Environmental Science and Pollution Research International, 26(15), 15199-15203.

Dreher, A. (2006), Does globalization affect growth? Evidence from a new index of globalization. Applied Economics, 38(10), 1091-1110.

Du, Q., Zhou, J., Pan, T., Sun, Q., Wu, M. (2019), Relationship of carbon emissions and economic growth in China's construction industry. Journal of Cleaner Production, 220(2), 99-109.

Etokakpan, M.U., Adedoyin, F.F., Vedat, Y., Bekun, F.V. (2020), Does globalization in Turkey induce increased energy consumption: Insights into its environmental pros and cons. Environmental Science and Pollution Research, 27(21), 26125-26140.

Fais, B., Sabio, N., Strachan, N. (2016), The critical role of the industrial sector in reaching long-term emission reduction, energy efficiency and renewable targets. Applied Energy, 162, 699-712.

Forster, P.M., Forster, H.I., Evans, M.J., Gidden, M.J., Jones, C.D., Keller, C.A., Lamboll, R.D., Quéré, C.L., Rogelj, J., Rosen, D., Schleussner, C.F., Richardson, T.B., Smith, C.J., Turnock, S.T. (2020), Current and future global climate impacts resulting from COVID-19. Nature Climate Change, 10(10), 913-919.

Frankel, J.A. (2009), Environmental Effects of International Trade. Thailand: HKS Faculty Research Working Paper Series. p1-61.

Galeotti, M., Lanza, A., Pauli, F. (2006), Reassessing the environmental Kuznets curve for CO_2 emissions: A robustness exercise. Ecological Economics, 57(1), 162-170.

Global Search on Data, Maps and Indicators-European Environment Agency. (n.d.), Collection-old Style. Available from: https://www.eea.europa.eu/data-and-maps/find/global#c12=bangladesh. [Last accessed on 2021 Aug 03].

Gold Library (U.S.). (1999), Sustainable Agriculture: Definitions and Terms. National Agricultural Library. Available from: https://www.books.google.com.bd/books?id=3ps-XDgT6VcC.

Gujarati, D.N., Porter, D.C. (2009), Basic Econometrics. United States: McGraw-Hill Irwin. Available from: https://www.books.google.com.bd/books?id=6l1CPgAACAAJ.

Gul, S., Zou, X., Hassan, C.H., Azam, M., Zaman, K. (2015), Causal nexus between energy consumption and carbon dioxide emission for Malaysia using maximum entropy bootstrap approach. Environmental Science and Pollution Research, 22(24), 19773-19785.

Haelg, F. (2020), The KOF globalisation index-a multidimensional approach to globalisation. Jahrbücher Für Nationalökonomie Und Statistik, 240(5), 691-696.

Harris, R., Sollis, R. (2003), Applied Time Series Modelling and Forecasting. United States: John Wiley.

Intergovernmental Panel on Climate Change, Edenhofer, O., editor. (2014), Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Islam, M.Z., Ahmed, Z., Saifullah, M.K., Huda, S.N., Al-Islam, S.M. (2017), CO_2 emission, energy consumption and economic development: A case of Bangladesh. The Journal of Asian Finance, Economics and Business, 4(4), 61-66.

Jaffe, A. (1995), Environmental regulation and the competitiveness of U.S. Manufacturing: What does the evidence tell us? Journal of Economic Literature, 33, 132-163.

Jena, P.R., Grote, U. (n.d.), Growth-Trade-Environment Nexus in India. Zürich: Proceedings of the German Development Economics Conference. p16.

Jorgenson, A., Givens, J. (2014), Economic globalization and environmental concern: A multilevel analysis of individuals within 37 nations. Environment and Behavior, 46, 484-871.

Kalaycı, C., Hayaloğlu, P. (2019), The impact of economic globalization on CO_2 emissions: The case of NAFTA countries. International Journal of Energy Economics and Policy, 9, 356-360.

KOF Globalisation Index. (n.d.), Available from: https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html. [Last accessed on 2021 Jul 06].

Kuznets, S. (1955), Economic growth and income inequality. The American Economic Review, 45(1), 19-28.

Latif, Z., Mengke, Y., Danish, Latif, S., Ximei, L., Pathan, Z.H., Salam, S., Jianqiu, Z. (2018), The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel estimation robust to heterogeneity and cross-sectional dependence. Telematics and Informatics, 35(2), 318-328.

Le, H.P. (2020), The impacts of globalization, financial development, government expenditures, and institutional quality on CO_2 emissions in the presence of environmental Kuznets curve. Environmental Science and Pollution Research, 27, 2.

Le, H.P., Van, D., Bao, H.H.G. (2018), The role of globalization on CO_2 emission in vietnam incorporating industrialization, urbanization, GDP per capita and energy use. International Journal of Energy Economics and Policy, 8, 275-283.

Li, L., Hong, X., Peng, K. (2019), A spatial panel analysis of carbon emissions, economic growth and high-technology industry in China. Structural Change and Economic Dynamics, 49, 83-92.

Li, T., Baležentis, T., Makutėnienė, D., Streimikiene, D., Kriščiukaitienė, I. (2016a), Energy-related CO_2 emission in European Union agriculture: Driving forces and possibilities for reduction. Applied Energy, 180, 2-10.

Li, T., Baležentis, T., Makutėnienė, D., Streimikiene, D., Kriščiukaitienė, I. (2016b), Energy-related CO_2 emission in European Union agriculture: Driving forces and possibilities for reduction. Applied Energy, 180, 682-694.

Liddle, B. (2001), Free trade and the environment-development system. Ecological Economics, 39, 21-36.

Lin, B., Lei, X. (2015), Carbon emissions reduction in China's food industry. Energy Policy, 86, 483-492.

Liu, X., Bae, J. (2018), Urbanization and industrialization impact of CO_2 emissions in China. Journal of Cleaner Production, 172, 178-186.

Mahbub, G.M., Nasir Uddin, S.M., Hossain, S., Akter, K. (2020), Does globalization degrade our environment? An empirical investigation in Bangladesh. International Journal of Social Science and Economic Research, 5(9), 2436-2451.

Majeed, M.T., Luni, T. (2019), Renewable energy, water, and environmental degradation: A global panel data approach. Renewable Energy, 13(3), 749-778.

Majeed, M.T., Tauqir, A. (2020), Effects of urbanization, industrialization, economic growth, energy consumption, financial development on carbon emissions: An extended STIRPAT model for heterogeneous income groups. Pakistan Journal of Commerce and Social Sciences, 14(3), 652-681.

Masuduzzaman, M. (2012). Electricity consumption and economic growth in Bangladesh: Co integration and causality analysis. Global Journal of Management and Business Research, 12, 31-48.

McAusland, C. (2010), Globalisation's direct and indirect effects on the environment. In: OECD, Globalisation, Transport and the Environment. Paris, France: OECD. p31-53.

Mohiuddin, O., Asumadu Sarkodie, S., Obaidullah, M. (2016), The relationship between carbon dioxide emissions, energy consumption, and GDP: A recent evidence from Pakistan. Cogent Engineering, 3, 1210491.

Mozumder, P., Marathe, A. (2007), Causality relationship between electricity consumption and GDP in Bangladesh. Energy Policy, 35(1), 395-402.

Narayan, P.K. (2004), Reformulating Critical Values for the Bounds F-statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji. Australia: MONASH University. p1-32.

Narayan, P.K., Smyth, R. (2005), Electricity consumption, employment and real income in Australia evidence from multivariate Granger causality tests. Energy Policy, 33(9), 1109-1116.

Nguyen, T., Hoi, L. (2020), Impact of globalization on CO_2 emissions in Vietnam: An autoregressive distributed lag approach. Decision Science Letters, 9, 257-270.

Nguyen, T.N., Wongsurawat, W. (2017), Multivariate cointegration and causality between electricity consumption, economic growth, foreign direct investment and exports: Recent evidence from Vietnam. Economic Growth, 7(3), 287-293.

Nkengfack, H., Fotio, H.K. (2019), Energy consumption, economic growth and carbon emissions: Evidence from the top three emitters in Africa. Modern Economy, 10(1), 52-71.

Oh, K., Bhuyan, I. (2018), Trade openness and CO_2 emissions: Evidence of Bangladesh. Asian Journal of Atmospheric Environment, 12, 30-36.

Ohlan, R. (2015), The impact of population density, energy consumption, economic growth and trade openness on CO2 emissions in India. Natural Hazards, 79, 1409-1428.

Ouattara, B. (2004), Modelling the Long Run Determinants of Private Investment in Senegal. In Economics Discussion Paper Series (No. 0413; Economics Discussion Paper Series). Economics, The University of Manchester. Available from: https://www.ideas.repec.org/p/man/sespap/0413.html.

Öztürk, Z. (2016), Enerji Tüketimi, Gelir, doğrudan yabanci yatirim ve CO2 emisyonu arasindaki ilişki: Türkiye Örneği. Cankiri Karatekin Universitesi Iktisadi Ve Idari Bilimler Fakultesi Dergisi, 6, 222.

Pant, K.P. (2009), Effects of agriculture on climate change: A cross country study of factors affecting carbon emissions. Journal of Agriculture and Environment, 10, 84-102.

Parajuli, R., Joshi, O., Maraseni, T. (2019), Incorporating forests, agriculture, and energy consumption in the framework of the environmental Kuznets Curve: A dynamic panel data approach. Sustainability, 11(9), 2688.

Parikh, J., Shukla, V. (1995), Urbanization, energy use and greenhouse effects in economic development: Results from a cross-national study of developing countries. Global Environmental Change, 5(2), 87-103.

Pata, U.K. (2017), The effect of urbanization and industrialization on carbon emissions in Turkey: Evidence from ARDL bounds testing procedure. Environmental Science and Pollution Research, 25(8), 7745-7746.

Pender, J. (2008), Community-led adaptation in Bangladesh. United Kingdom: Forced Migration Review. p54-55.

Pesaran, H., Shin, Y. (1995), An autoregressive distributed lag modeling approach to co-integration analysis. In: Econometncs and Economic Theory in the 20st Century: The Ragnar Frisch Centennial Symposium. Cambridge: Cambridge University Press. p31.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Phillips, P.C.B., Hansen, B.E. (1988), Estimation and Inference in Models of Cointegration: A Simulation Study. In Cowles Foundation Discussion Papers (No. 881; Cowles Foundation Discussion Papers). Cowles Foundation for Research in Economics, Yale University. Available from: https://www.ideas.repec.org/p/cwl/cwldpp/881.html.

Phong, L.H., Van, D.T.B., Bao, H.H.G. (2018), The role of globalization on CO_2 emission in vietnam incorporating industrialization, urbanization, GDP per capita and energy use. International Journal of Energy Economics and Policy, 8(6), 275-283.

Rabbi, F. (2015), Environment Kuznets Curve for carbon emissions: A cointegration analysis for Bangladesh. International Journal of Energy Economics and Policy, 5(1), 45-53.

Raheem, I., Ogebe, J. (2017), CO_2 emissions, urbanization and industrialization: Evidence from a direct and indirect heterogeneous panel analysis. Management of Environmental Quality: An International Journal, 28(6), 851-867.

Rahman, H.U., Zaman, U., Górecki, J. (2021), The role of energy consumption, economic growth and globalization in environmental degradation: Empirical evidence from the BRICS region. Sustainability, 13(4), 1-16.

Ramsey, J.B. (1969), Tests for specification errors in classical linear least-squares regression analysis. Journal of the Royal Statistical Society. Series B Methodological, 31(2), 350-371.

Rayhan, I., Akter, K., Islam, M., Hossain, M. (2018), Impact of urbanization and energy consumption on CO_2 emissions in Bangladesh: An ARDL bounds test approach. International Journal of Scientific and Engineering Research, 9, 838-843.

Report, S.B. (2021), Govt Plans Compliance Platforms Like Accord, Alliance: Salman. The Daily Star. Available from: https://www.thedailystar.net/business/news/govt-plans-compliance-platforms-accord-alliance-salman-2129591.

Richard, A., Berntsen, T., Bindoff, N.L., Chen, Z., Bindoff, L., Chen, Z. (2007), Climate Change 2007: The Physical Science Basis. Geneva, Switzerland: IPCC. p1-18.

Robert, F.E., Granger, C.W.J. (1987), Co-integration and error correction: Representation, estimation, and testing. Econometrica, 55(2), 251-176.

Ryan-Collins, L., Ellis, K., Lemma, A. (2011), Climate Compatible Development in the Infrastructure Sector. London, United Kingdom: Institution of Civil Engineers. p1-82.

Sadorsky, P. (2014), The effect of urbanization on CO_2 emissions in emerging economies. Energy Economics, 41, 147-153.

Salahuddin, M., Alam, K., Ozturk, I., Sohag, K. (2018), The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO_2 emissions in Kuwait. Renewable and Sustainable Energy Reviews, 81, 2002-2010.

Salahuddin, M., Gow, J., Ali, I., Hossain, R., Al-Azami, K.S., Akbar, D., Gedikli, A. (2019), Urbanization-globalization-CO_2 emissions nexus revisited: Empirical evidence from South Africa. Heliyon, 5(6), e01974.

Samreen, I., Majeed, M. (2020), Spatial econometric model of the spillover effects of financial development on carbon emissions: A global analysis. Pakistan Journal of Commerce and Social Science, 14, 569-602.

Sauerbeck, D.R. (2001), CO_2 emissions and C sequestration by agriculture-perspectives and limitations. Nutrient Cycling in Agroecosystems, 60(1), 253-266.

Sebastiaan, P. (1999), The California Effect In The EC's External Relations A Comparison of the Leghold Trap and Beef-Hormone Issues Between the EC and US and Canada. Pittsburg, PA: UNSPECIFIED. p1-27.

Selden, T.M., Song, D. (1994), Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution Emissions? Journal of Environmental Economics and Management, 27(2), 147-162.

Shahbaz, M., Hye, Q.M.A., Tiwari, A.K., Leitão, N.C. (2013), Economic growth, energy consumption, financial development, international trade and CO_2 emissions in Indonesia. Renewable and Sustainable Energy Reviews, 25, 109-121.

Shahbaz, M., Khan, S., Ali, A., Bhattacharya, M. (2015a), The impact of globalization on CO_2 emissions in China. The Singapore Economic Review, 62(4), 2.

Shahbaz, M., Khan, S., Ali, A., Bhattacharya, M. (2015b), The Impact of Globalization on CO_2 Emissions in China. Germany: In MPRA Paper No. 64450; MPRA Paper. p22.

Shahbaz, M., Khan, S., Ali, A., Bhattacharya, M. (2017), The impact of globalization on CO_2 emissions in China. The Singapore Economic Review, 62(4), 929-957.

Shahbaz, M., Mallick, H., Mahalik, M.K., Sadorsky, P. (2016), The role of globalization on the recent evolution of energy demand in India: Implications for sustainable development. Energy Economics, 55, 52-68.

Sharif, M.A.H. (2011), Challenges of globalization: How Bangladesh can adapt itself to reap the best benefits in the 21st century. MIST Journal Galaxy (Dhaka), 3, 8052.

Sharmin, M., Tareque, M. (2018), Econometric analysis of the effect of economic globalization, energy intensity, urbanization, industrialization and growth on CO_2 emissions of Bangladesh. Managing Global Transitions, 16(4), 335-354.

Shikwambana, L., Mhangara, P., Kganyago, M. (2021), Assessing the relationship between economic growth and emissions levels in South Africa between 1994 and 2019. Sustainability, 13(5), 2645.

Sohag, K., Al Mamun, M., Uddin, G.S., Ahmed, A.M. (2017), Sectoral output, energy use, and CO_2 emission in middle-income countries. Environmental Science and Pollution Research, 24(10), 9754-9764.

Soren, J., Jtiselius, K. (1990), Maximum likelihood estimation and inference on cointegration-with appucations to the demand for money. Oxford Bulletin of Economics and Statistics, 52(2), 169-210.

Soytas, U., Sarı, R. (2009), Energy consumption, economic growth, and carbon emissions: Challenges faced by an EU candidate member. Ecological Economics, 68(6), 1667-1675.

State of the Global Climate (WMO-No-1264). (2020), World Meteorological Organization. United States: State of the Global Climate.

Suri, V., Chapman, D. (1998), Economic growth, trade and energy: Implications for the environmental Kuznets curve. Ecological Economics, 25(2), 205.

Tiwari, A., Nasir, M. (2013), The effects of financial development, economic growth, coal consumption and trade openness on environment performance in South Africa. Energy Policy, 61, 1452-1459.

Tubiello, F.N., Salvatore, M., Rossi, S., Ferrara, A., Fitton, N., Smith, P. (2013), The FAOSTAT database of greenhouse gas emissions from agriculture. Environmental Research Letters, 8(1), 015009.

US EPA National Center for Environmental Assessment. (2011), Exposure Factors Handbook 2011 Edition (Final Report) Reports and Assessments. Available from: https://www.cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252.

van Vuuren, D.P., Stehfest, E., Gernaat, D.E.H., Doelman, J.C., Tabeau, A. (2017), Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm. Global Environmental Change, 42, 237-250.

Wang, Z., Shi, C., Li, Q., Wang, G. (2011), Impact of heavy industrialization on the carbon emissions: An empirical study of China. Energy Procedia, 5, 2610-2616.

World Development Indicators, DataBank. (n.d.), Available from: https://www.databank.worldbank.org/source/world-development-indicators. [Last accessed on 2021 Jul 12].

York, R., Rosa, E.A., Dietz, T. (2003), STIRPAT, IPAT and ImPACT: Analytic tools for unpacking the driving forces of environmental impacts. Ecological Economics, 351-365.

Zhang, J. (2021), Environmental Kuznets Curve hypothesis on CO_2 emissions: Evidence for China. Journal of Risk and Financial Management, 14(3), 12-20.

Zhang, L., Pang, J., Chen, X., Lu, Z. (2019), Carbon emissions, energy consumption and economic growth: Evidence from the agricultural sector of China's main grain-producing areas. The Science of the Total Environment, 665, 1017-1025.

Zhou, X., Zhang, J., Li, J. (2013), Industrial structural transformation and carbon dioxide emissions in China. Energy Policy, 57, 43-51.