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Assessing Trade Openness of Philippines and China and its Environmental Consequences in the Philippine Context

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***Abstract*: Studies on environmental degradation and its association with various drivers of economic growth have received a considerable amount of attention recently; although they resulted in different outcomes, it still greatly contributes to the ongoing debate on environmental-economic literature. Openness to trade is regarded as a key factor of economic growth; however, increased integration of economies worldwide through trade openness has a pertinent effect on environmental quality. Despite its substantial contribution to economic growth, it aggravates the environmental quality, particularly in developing countries. Similarly, the use of energy plays a crucial role in increasing production level of goods and services and stimulating economic growth while posing harm to environmental quality. This study would also like to determine the possibility of enhancing economic growth without deteriorating the environment by harnessing renewable energy sources. It is commonly known that some countries are unwilling to mitigate CO_2 emissions as it can slow down economic growth; hence, potential conflict arises between economic productivity and environmental quality. Accordingly, the study employed ARDL method to determine the linkage between economic growth, trade openness, disaggregated energy consumption (non-renewable and renewable) and its effect on CO_2 emissions in the Philippines. With this, the results confirmed a cointegrating relationship between the underlying variables but yields no presence of the EKC hypothesis.**

***Keywords*: CO_2 emissions, economic growth, energy consumption, Environmental Kuznets Curve (EKC), Philippines, trade openness.**

1. Introduction

International trade plays a vital role in sustaining and driving one's economy. It is believed that open economies relatively perform better and have rapid growth rates than closed economies (Grossman & Helpman, 1993), as it can facilitate the movement of resources wherein it effectively responds to the needs and wants of its people through engaging in trade of goods and services with other countries. It is reported that approximately 70 percent of developing countries account for manufacturing exports (UNCTAD, 2021). Along with the growing share of exports, an increasing trend in imports is necessary to provide developing countries with resources to foster economic growth.

With the increased integration of the world economy in the pursuit of economic growth, greenhouse gas (GHG) levels have been rapidly growing, primarily due to various economic activities brought about by trade openness which has become a global concern that policymakers can no longer disregard. Developing countries have witnessed phenomenal economic growth in recent years. Accordingly, since 1990, there has been an increased volume of trade from 20 to 50 percent evident in some Asian countries (UNCTAD, 2015). In this regard, trade openness significantly contributes to achieving this exponential growth by accumulating foreign exchange through exports and gaining capital goods and materials necessary for rapid growth through imports (Hultberg, 2018). Trade openness has been a driving force for countries, specifically developing countries, to stimulate economic growth and development. However, despite its key advantages, it entails costs to the environmental quality; in particular, it escalates the country's volume of carbon dioxide emissions (hereinafter referred to as CO_2 emissions). Thus, in the presence of heightened trade openness, it is imperative to identify and evaluate its possible repercussions on environmental degradation (Akbar et al., 2020).

In general, trade is beneficial for trading countries as it increases their efficiency and provides greater wealth for both countries. However, in some cases, economic growth brought about by trade openness can have direct environmental consequences by degrading natural resources and increasing CO_2 emissions. An increase in trade will likely increase fuel consumption because of its heavy reliance on transportation and energy use leading to higher pollution. In this sense, with such economic gains comes a disproportionately higher share of the world's energy use and CO_2 emissions. This paper focuses on the Philippines, which is currently known as one of the fast-growing economies in Asia. Wherein along its substantial growth is the growing concern for the environment, which must be investigated and addressed accordingly. The study of Afridi et al., (2019) emphasized that an increase in energy use has detrimental effect on the environment. Given that the country lies along the Pacific Ring of Fire, it is considered highly vulnerable to detrimental effects of climate change, specifically

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in the occurrence of extreme weather disturbances. Hence, rising CO_2 emissions in the Philippines has only made the country more vulnerable to climate change. Furthermore, considering the strong bilateral trade of Philippines and China, it is noteworthy to incorporate the trade openness of the two countries. Accordingly, the energy sector in the Philippines is characterized by heavy reliance on non-renewable energy which is considered to produce high levels of CO_2 emissions. Moreover, taking into account that China has been recognized as the largest contributor to CO_2 emissions with the highest energy consumption and the world's largest trading volume (Jun et al., 2020). Thus, it is pertinent to examine how trade openness of the two countries, China and the Philippines can affect the environmental degradation present in the Philippines.

Pursuing higher growth, requires higher demand for energy use. However, the increasing CO_2 emissions are mainly caused by non-renewable energy consumption including: natural gas, coal, and oil. Since it is affordable than renewable ones, most developing countries heavily rely on non-renewable resources for the production and supply of power. In an empirical study by Neague (2020), greenhouse gas (GHG) emissions such as harmful pollutants, exacerbate environmental degradation, which causes global warming. In this regard, an increase in CO_2 emissions is a significant contributor to global warming (IPPC, 2018), which may lead to severe environmental degradation and poses adverse economic consequences (Ahmad et al., 2019) since CO_2 is the main GHG that causes global warming, in fact, it makes up about 64 % of emissions. To curtail the increasing GHG emissions, countries are slowly shifting towards utilizing and investing more in sustainable and renewable energy sources instead of non-renewable ones. Currently, the primary renewable energy sources are hydropower, solar, and wind, wherein these sources are sustainable, thus can be regenerated, and have no detrimental impact on the environment. While the country is facing an ever-increasing energy demand and its known heavy reliance on non-renewable sources of energy, the Philippine government has made initiative efforts to shift into energy self-sufficient, promoting the combination usage of fossil fuels and renewable energy. Therefore, shifting to renewable energy would help reduce CO_2 emissions. Thus, lessening the use of non-renewable energy and increasing the renewable ones in the energy mix could be a viable solution for reducing further deterioration of the environment since it represents a clean source of energy. This growing interest in utilizing renewable energy sources is attainable since the Philippines is renowned for its abundant renewable resources such as wind, solar, and hydropower (Barrows et al., 2018). Accordingly, amongst the members of the ASEAN countries, the Philippines pioneered in investing in large-scale solar and wind technologies.

While there is much empirical research on the environmental impact of trade openness, they are mostly cross-country studies, and only developed countries are included. Although, a rising amount of studies have identified the contributing factors that influence CO_2 emissions in various nations, the correlation between trade openness, economic growth and environment remains unclear. Multiple studies have accentuated the significance of trade openness in environmental protection and emissions reduction policy (Omri 2013; Ullah et al., 2019). However, the outcomes remain inconclusive. In addition, most studies failed to acknowledge that economic growth also stimulates energy consumption. Thus, it should be accounted for when estimating the environmental consequences brought about by trade openness. Moreover, to further contribute to existing literature, the authors used disaggregated energy consumption instead of focusing only on aggregated energy consumption. Therefore, this study utilized non-renewable and renewable energy consumption as both energy sources are expected to affect the environment differently. This study also aims to investigate the viability of harnessing renewables in mitigating the negative externalities of CO_2 emissions in the Philippines.

In this paper, therefore, the researchers attempt to extend the study of previous works by examining the trade-growth-energy-environment nexus of the Philippines in the EKC framework.

The objectives for this study include:

- To examine the trade openness of Philippines and China but will only focus on its impact on the environmental degradation present in the Philippines.
- To investigate the presence of the EKC hypothesis in the Philippine, incorporating other economic variables, specifically, trade openness, GDP per capita, disaggregated energy consumption, and CO_2 emissions.
- To determine if shifting to renewable energy sources can be a viable solution in mitigating CO_2 in the Philippines.

As Keho (2015) stated, different countries display diverse patterns of CO_2 emissions and their drivers, such as economic growth and trade openness. Therefore, in an attempt to contribute to the existing literature, this research will provide an analysis of two developing countries, namely China and the Philippines, which are both assessed as fast-growing economies in Asia. Many developing countries' primary reform agenda is to open up to the global economy. These countries have developed as industrial production countries as a result of trade openness; hence, they are experiencing strong economic growth and expansion without enforcing strict environmental restrictions. Rapid economic growth may be achieved, but it can be at the expense of environmental quality. Hence, there has been a lack of environmental management, serious environmental degradation, and alarmingly high levels of CO_2 emissions. In analyzing the conflict goals between economy and environment, it is apparent to investigate if the EKC hypothesis is present in the Philippines, to examine if the increasing CO_2 emissions is only temporary in the country and identify if sustainable growth can be achieved in the long run.

Hence, in proving or disproving the presence of the EKC hypothesis, the current study aims to provide significant policy implications that would mitigate CO_2 emissions while achieving sustainable economic growth. According to IRENA (2016), apart from the obvious negative externalities that CO_2 emissions causes the environment, the external costs of the air pollution brought about by various economic activities will increase by 35 percent, wherein the cost is forecasted to rise from $167B in 2014 to $225B in 2025 in ASEAN countries. In this regard, reducing the dependency on non-renewable energy has also important implications on economic perspective, not just on environmental one.

In analyzing issues of environmental quality in the Philippine context, various aspects can be integrated, such as water pollution, carbon dioxide emissions, and solid waste. However, due to limited time and data available, it is apparent that this study will only focus on the CO_2 emissions per capita as a proxy for environmental degradation, as CO_2 emissions has been recognized as a major pollutant (Edoja et al., 2016) accounting for 75% of greenhouse gas emissions (Abbasi & Riaz, 2016). Likewise, earlier studies also used CO_2 emissions as dependent variable (Al-Mulali et al., 2015; Ertugrul et al., 2016; Mahrinasari et al., 2019), which is measured as "metric tons per capita".

As seen in the Figure 1 below, it shows the trade openness exports plus imports to China from the Philippines and vice versa from 1985 to 2020. In recent years, China has been the Philippines' top trading partner, export market destination, and import source, indicating the strength of our bilateral trade relations. In 2019, bilateral trading between the Philippines and China was close to $50 billion, up 17 percent over the previous five years. Exports to China increased by 16.02 percent in 2019, from US$18.4 billion in 2018 to US$19.5 billion in 2019. Electronics, minerals, fresh food, electricity, chemicals, equipment, fashion accessories, transportation, and other industrial items are the top export sectors. Electronic components and semiconductors, mineral ores, and agricultural items such as bananas, pineapples, and marine products are among the top exports to China. China allowed the inclusion of fresh young coconuts from the Philippines and Hass avocado from the Philippines in 2019, expanding the Philippine fresh fruit basket for export to China.

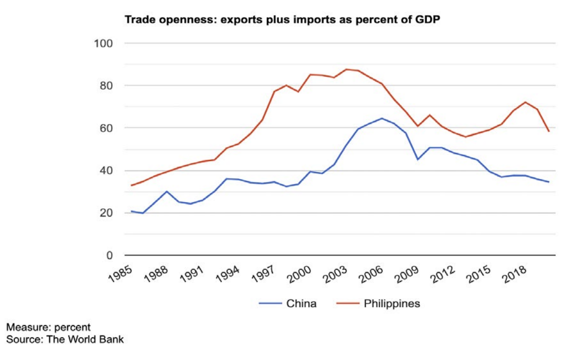


Fig. 1. Trade openness of China and Philippines

Significance of the Study:

With the Philippines being recognized as one of the fastest growing economies in Asia, it is noteworthy to identify the contributing factors of environmental degradation in the country. Therefore, the significant of this paper is it contributes to the present literature on determining the effects of trade openness, economic growth, and disaggregated energy consumption on CO_2 emissions. More importantly, to provide relevant policy suggestions in addressing the conflicting goals of the economy and environment.

2. Literature Review

A. Trade Openness and Environment Nexus

As a result of growing concerns on environmental deterioration caused by rapid industrialization, economic growth, and globalization, a plethora of literature on trade and its impact on the environment emerged almost recently. However, studies have presented conflicting results, which created a growing debate on a wide range of issues associated with the trade-environment nexus. Apart from the significant contribution of trade openness as an engine of growth of an economy, it also poses threats on environmental quality (Zeeshan et al., 2022). Therefore, existing studies on the trade-environment nexus give pieces of evidence for positive and negative effects.

Generally, it is ambiguous to assume whether free trade amongst countries promotes environmental degradation. Therefore, Grossman and Krueger (1991) presented a systematic analysis of the trade-environment nexus. They deconstructed three major environmental effects associated with free trade. First, the scale effect where it proves that tremendous growth in economic activities tends to deteriorate the environment due to trade openness. Resulting in increased production by emitting CO_2 emissions (Mahmood et al., 2020). Hence, the scale effect is negative. Second, the composition effect, during this phase, the economy gradually shifts into lower polluting industries (Liobikienė & Butkus, 2019). Thus, the effect of economic growth becomes positive on the environment (Shahbaz & Sinha, 2019). Whereas technique effect contends that innovation of new and green technologies would lessen the forecasted pollution levels (Ramos et al., 2017). When the economy starts to invest in research and development, they gradually shift to knowledge-intensive instead of capital-intensive. Trade openness has been proven to help reduce emissions when an economy invests on environmental friendly technologies and energy-efficient manufacturing technologies (Sebri & Ben-Salha, 2014). Therefore, as economic growth rises, environmental quality gradually improves in this phase. In a broader sense, what matters the most for the environment is the net effect, not its individual component. According to Vutha (2008), if the composition and technique effect outweigh the scale effect, trade openness would enhance environmental quality while if the opposite holds it would have detrimental impact on the environment.

Trade openness provides substantial economic growth in developing countries. However, alongside its significant contribution, trade activities generated various environmental challenges, mainly, CO_2 emissions. Due to harmful gas emissions, the environmental quality is deteriorating, imposing severe repercussions on health and sustainability. A number of studies claimed that trade leads to increased CO_2 emissions. In this context, Ullah et al., (2019) analyzed China from 1999 to 2017 and proved that trade openness is a contributing factor of CO_2 emissions. Moreover, Nguyen et al., (2021) concluded that trade openness degrades the environment. Likewise, Mahrinasari et al., (2020) confirmed the relationship between trade openness and environmental degradation in Asian countries. Their findings show positive correlation between trade openness and CO_2 emissions.

Conversely, Afridi et al., (2019) demonstrated a negative relation between trade openness and environmental degradation in emerging economies. Similarly, Zhang et al., (2017) examined the link between CO_2 emissions and trade openness in ten newly industrialized countries and found a negative relationship between the two variables, hence an inverse effect on the environment. Accordingly, Khan et al., (2021) asserted that trade openness reduced CO_2 emissions in developed countries and concluded that renewable energy is beneficial to the environment. Moreover, Akin (2014) argued that CO_2 emissions could be reduced through trade openness and investigated a unidirectional causal relationship between the two. Thus, proponents of free trade contends that the net effect of trade increases general welfare. Whereas, Omri (2013) claimed that trade openness is an insignificant indicator of CO_2 emissions.

B. Economic Growth and Environment Nexus

The negative externalities of environmental deterioration have a significant impact on people. Economic expansion causes higher CO_2 emissions, which harms the environment and biodiversity. The relationship between growth, energy consumption, and CO_2 emissions is paradoxical and incongruent, making it difficult for policymakers to guarantee long sustainable growth.

Using the EKC hypothesis as a theoretical framework, previous research has mostly focused on the relation between environmental sustainability and economic growth. According to the EKC hypothesis, increasing economic growth would surely produce an increase in carbon dioxide emissions, but at a certain point, further increases will lead to a decrease in carbon dioxide emissions Kaika & Zervas (2013). Contradictory results have been found in the most current study on the growth-CO2 emissions nexus under the EKC theory. As per Hassan et al., (2019) for Pakistan, Chontanawat (2020) for ASEAN countries, Petak et al., (2020) for BRICS economies, and Petrovi & Lobanov (2020) for OECD countries have all verified the EKC theory. However, On the contrary, Yilanci & Pata (2020), Aydin & Turan (2020), and Aydin et al., (2020) invalidated the EKC hypothesis for China, the BRICS economies, and 26 European nations, respectively.

Moreover, it was shown by (Ansari et al., 2020) that economic expansion had a considerable and positive influence on the GCC nations' CO_2 emissions. Ahmed et al., (2020) claim that China's fast urbanization and economic expansion have increased carbon emissions. On the other hand, the majority of research ignored the impact of other factors and only looked at the relationship between the environment and growth from the perspective of the EKC notion. Considering different countries implemented different growth strategies and regulatory frameworks that may have an effect on CO_2 emissions, the inconsistent empirical results of the EKC hypothesis revealed that the link between CO_2 emissions and growth differed between countries. Additionally, studies have associated carbon dioxide emissions to economic industry economic development, energy composition, and institutional integrity (Nasir et al., 2019).

The North American Free Trade Agreement's (NAFTA) potential impacts research by Grossman and Krueger at the beginning of the 1990s developed the concept that economic growth is required to maintain or improve environmental quality. The EKC hypothesis describes the link between real growth and carbon dioxide emissions as an inverted U-shape. It showed that during the initial phases of economic expansion, environmental deterioration grows as actual production rises. Due to technology improvements, ecologically friendly domestic and international policies, and more public awareness, environmental degradation decreases as economic expansion grows until a certain threshold is achieved. In fact, extensive research has shown that EKC occurs in nations all over the world.

Also, “a variety of reasons lead to the deterioration of the environment”. For instance, it utilizes natural resources to fuel economic growth, rapid industrialization is seen to be the primary cause of environmental deterioration (Chakravarty and Mandal, 2020). Financial development has been included into study models by (Jian et al., 2019; Pata, 2018) to analyze its possible influence on environmental deterioration. However, rapid economic growth may attract FDI (foreign direct investment) from industrialized nations, which might include efficient green technology and protection of the environment. As a result, in order to reduce emissions and spur development, we need a sustainable financial system (Jan et al., 2021B; Azhar et al., 2021). In China and Turkey, economic growth and environmental degradation are strongly associated, according to studies of Jian et al., (2019) and Pata, (2018). Economic growth is numerically negligible, according to studies conducted for Malaysia by Saboori & Sulaiman (2013) and for Brazil and Indonesia by Ertugrul et al., (2016).

Lastly, findings of the EKC hypothesis is invalid in this sample because as per Ahmed et al., (2017), “economic growth has a negative impact on CO_2 emissions in the low regime but has a positive impact in the high regime”. Furthermore, the researchers observe a U-shaped relationship between economic growth and CO_2 emissions, wherein rising GDP first causes a decline in CO_2 emissions before crossing a threshold at which point CO_2 levels rise. This suggests that after a certain GDP level, additional GDP growth may be possible at the expense of environmental damage. One reason for these factors could be that increased pollution results from a country's industrialization. Economic expansion will have a detrimental environmental effect since expanding production and consumption result in rising environmental damage. This happens because more manufacturing will naturally be pursued as income levels rise. The presence of these industries may ultimately lead to significant environmental degradation if there are no complementary rules requiring them to implement ecologically friendly manufacturing techniques and procedures in order to reduce their pollution levels.

C. Energy Consumption and Environment Nexus

In the study of China, critics argued that economic growth brought about by trade openness has deleterious effects on the environment with an increasing volume of exports has turned the country into a "manufacturing powerhouse" which has increased energy consumption, thus, has increased carbon emissions. With $2.26 trillion of exports, it has been reported that China is the largest exporter of goods in the world (World Bank, 2018).

As discussed in the 5th environmental report of ASEAN economies, growing energy consumption was the primary driver of rising CO_2 emissions wherein demand for energy consumption was forecasted to rise up to 61% between 2014 to 2025 (Burki & Tahir, 2022). Therefore, it is noteworthy to examine energy consumption and its impact on the environment as it significantly increases CO_2 emissions (Rahman et al., 2020). However, numerous studies have failed to acknowledge its relevance on CO_2 emissions. Therefore, the lack of empirical studies on the two variables motivated the study of (Nguyen, 2019), where it determined the contributing factors of CO_2 emissions in developing nations; the outcomes implied that economic growth and energy consumption positively affects CO_2 emissions in their study on South East Asia. Likewise, Rasiah et al., (2018) emphasized that trade openness along with energy use and economic growth has a positive effect on CO_2 emissions in a number of ASEAN countries. Studies from (Mulali & Sab 2012; Jian et al., 2019) have proved that increasing energy demand harms environmental quality.

Ertugrul et al., (2016) claimed trade openness, energy consumption, and economic growth are the key drivers of CO_2 emissions in the top 10 emitters among developing countries in the long run. Multiple studies argued that foreign trade, capital investment, economic growth, and energy consumption causes severe implications for environmental protection (Saibu & Mesagan, 2016). Thus, economic growth generated through international trade increases energy use, indicating a short and long-run effects on the environment (Mesagan et al., 2017). For 5-ASEAN countries, study of (Saboori & Sulaiman 2013) confirmed that as a result of growth in industrialization of these economies, it has only led to rising energy demand which is met by utilizing fossil fuels. This finding implies that the rising level of CO_2 emissions, is a consequence of increasing energy consumption. Furthermore, this finding is in line with the study of Li et al., (2016) for China.

Studies from (Baek & Gweisah, 2013; Saudi et al., 2019) concluded that energy use has a positively affects CO_2 emissions. Undeniably, it also plays a vital role in enhancing economic growth wherein Yang (2022) mentioned that energy activities are the main contributor to CO_2 emissions, accounting for more than 90 percent of CO_2 emissions and 75 percent of GHG emissions. Similarly, Buenavista and Palanca et., al (2020) indicated that economic activities, particularly burning fossil fuels, greatly contribute to excessive GHG emissions, which cause global warming. For instance, Adebayo et al., (2021) inspects the link between economic growth and environmental quality in South Africa, results have shown that for every 1 unit increase of energy consumption environmental degradation increases by 1.077 percent. Whereas Al-Mulali et al., (2015) incorporated the renewable energy consumption in their study and revealed that although it is negatively correlated but renewable sources has no effect with CO_2 emissions since it is statistically insignificant.

D. Synthesis

In writing this study, the authors aimed to examine the driving factors of CO_2 emissions present in the Philippines. With the alarming issues concerning the environmental quality, it is imperative to determine what causes environmental degradation in order to put policies in place. Previous studies have shown that economic factors including trade openness, economic growth, and energy consumption have an impact on CO_2 emissions both positively and negatively. Based on the existing literature, there are insufficient studies that looked at the conflicting goals of environmental quality and economic growth in the Philippines.

For the past years, the association between trade openness and CO_2 emissions has been studied by many. In incorporating trade openness, it should be noted that its effect on environment may vary depending on trade policies of a certain country. With this, if the country invests on green technologies, then, trade openness may enhance environmental quality (Sebri & Ben-Salha, 2014). Hence, this benefit may be due to composition and technique effects. In contrast, Mahrinasari et al., (2020) argued that trade openness has a detrimental impact on the environment since it raises the level of CO_2 emissions in countries.

The EKC hypothesis is greatly utilized in most studies especially in investigating the relation between GDP and CO_2 emissions. EKC hypothesis argued that at an initial stage of development in the country, the rise in environmental degradation is expected, but negative externalities from stimulating economic activities diminishes once the economy reaches a certain level of growth. In other words, substantial economic growth would enhance environmental quality in the long-run (Kaika & Zervas, 2013). Multiple studies have resulted to contradicting results. Therefore, since the Philippines has not been extensively studied, it is difficult to determine whether EKC hypothesis is present in the country.

Lastly, amongst the observed variables only the association between energy consumption and CO_2 emissions seemingly provide consistent outcomes. The majority of research revealed a long-term positive correlation between energy consumption and CO_2 emissions, such as the studies of Saboori & Sulaiman (2013) for 5-ASEAN countries and Li et al., (2016) for China.

E. Theoretical Framework

The Environmental Kuznets Curve (EKC) is based on the Kuznets (1995) curve, which claimed that as countries' GDPs increased, carbon dioxide emissions (C02) increased as well, signaling environmental degradation (Grossman and Krueger, 1991). CO2 levels are expected to rise and then decline, signaling an improvement in the environment. The relationship between environmental quality and economic growth is commonly highlighted using the EKC. According to the theory, the link between various environmental quality indices and economic production per person is inverted U-shaped. The curve's form may be described as increasing environmental deterioration as GDP per capita rises. On the other side, rising GDP per capita to a certain degree assists in reducing environmental consequences.

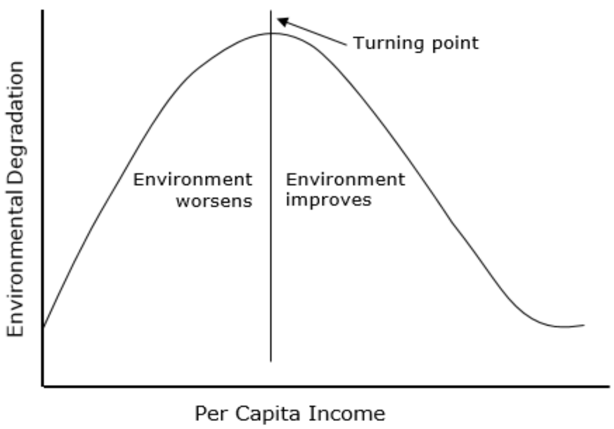


Fig. 2. Environmental Kuznets Curve (Grossman and Krueger, 1995)

Grossman and Krueger provided data in 1991 that indicated that, while some pollutants increase with income at low-income levels, a tipping point is reached at higher income levels, and subsequent income growth results in reduced emissions where it is indicated. Similarly, as incomes grow, so do the demands for improving environmental quality and the resources available for investment, according to the World Bank's 1992 World Development Report (Karsch, 2019). In addition, there is evidence of an inverted U-shaped association between per capita income and environmental deterioration.

Throughout time, as more money enters the economy, it will be able to extend its ability to build new sectors, notably in elevated and service sectors (Cederborg & Snöbohm, 2016). The scale effect, which defines the initial rise in CO_2 emissions in the economy as a result of increased production, is one of the classifications in the EKC hypothesis. This effect is considered to be accountable for the right side of the EKC curve. Since they are still evolving, underdeveloped and emerging economies frequently reflect the scale impact of the curve. Cederborg & Snöbohm, (2016) define industrialized economies as those that are already developed but continue to use practices that increase the amount of carbon emissions. Unsustainable production methods, transportation, and other human economic activities are typical examples.

Additionally, it asserts that environmental deterioration worsens in the first stages of economic development and expansion. After each stage of economic progress, the co-movement is likely to revert. In the research that follows, the Kuznets curve is called to as the Environmental Kuznets curve (EKC) when it is used to investigate the relationship between climate, wealth, and emissions (Chen et al., 2019). According to Bansal et al., (2019), a society must make use of natural resources in order to build long-term, sustainable development, which might have some long-term effects on the environment. As a result, people lose their empathy and become more concerned with material success than with the environment in which they live.

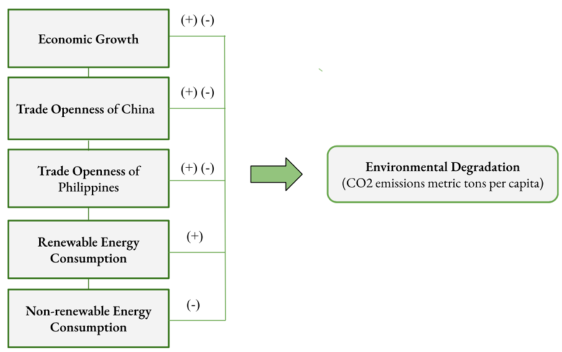
F. *Conceptual Framework*

Although trade openness serves as a driving force for nations, especially for developing ones, it still adversely affects the environment. Hence, it is claimed that trade openness and environmental objectives are in constant conflict. Despite achieving rapid economic growth through various trade activities, pursuing such development can be at the expense of the environment, hindering long-term sustainable growth. On the contrary, environmental degradation will only happen at the initial stage of economic growth. In supporting EKC, economic growth itself is a solution, not the destruction of the environment (Abdouli & Hammami, 2017). Furthermore, economic activities require energy consumption, such as production, mobilization, transportation, and technologies. However, the cost of such economic gains has detrimental impact on the environment (Luo et al., 2021).

G. *Statement of Hypothesis*

- *Null Hypothesis (H_0):* Economic growth has no significant effect on CO_2 emissions in the Philippines
- *Alternative Hypothesis (H_a):* Economic growth has a significant effect on CO_2 emissions in the Philippines.
- *Null Hypothesis (H_o):* Trade openness between of Philippines has no significant effect on CO_2 emissions in the Philippines.
- *Alternative Hypothesis (H_a):* Trade openness of Philippines has a significant effect on CO_2 emissions in the Philippines.
- *Null Hypothesis (H_o):* Trade openness of China has no significant effect on CO_2 emissions in the Philippines.
- *Alternative Hypothesis (H_a):* Trade openness of China has a significant effect on CO_2 emissions in the Philippines.
- *Null Hypothesis (H_0):* Non-renewable energy consumption has no significant effect on CO_2 emissions in the Philippines.
- *Alternative Hypothesis (H_a):* Non-renewable energy consumption has a significant effect CO_2 emission in the Philippines
- *Null Hypothesis (H_0):* Renewable energy consumption has no significant effect on CO_2 emissions in the Philippines.
- *Alternative Hypothesis (H_a):* Renewable energy consumption has a significant effect on CO_2 emissions in the Philippines.

H. Simulacrum



3. Research Method

A. Research Design

The current study aims is to investigate the presence of the EKC hypothesis in the Philippines. In this regard, the authors also explored the relationship between trade openness of China and Philippines, economic growth, non-renewable and renewable energy consumption on the environment. Despite extensive improvements in the economy, environmental quality has often been neglected. In conducting this study, the authors used quantitative-time series which contains a positive and negative relationship between the dependent variable: CO_2 emissions and three independent variables: trade openness, economic growth, non-renewable, and renewable energy consumption.

B. Data Collection

The authors utilize the usage of online resources to gather data from various academic journals and research articles. Moreover, to carry out empirical analysis, the study employed time series covering the period of 1965 to 2018 due to the data's accessibility. The data for CO_2 emissions, economic growth, trade openness, and disaggregated energy consumption were obtained from Our World in Data by University of Oxford.

C. Data Analysis/Econometric Model

Following the similar approach of Chng (2019), the authors employed the Autoregressive Distributed Lag (ARDL) bounds test by Pesaran et al., (2001) to investigate whether the variables are cointegrated. The econometric model used to examine the presence of the EKC hypothesis is written as:

$$\log CO2 = \beta o + \beta_1 (\log GDP)_t + \beta_2 (\log GDP)^2{}_t + \beta_3 (\log \mathrm{PH})_t + \beta_4 (\log \mathrm{CH})_t + \beta_5 (\log \mathrm{NREN})_t + \beta_6 (\log \mathrm{REN})_t + \varepsilon_t \quad (1)$$

Wherein CO_2 is the carbon dioxide emissions (metric tons per capita) as a proxy for environmental degradation, GDP and GDP^2 refer to GDP per capita (constant 2015 US$) and its squared term, PH and CH represents trade openness of Philippines and China measured as the sum of exports plus imports to GDP; NREN is non-renewable energy consumption (Coil, Oil, Natural Gas); REC is renewable energy consumption (Wind, Solar, Hydropower) both are measured in Megawatts. Lastly, βo, and ε_t are the regression coefficient and the standard error term. Additionally, time-series data are converted into logarithmic form to interpret the elasticity of the parameter, providing more consistent and efficient results.

According to Ansari et al., (2019), when $\beta_1 > 0$ and $\beta_2 < 0$, an inverted U-shaped curve exists, validating the EKC hypothesis. Therefore, β_1 and β_2 should be positive and negative respectively. β_1 is expected to be positive as this means that greater the economic growth, greater the CO_2 emissions. Whereas, β_2 is expected to be negative as it corresponds to the EKC's turning point. In this situation, economic growth gradually decreases CO_2 emissions. Moreover, when β_2 is found to be insignificant then it can be concluded that CO_2 emissions increases monotonously. In addition, β_3 and β_4 is dependent on trade of the countries, the result may either be positive or negative. Furthermore, β_5 is assumed to be positive as large consumption of non-renewable energy may lead to environmental degradation. On the other hand, β_6 is expected to be negative, since renewable energy could be a potential source of mitigating CO_2 emissions.

D. Estimation Procedure

The following empirical steps are done to assess the linkage among the dependent variable: CO_2 emissions, and independent variables: trade openness, economic growth, and disaggregated energy consumption. Therefore, in determining the order of integration in the time series analysis, two-unit root tests will be employed, the Augmented Dickey-Fuller and Philips-Perron tests. In the second step, the Johansen cointegration test will be utilized to identify the long-run relationship between variables. In the next step, to further test the cointegration between variables, ARDL method will be incorporated. Finally, the Error Correction Model will also be employed to inspect the long-run and short-run elasticities between CO_2 emissions with respect to each independent variable.

1) Unit Root Tests

For time-series data, regressing non-stationarity may lead to spurious outcomes. Therefore, two different unit-root tests are utilized, the Augmented Dickey-Fuller and Philips Perron tests as introduced by Dickey-Fuller (1981), and Philips Perron (1988), in order assess the existence of unit root in the variables. The null hypothesis for both tests implies that there exists a unit root and the time-series of the variable is non-stationary. Moreover, the null hypothesis can be rejected if the time series has no unit root, which indicates that variables are stationary.

2) Johansen Cointegration Test

To confirmed whether cointegration exists between variables, the Johansen cointegration by Johansen & Juselius (1990) will be employed. The null hypothesis of this test indicates no cointegration between the underlying variables in the long-run. If null hypothesis is rejected, then it can be concluded that variables are cointegrated.

3) Autoregressive Distributed Lag Model

In examining the existence of cointegration between variables, ARDL bounds test was employed. Since, this method does not require the same level of integration, it may be used with variables that are $I(1)$, $I(0)$, or a mixed of both for as long as none of the variables are in I(2) or beyond. Therefore, it is necessary to test for stationary to confirm that all variables must satisfy the underlying assumptions of the ARDL approach. Furthermore, the short and long run relationship between variables are assessed simultaneously, which makes determining long and short run cointegration relatively simple.

To confirmed the existence of cointegrating relationship between the dependent and independent variables, the ARLD framework of Eq. (2) is hereby presented as follows:

$$\begin{aligned}\Delta \ln(C0_2) = \alpha_0 &+ \sum_{k=1}^{n} a_{1k}\Delta \ln(C0_2)_{t-k} + \sum_{k=0}^{n} a_{2k}\Delta \ln(\mathrm{GDP})_{t-k} + \sum_{k=0}^{n} a_{3k}\Delta \ln(\mathrm{GDP})^2{}_{t-k} \\ &+ \sum_{k=0}^{n} a_{4k}\Delta \ln(\mathrm{CH})_{t-k} + \sum_{k=0}^{n} a_{5k}\Delta \ln(\mathrm{PH})_{t-k} + \sum_{k=0}^{n} a_{6k}\Delta \ln(\mathrm{REN})_{t-k} + \\ &+ \sum_{k=0}^{n} a_{7k}\Delta \ln(\mathrm{REN})_{t-k} + \emptyset_1 \ln(C0_2)_{t-1} + \emptyset_2 \ln(\mathrm{GDP})_{t-1} + \emptyset_3 \ln(\mathrm{GDP})^2{}_{t-1} \\ &+ \emptyset_4 \ln(\mathrm{PH})_{t-1} + \emptyset_5 \ln(\mathrm{CH})_{t-1} + \emptyset_6 \ln(\mathrm{NREN})_{t-1} + \emptyset_7 \ln(\mathrm{REN})_{t-1} + \varepsilon_t\end{aligned} \quad (2)$$

Where α_1, α_2, α_3, α_4, α_5, and α_6 represents the short-run error-correction dynamics. While, ϕ_1, ϕ_2, ϕ_3,ϕ_4, ϕ_5, ϕ_6, and ϕ_7 corresponds to the long-run relationship. Moreover, α_0 is constant term and ε_t is white noise error term. The null hypothesis in above equation is H_0: $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = \phi_6 = \phi_7 = 0$, implies non-existence of cointegration. While the alternative hypothesis is H_1: $\phi_1 \neq \phi_2 \neq \phi_3 \neq \phi_4 \neq \phi_5 \neq \phi_6 \neq \phi_7 \neq 0$. The calculated F-statistic is utilized mainly for the decision rule and it is then compared to the lower and upper bound. The former corresponds for variables at $I(0)$ and the latter corresponds for variables at $I(1)$. In this regard, if the F-statistics is less than the lower bound, the null hypothesis is accepted, which suggests no cointegration. Meanwhile, if the F-statistic exceeds the upper bound, then the null hypothesis is rejected. Whereas, the outcome is deemed inconclusive when the F-statistic falls between the lower and upper bound.

4) Error Correction Model

Error Correction Model will be employed if the cointegrating relationship between variables has already been established. ECM is performed to estimate short-run elasticities. Therefore, the ECM framework of Eq. 3 is presented as:

$$\begin{aligned}\ln(C0_2) = \alpha_0 &+ \sum_{k=1}^{n} a_{1k}\Delta \ln(C0_2)_{t-k} + \sum_{k=0}^{n} a_{2k}\Delta \ln(\mathrm{GDP})_{t-k} + \sum_{k=0}^{n} a_{3k}\Delta \ln(\mathrm{GDP})^2{}_{t-k} \\ &+ \sum_{k=0}^{n} a_{4k}\Delta \ln(\mathrm{PH})_{t-k} + \sum_{k=0}^{n} a_{5k}\Delta \ln(\mathrm{CH})_{t-k} \sum_{k=0}^{n} a_{6k}\Delta \ln(\mathrm{NREN})_{t-k} \\ &+ \sum_{k=0}^{n} a_{7k}\Delta \ln(\mathrm{REN})_{t-k} + \theta * ECT_{t-k} + \varepsilon_t\end{aligned} \quad (3)$$

Wherein *ECT refers to the error correction term, which represents the speed of adjustment to reach long-run equilibrium. Moreover, in ensuring the model's goodness of fit, diagnostic tests such as serial correlation, normality, and heteroskedasticity are also conducted.

4. Results and Discussion

To assess the stationarity properties of the underlying variables, ADF and PP tests, were employed. This is necessary since regressing non-stationary variables will lead to spurious estimations. Table 1 presents the summary results of ADF and PP unit root tests for all the variables of interest on their natural logarithms both at levels and first differences with the inclusion of constant and constant and trend. It was found that at I(0), only variables PH and NREN are stationary in the ADF test and only variable NREN is stationary in the PP test. Based on this result, it was necessary to conduct the first difference to determine whether variables in the study would reach overall stationarity. As a result, the remaining variables became stationary at I(I). Overall, the results revealed a mixed order of integration, in which all variables are stationary at either I(0) or I(1), and none is stationary at I(2) or beyond. A result of mixed order of integration is acceptable when utilizing the ARDL approach since the variables are not required to be integrated with the unified order. Hence, the null hypothesis of two-unit root tests can be ruled out. Therefore, the use of ARDL approach is validated.

Table 1
Unit root tests

ADF				
	I(0)		I(1)	
	C	C & T	C	C&T
Log_CO_2	0.7138	0.1321	0.0000	0.0001
Log_GDP	0.9960	0.9853	0.0091	0.0213
Log_GDP^2	0.9960	0.9853	0.0091	0.0213
Log_PH	0.6363	0.0000	0.0198	0.1040
Log_CH	0.5308	0.9884	0.0000	0.0000
Log_NREN	0.7343	0.0012	0.0000	0.0001
Log_REN	0.4492	0.929	0.0000	0.0000

PP				
	I(0)		I(1)	
	C	C & T	C	C&T
Log_CO_2	0.4388	0.4096	0.0000	0.0000
Log_GDP	0.9982	0.9924	0.0071	0.0190
Log_GDP^2	0.9982	0.9924	0.0071	0.0190
Log_PH	0.6462	0.8294	0.0000	0.0000
Log_CH	0.5308	0.9884	0.0000	0.0000
Log_NREN	0.7343	0.0012	0.0000	0.0001
Log_REN	0.4492	0.9290	0.0000	0.0000

Source: EViews Software

Table 2
Lag order selection criteria

Lag Criteria	AIC	SC	HQ
0	-3.780245	-3.509985	-3.677708
1	-4.030876*	-3.722007*	-3.913692*
2	-4.026629	-3.679151	-3.894796
3	-3.995775	-3.609689	-3.849295
4	-3.971090	-3.546396	-3.809962
5	-3.974066	-3.510763	-3.798290

Source: EViews Software
Note: * indicates lag order selected by the criterion

Prior to estimating cointegration between the observed variables, it is vital to establish the optimal lag order; therefore, VAR was utilized. As seen, Table 2 represents the result of the estimated VAR equation wherein the results of lag criteria showed that among the three criteria, namely, AIC, SC, and HQ. AIC has the lowest value which is the decision rule in selecting which criterion should be employed. Therefore, AIC was utilized to determine the appropriate lag order imposed in the model. The result of (-4.030876*) under AIC was found to be the lowest value across the selection. Moreover, as seen in the table, it indicates an appropriate lag order of 1 in employing the ARDL approach.

After establishing that all underlying variables are stationary, the Johansen cointegration test was employed to evaluate if the variables are cointegrated. Table 3 depicts the results under the trace statistic, and table 4 represents the results under the max-eigen statistic. At the significance level of 0.05, the result of trace statistics revealed four (4) cointegrating relationships between variables. At the same time, the result of max-eigen statistics revealed two (2) cointegrating relationship between variables. Therefore, considering the outcomes, long-run relationship between CO_2 emissions, GDP per capita, trade openness, and disintegrated energy consumption is confirmed.

Table 3
Trace static

Johansen Cointegration Test			
Hypothesized No. of CE(s)	Trace Statistic	Critical Value	Prob.**
None*	200.8617	125.6154	0.0000
At most 1*	133.9603	95.75366	0.0000
At most 2*	81.63457	69.81889	0.0043
At most 3*	50.02154	47.85613	0.0308
At most 4	27.15245	29.79707	0.0980
At most 5	13.55385	15.49471	0.0960
At most 6	1.116753	3.841465	0.2906

Source: EViews Software
Trace indicates 4 cointegrating equations at the 0.05 level
Note: * denotes rejection of the hypothesis at the 0.05 level

Table 4
Max-eigenvalue statistic

Johansen Cointegration Test			
Hypothesized No. of CE(s)	Max-Eigen Statistic	Critical Value	Prob.**
None*	61.56762	46.23142	0.006
At most 1*	54.58004	40.07757	0.006
At most 2*	38.99408	33.87687	0.0112
At most 3*	27.86793	27.58434	0.046
At most 4	18.54216	21.131162	0.1109
At most 5	12.1236	12.2646	0.1061
At most 6*	7.230172	3.841465	0.0072

Source: EViews Software
Max-eigenvalue test indicates 4 cointegrating equations at the 0.05 level

Taking into account the study of Vo et al. (2019) as a point reference, this study also employed two cointegration tests, Johansen cointegration test, which was previously discussed and the ARDL approach. Since it was presented that all variables are integrated at a mixture of I(0) and I(1), it is more appropriate to employ the latter test to confirm cointegration between variables as it leads to more consistent outcomes. Hence, after determining the suitable criterion and lag order, ARDL bounds testing approach is employed. The AIC suggests the optimum lag length is equal to (1,1,0,0,0,0,0) for CO_2, GDP, GDP^2, PH, CH, NREN, and REN. The existence of cointegration amongst the variables is confirmed on the basis of upper and lower-bound values. As mentioned above, if the computed F-statistic is higher than the upper bound value, then there exists a long-run relationship between variables. In table 5, it is evidently shown that the variables are cointegrated as the computed F-statistic is found to be 27.28921, which exceeded the upper bound critical value at 1% level of significance. Thus, it can be concluded that the null hypothesis of no cointegration is rejected, which tends to be in favor of the alternative. Therefore, the result confirms a long-run relationship between variables in the Philippines in which confirmed cointegration is also verified by the statistically significant and negative value of ECT (-0.827348). It is an indication that about 82.73 percent of the disequilibrium of environmental pollution level in the Philippines can adjust towards long-run equilibrium after short-run shock. Moreover, it will take about 1.2 periods to reach the long-run equilibrium level. Similar to the study of Peña et al. (2022), in which computed F-statistic proved that there exists cointegration between their observed variables in the study. Furthermore, although the findings of Chng (2019) indicated inconclusive F-statistics in the case of Singapore, Malaysia, and Philippines in their study of 6-ASEAN countries, it was still supported by the statistically significant and negative values of ECT_{t-1}, implying that short-run shocks are able to adjust to the long-run equilibrium in the mentioned countries.

Table 5
ARDL cointegration test

Max. lags imposed	1,1
Selected Model	1,1,0,0,0,0,0
F-statistic	27.28921
Cointegration	Yes
ECT_{t-1}	-0.827348 ***

Signif.	I(0)	I(1)
10 %	2.53	3.59
5 %	2.87	4
2.5 %	3.19	4.38
1 %	3.6	4.9

Source: EViews Software

To ensure the model's goodness of fit, diagnostic tests were conducted. At 5% level of significance, the outcomes confirmed the absence of serial correlation and heteroskedasticity by employing LM test and Breusch-Godfrey-Pagan-Heteroskedasticity test. The Jarque-Bera test was also used to determine whether the model is normally distributed, and since the p-value is greater than 5%, this verifies that residuals are normally distributed. Additionally, it can also be concluded that the study is free from autocorrelation, which is confirmed by the value of Durbin Watson. All the aforementioned diagnostic tests are summarized in table 6.

Table 6
Diagnostic test

Diagnostic Tests	Results	Interpretation
LM Test	P-value > 0.05	No presence of serial correlation
Breusch-Godfrey-Pagan-Heteroskedasticity Test	P-value > 0.05	No presence of heteroskedasticity
Jarque-Bera Test	P-value > 0.05	Presence of normality
Durbin Watson	Value is near 2	No presence of autocorrelation

Source: EViews Software

Table 7 delineates the short and long-run ARDL estimation results where it was presented that all variables except for GDP, GDP^2, and REN are statistically insignificant, where GDP and GDP^2 are proven to be negative and positive, respectively. Hence, there is insufficient statistical evidence to conclude that economic growth affects environmental pollution in the case of the Philippines. As opposed to the rule of thumb when proving the validity of the EKC hypothesis, noting that variables GDP and GDP^2 should be significant, respectively. Therefore, the presence of EKC is not found in the Philippines. This result might be attributed to the fact that the Philippines is a developing country and is presently at the increasing side of the EKC curve. Therefore, the absence of the EKC hypothesis in the Philippines indicates that the country is yet to reach the level where economic growth could enhance the environment, where people would most likely demand a better-quality environment because of an increase in their income. This finding is in line with the study of Ertugrul et al., (2016), where both GDP and GDP^2 are also found to be statistically insignificant, disproving the validity of an inverted U-shaped relation between CO_2 emissions and economic growth in Brazil and Indonesia. Furthermore, REN is negatively correlated with CO_2 but is also found statistically insignificant. The result is similar with Al-Mulali et al., (2015) where non-renewable sources have no pertinent effect on pollution in Vietnam.

Moreover, PH and NREN positively affect CO_2 emissions in the long run, while CH negatively affects CO_2 emissions. In analyzing statistically significant variables, as a result of every one unit increase in CO_2 emissions, there will be an increase of 0.087 in the long run for PH. And since the p-value of PH in the short-run is greater than 0.05, it can be concluded that trade openness of Philippines has no effect on CO_2 emissions in the short-run. Moreover, for every one unit increase in increase in CO_2 emissions there will be an increase of 0.784 for non-renewable energy consumption in the long run and 0.649 in the short run. Similarly, trade openness has been found detrimental in the study of Mahrinasari et al. (2019) as it raises the levels of toxic emissions, specifically CO_2 emissions. Undeniably, the role of trade openness has always been crucial in stimulating economic growth across countries. However, it poses repercussions on environmental degradation (Akbar et al., 2020). In previous years, the Philippine economy has become more persistent in shifting towards more open trade relations, as this serves as a strategy for the country to compete with neighboring nations. With the upward trend of trade activities in the country and despite its substantial contribution to stimulating economic growth, a considerable amount of CO_2 emissions are emitted due to various transactions, hence, greater demand for energy use in order to accelerate the transport of goods and services. Along with this, the positive and statistically significant result of non-renewable energy consumption is attributed to the rapidly increasing energy demand in the Philippines, which is expected since the country is in a developing phase; therefore, industrial and service sectors rely heavily on energy use to be able to meet production demand. It is almost certainly impossible to produce and transport commodities without energy consumption. Hence, fossil fuels were extensively utilized to respond to booming energy demand. In this regard, the energy sector in the Philippines deals with dual challenges of (1) soaring energy demand and (2) its heavy reliance on imported fossil fuels which account for about 75%, wherein it will likely increase in the succeeding years to satisfy the future demand which would further deteriorate the environment in the process if not addressed properly (Mondal et al., 2018). Moreover, the same results were presented in the study of Buenavista and Palanca et al. (2020), where economic activities, particularly burning fossil fuels, greatly contribute to excessive GHG emissions, which cause global warming.

On the other hand, there will be a decrease of 0.159 for CH in the long run and 0.132 in the short run and 0.042 for renewable energy consumption in the long run, and 0.035 in the short run for every one unit increase in CO_2 emissions. The study investigated if China's trade openness has a detrimental effect on the Philippines' environment. However, results have shown an inverse relationship between the trade openness of China and CO_2 emissions in the country, wherein it can be concluded that instead of the expected detrimental effect of China's trade openness, it enhances the environmental quality of the Philippines. This finding can be associated with the fact that China is composed of top solar and wind companies and has had a remarkable energy transition in past years. Furthermore, China envisions developing an "ecological civilization" that would only materialize through the deployment of renewable sources to lessen pollution levels, mitigate climate change, and improve energy efficiency in China.

Table 7
Short and long run ARDL estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CO_2 (-1)	-0.827348	0.080437	-10.28566	0.0000
GDP (-1)	-1.688544	0.002546	-1.122941	0.2677
GDP^2 (-1)**	0.113835	0.080437	1.154100	0.2548
PH**	0.072679	1.503679	1.950257	0.0577
CH**	-0.132108	0.098635	-3.852003	0.0004
NREN**	0.649046	0.037266	9.273663	0.0000
REN**	-0.035079	0.034296	-1.887502	0.0659
D(GDP)	-1.348234	0.018585	-0.908204	0.3688

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	-2.040911	1.863269	-1.095339	0.2795
GDP^2	0.137590	0.121940	1.128344	0.2654
PH	0.087846	0.041967	2.093198	0.0423
CH	-0.159677	0.041353	-3.861307	0.0004
NREN	0.784489	0.047955	16.35880	0.0000
REN	-0.042399	0.021560	-1.966511	0.0557

EC = CO_2 – (-2.0409*GDP + 0.1376*GDP^2 + 0.0878*PH - 0.1597*CH + 0.7845 – 0.0424*REN)
Source: EViews Software

5. Conclusion and Policy Implications

The present study sought to analyze the impact of GDP, trade openness, and disaggregated energy consumption on CO_2 emissions over the period of 1965-2018 in the Philippine context. The key objective of this study was to test the validity of EKC hypothesis in the country and thereby assess the potential of renewable energy sources to curtail CO_2 emissions brought about by various economic activities in stimulating economic growth.

The Philippines is a developing country that is considered one of the fastest-growing economies in Asia; along with its substantial growth aspirations, it is also found vulnerable to climate change; therefore, it is imperative to take action to mitigate CO_2 emissions. And since the country is experiencing faster growth, it is reasonable for the government to take advantage of the current situation as they would have more means and resources to lessen the ever-increasing CO_2 emissions present in the country.

In a real sense, it's a key challenge to formulate policies that promote economic growth while simultaneously addressing environmental issues since pursuing growth can result in environmental consequences, as suggested by the outcomes of the current study. Hence, both can be in constant conflict. Currently, the study yields no presence of EKC in the Philippines. In this regard, the government should not rely on economic growth alone to mitigate environmental degradation. Instead, they should take initiative efforts in achieving sustainable growth rather than blind pursuit of economic expansion.

On the other hand, the other underlying variables that are statistically associated with CO_2 emissions are the trade openness of both countries and non-renewable energy consumption; results have shown that the trade openness of

Philippines in the long run is a contributing factor for raising the levels of CO_2 emissions. The rising trend of trade activities has intensified energy use since it entails the transportation of goods and services. Thus, generating more CO_2 emissions. With this, it can be concluded that utilizing non-renewable consumption not only enhances economic growth but also deteriorates the environment in the form of rising levels of CO_2 emissions. Especially since the energy sector in the country is heavily dependent on non-renewable energy, the demand for this is expected to increase to meet future energy demand, which would only bring environmental consequences. Moreover, aside from proving the presence of the EKC hypothesis in the Philippine context, this study also explored the role of renewable energy consumption in lowering CO_2 emissions in the country. Accordingly, the negative and statistically insignificant coefficient of REN in the short and long-run, wherein its supposed role in mitigating CO_2 emissions, cannot be confirmed. This result only indicates that despite the great interest of the government in lowering CO_2 emissions in the country through gradually shifting to renewable sources, the energy mix is still being dominated by non-renewable ones.

In terms of policy implications, this paper has considerable suggestions in terms of achieving a win-win situation on the long-desired economic growth without implicating further CO_2 emissions or the very least, minimizing it. In this regard, it is imperative for the government and policymakers in the Philippines to find a balance between the pursuit of economic growth and environmental protection and management. Trade policies should be put into place and be subjected to reasonable economic-environmental policies. In line with this, the government should also demand accountability from private sectors that contribute to the increasing pollution. Therefore, it is only reasonable to impose taxes on trade-related CO_2 emissions. Through this, it would encourage firms to invest in clean and environment-friendly technologies in producing goods and services that foster economic growth. Furthermore, since previous chapters have already established that country's economic activities depend heavily on non-renewable energy consumption. Consequently, the Philippines is in dire need of comprehensive yet clear policies on sustainable energy transition, especially when the rising demand for fossil fuel is met through imports. And because of this alarming issue, since the year 2020, the country has been committed to a 75% reduction of GHG emissions by the year 2030; although it is quite ambitious for some, it is still feasible to achieve given the renewable energy potential of the country. To achieve this goal, the energy mix must be diversified, and this can be done through increasing the role of renewable sources in stimulating economic activities. Its potential role in the Philippines is relatively high, wherein shifting towards a clean and green industry to escape dependency on imported fossil fuels is a viable solution and would greatly contribute to achieving sustainable growth since the country is abundant with natural resources. Therefore, increasing the demand for renewable energy could respond and meet the rising demand of the energy sector. According to IRENA (2016), being heavily dependent on non-renewable sources pose consequences not only to environment but to the economy as well since addressing negative externalities are costly. In fact, contrary to popular belief, every dollar spent on clean and green technologies would have a three to seven returns. Hence, the gains in investing on renewables outweigh the costs. Moreover, the government's role should not only revolve around formulating sound policies but also monitoring if formulated policies are effectively implemented as it will be insignificant to have policies that are not strictly enforced. Ultimately, these suggested policies aim not only to mitigate CO_2 but also to promote the pursuit of sustainability in the long run.

While this study contributes to the existing literature on environmental economics through identifying the existence of EKC hypothesis in the Philippines and assessing the potential of renewable energy consumption in curtailing CO_2 emissions in the country, there are still areas to improve for future researchers. Thus, this study only incorporated aggregated trade openness, which presents a pivotal point to improve in consideration of future studies in this area. Perhaps, it is worthwhile to incorporate the components of trade openness (imports and exports) separately. With this, utilizing disaggregated trade openness would further expound the distinct influence of the breakdown variables on CO_2 emissions in the Philippines. Furthermore, future researchers of the same study could also consider testing the causality. From this, the government could establish a more specific and suitable measures in addressing environmental issues at hand.

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