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Abstract: The world has changed drastically in favor of the human race as the processes of production improve, leading to the stimulation of economic growth. However, we failed to consider how these changes affect the environment, causing pollution levels to rise due to it being an unavoidable by-product of production. Eventually, nations were driven to develop a strategy to combat climate change and increase greenhouse gas emissions in the form of the Kyoto Protocol. This research compares two of the Kyoto Protocol Mechanisms, specifically the Clean Development Mechanism (CDM) and the Emissions Trading Scheme (ETS), to investigate the effect of such mechanisms on the economic growth and the greenhouse gas emissions of developed and developing countries that have chosen to adopt their specific mechanism. The research utilizes a panel data regression model and the difference-in-difference (DID) model in quantifying the contribution rate of the country-specific economic indicators and the effect of the Kyoto protocol mechanisms on developed and developing countries. Findings from the study depict the ineffectiveness of the aforementioned mechanisms for most of the developed and developing countries, given that the drivers in pursuit of viable development vary in different areas. In assessing the findings, we have provided aspects to consider for the extension of the study on investigating emission reduction approaches. Policy insights were also devised for leaders and institutions that aim to mitigate emissions further.

Keywords: kyoto protocol mechanism, emissions trading scheme, clean development mechanism, greenhouse gas emissions, sustainable development

1. INTRODUCTION

In an attempt to mitigate the environmental effects of emissions caused by the processes employed in stimulating economic development, groups of countries have created means to improve environmental conditions. The United Nations Framework Convention on Climate Change (UNFCCC) introduced the Kyoto Protocol, which was adopted in 1997, then later put into action in 2005. The international treaty mandated industrialized countries and encouraged developing countries to make conscious efforts in reducing greenhouse gas (GHG) emissions (UNFCCC, n.d.). Under the Kyoto Protocol are three different mechanisms, namely, the clean development mechanism (CDM), emissions trading scheme (ETS), and joint implementation (JI), which were all developed to assist in stimulating sustainable development, give countries a cost-effective alternative to reduce emissions, and encourage private firms and developing countries to participate (Gupta, 2016, p. 15).

Among the three mechanisms, both the CDM and JI encouraged developed countries to finance projects related to emission reduction. Under CDM, the reduction obligation is not necessarily required, and the recipients of such projects are developing countries. Meanwhile, the host countries under JI are developed countries with emission reduction obligations to fulfill, and the ERU (emission reduction units) are then credited to the financing countries once the project reaches the target emission reduction.

On the other hand, ETS, which is also known as cap and trade, has been the most common method in approaching decarbonization as capitalizing permits to emit has provided economic incentives for some (e.g., dodging carbon tax, strengthening international ties, etc.). Wherein, a ceiling for the amount of GHG emissions units that a country can utilize is set up by the number of permits that a country holds so that emission units can be allocated globally. Furthermore, these permits can also be bought (sold) from (to) other countries, increasing (decreasing) one's emissions ceiling (Gupta, 2016, p. 10; Sullivan, 2008).

Because the chosen mechanism/s differ per country, and each mechanism contributes at a different level and through distinct projects, this research aims to answer the question:

How well does the CDM stimulate economic growth compared to the ETS in developed and developing countries?

With that said, this study primarily aims to evaluate the viability of the Kyoto Protocol mechanisms (CDM and ETS) adopted by the developing and transitional countries. Additionally, this study seeks to identify the impact of emission reduction policies regulated by UNFCCC on a country's economic growth, assess

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the effectiveness of the emission reduction policies mandated by UNFCCC under the Kyoto Protocol between developed and developing countries, and differentiate the effects of implementing CDM versus implementing ETS for the developed and developing countries.

2. LITERATURE REVIEW

As early as the 1980s, the rising levels of greenhouse gases piqued the public's concern as these were viewed to be a vector of global warming. As a result, studies were performed on the awareness and the degree of concern of individuals towards global warming on a national and international level. In a more recent study from Ciarli and Savonal (2019), they had found that certain structural changes of an economy may induce both economic growth and climate change. Moreover, as globalization continues to improve relationships between countries, advances in international trade have stimulated both growth and development through the exchange of resources and capital mobility. However, previous literature from Muhammad et al. (2020) suggested that international trade induces increased carbon emissions and contributes to environmental degradation.

Aside from trade, numerous studies have investigated the relationship between economic development and its effects on the environment due to concerns regarding increasing emissions, global warming, climate change, and many more (Ahmed et al., 2017; Al-Mulali et al., 2015; Özokcu & Özdemir, 2017). Al-Mulali et al. (2015) found that GDP growth (along with other factors such as urbanization, trade openness, and financial development) is positively correlated with CO2 emissions in Europe through panel data analysis. Whether or not the different policies above are positively correlated with a country's economy and emissions level depends on said country's willingness to cooperate, which is determined by their type of government. A study on the impact of democracy on environmental conditions in developing African nations by Adams and Acheampong (2019) found that democratization reduces carbon emissions.

In response to this, there have been conscious efforts from different countries to improve the current situation on greenhouse gas exchange through the implementation of mechanisms such as carbon tax, CDM, and emissions trading schemes (EMS). Analyses regarding the Kyoto Protocol seem to conclude varying results in terms of the treaty's effectiveness. However, it has been established that the Kyoto Protocol mechanisms were constructed to advance towards sustainable development. However, there are numerous definitions of the concept of sustainable development. For this study, we have adopted the sustainable development triangle framework by Munasinghe (1992). With this approach, sustainable development consists of three major aspects: economic, social, and environmental. Having different points of view allows for a more balanced and integrated analysis of the concept.

3. FRAMEWORK

Environmental Kuznets Curve

EKC is a hypothesized association stating that at the first stages of economic growth wherein income per capita levels are low, increases in pollution levels are seen until a certain level of income per capita. The trend eventually reverses when high-income levels generate economic growth, leading to the reduction of pollution and improvements in the environment (Kuznets, 1955). However, earlier studies have also recognized the limitations of this hypothesized relationship, finding mixed empirical evidence on whether economic growth and development actually causes decreases in pollution levels (Tisdell, 2001; Ozturk et al., 2015).

Ecological Modernization Theory

The ecological modernization theory is concerned with identifying the relationship with industrial development or economic growth and the environment; putting more focus on how industrialism brings about society's increased awareness regarding environmental risks, eventually leading to society's realization of the need to call for plans of action such as environmental policies, in order to address these threats posed by industrial development (Bailey et al., 2011; Murphy & Gouldson, 2000). Meanwhile, a country in its earlier stages of development is expected to have little consideration for the environment, which may also be observed in its industries, production processes, and regimes (Prell & Sun, 2015).

Externality Theory

The externality theory refers to the spillover effects caused by the process of production, consumption, or market transactions that may affect even those third-party individuals who are not directly involved in the processes. These can be positive or negative; positive effects include the technological spillover or the transfer of technology from one area to another, allowing production to become more efficient, while negative externalities include pollution. The main drivers of negative externality pollution were caused by both foreign and domestic production processes (Markusen, 1975). Therefore, to address this issue, the solution proposed by previous literature was the imposition of a specific tax on products that contribute to increasing negative externalities (Pigou, 1920; Baumol & Oates, 1988).

4. METHODOLOGY

Data

The study makes use of data covering the periods 1995 to 2016 from developed and developing countries that have been categorized based on their respective regions, namely, East Asia and the Pacific (EAP), Southeast Asia (SEA), East Central Asia (ECA), Middle East and North Africa (MENA), Latin America and the Caribbean (LAC), South Asia (SA), and Sub-Saharan Africa (SSA). The two dependent variables, namely, total greenhouse gas emissions (*TGHG*) and GDP, measured in local

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currency unit (*GDPLCU),* are sourced from Our World in Data (OWID) and World Development Indicators (WDI), respectively. Independent variables such as net barter trade (*nbt*), labor force population (*lfpop*), urban population (*upop*), and financial development (*findev*) are from the World Development Indicators (WDI) database. Meanwhile, data regarding the Kyoto Protocol mechanism employed by a country is based on the International Energy Agency (IEA) database. Finally, the democracy indicator of a country is from the Polity V Project.

Panel Regression

Panel data regression models were utilized to look into the effects of the covariates on a country's GDP in local currency unit and its total greenhouse gas emissions over time while disregarding the effects of the Kyoto Protocol mechanisms.

The first-panel regression model will use total greenhouse gases (*TGHG*) as the dependent variable, subject to the country-specific economic variables including, democracy (*dem*), net barter trade (*nbt*), labor force population (*lfpop*), urban population (*upop*), financial development (*findev*), and public debt (*pubd*) of a country.

$$TGHG_{it} = \beta_{0_{it}} + \beta_1 dem_{it} + \beta_2 nbt_{it} + \beta_3 lfpop_{it} + \beta_4 upop_{it} + \beta_5 findev_{it} + \beta_6 pubd_{it} + \nu_{it} \quad (1)$$

Meanwhile, the second model will observe the gross domestic product in the local currency unit (*GDPlcu*) as the dependent variable, subject to the country-specific economic variables including democracy (*dem*), net barter trade (*nbt*), labor force population (*lfpop*), urban population (*upop*), financial development (*findev*), and public debt (*pubd*) of a country.

$$GDPLCU_{it} = \beta_{0_{it}} + \beta_1 dem_{it} + \beta_2 nbt_{it} + \beta_3 lfpop_{it} + \beta_4 upop_{it} + \beta_5 findev_{it} + \beta_6 pubd_{it} + \nu_{it} \quad (2)$$

Difference-in-Difference Estimation

In order to complement the panel data regression models, the study utilizes the difference-in-difference (DID) method to appropriately evaluate and account for the true causal effect of the Kyoto Protocol mechanisms on a longitudinal perspective.

To perform the DID method, a treatment group (where a portion of the sample to be observed are given a particular treatment, which is the Kyoto protocol mechanism in this study) and a control group (which is the portion of the sample that remains untreated as it captures the result of the absence of treatment) are required.

The first set of DID models observes the effect of implementing CDM in a country as compared to countries that did not implement any Kyoto Protocol mechanism at all. Equation 3.1 specifically observes the greenhouse gas emission rate as the regressor and is formulated as follows:

$$TGHG_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 CDM_{it} + \beta_3 (time \cdot CDM)_{it} + \beta_4 dem_{it} + nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (3.1)$$

Equation 3.2 investigates the GDP measured in constant local currency unit (lcu) as the dependent variable and is formulated as follows:

$$GDPLCU_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 CDM_{it} + \beta_3 (time \cdot CDM)_{it} + \beta_4 dem_{it} + \beta_5 nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (3.2)$$

In measuring the treatment effect of CDM, both equations will be subject to the other country-specific economic variables such as public debt (*pubd*), financial development (*findev*), labor force population (*lfpop*), urban population (*upop*), net barter trade (*nbt*), and the democracy indicator (*dem*) of a country; the dummy variables are time dummy (*time*) and treatment dummy (*CDM*).

The second set of DID models aims to show the true causal effect of implementing ETS in a country compared to countries that did not implement any Kyoto Protocol mechanism. Equation 4.1 specifically observes the greenhouse gas emission rate as the regressor and is formulated as follows:

$$TGHG_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 ETS_{it} + \beta_3 (time \cdot ETS)_{it} + \beta_4 dem_{it} + \beta_5 nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (4.1)$$

Equation 4.2 looks into the GDP as the dependent variable and is formulated as follows:

$$GDPLCU_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 ETS_{it} + \beta_3 (time \cdot ETS)_{it} + \beta_4 dem_{it} + \beta_5 nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (4.2)$$

In measuring the treatment effect of ETS, both equations will be subject to the other country-specific economic variables such as public debt (*pubd*), financial development (*findev*), labor force population (*lfpop*), urban population (*upop*), net barter trade (*nbt*), and the democracy indicator (*dem*) of a country; the dummy variables are time dummy (*time*) and treatment dummy (*ETS*).

As the study aims to distinguish the effect of ETS and CDM, the third set of DID models addresses the countries that only

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employed CDM as the control group, whereas the countries that implemented both CDM and ETS are represented as the treatment group. Hence, the third model will be excluding countries that did not adopt any Kyoto Protocol mechanism at all.

Equation 5.1 looks into differences affecting the GHG emission levels of the treatment group among the developed and developing countries, before the implementation of the ETS but after the implementation of CDM (pre-treatment) and after the implementation of both CDM and ETS (post-treatment) and is formulated as follows:

$$TGHG_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 CE_{it} + \beta_3 (time \cdot CE)_{it} + \beta_4 dem_{it} + \beta_5 nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (5.1)$$

Meanwhile, Equation 5.2 looks into the GDP as the dependent variable and is formulated as follows:

$$GDPLCU_{it} = \beta_{0_{it}} + \beta_1 time_{it} + \beta_2 CE_{it} + \beta_3 (time \cdot CE)_{it} + \beta_4 dem_{it} + \beta_5 nbt_{it} + \beta_6 lfpop_{it} + \beta_7 upop_{it} + \beta_8 findev_{it} + \beta_9 pubd_{it} + \nu_{it} \quad (5.2)$$

Both equations will be subject to the other country-specific economic variables such as public debt (*pubd*), financial development (*findev*), labor force population (*lfpop*), urban population (*upop*), net barter trade (*nbt*), and the democracy indicator (*dem*) of a country; the dummy variables are time dummy (*time*) and treatment dummy (*CE*).

5. RESULTS AND DISCUSSION

Difference-in-Difference Estimates

Table 1

Results of DID Analysis on TGHG

Developed

Region		CDM	ETS	CDM and ETS
	Before	1.10E+08	3.90E+07	-7.00E+07
	After	1.10E+08	3.90E+07	-7.00E+07
EAP	**DID**	**0.00E+00***	**0.00E+00**	**0.00E+00***
	Before	-3.10E+07	-2.60E+06	0.00E+00
ECA	After	-2.80E+07*	-9.50E+06	2.00E+07
	DID	**3.10E+06**	**-6.90E+06**	2.00E+07
	Before	-1.10E+08	-4.70E+07	1.10E+08
	After	-1.10E+08	-4.70E+07	1.10E+08
NA	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Developing

Region		CDM	ETS	CDM and ETS
	Before	-3.80E+06	0.00E+00	0.00E+00
	After	-1.60E+06	0.00E+00	0.00E+00
EAP	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	1.60E+08	-3.10E+08	-2.60E+08*
	After	-2.00E+08*	-3.10E+08	-2.60E+08*
SEA	**DID**	**-3.50E+08**	**0.00E+00**	**0.00E+00**
	Before	-3.50E+07	1.50E+08*	0.00E+00
	After	-3.50E+07	1.50E+08*	0.00E+00
ECA	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	-6.50E+07*	0.00E+00	**0.00E+00**
	After	-6.50E+07*	0.00E+00	**0.00E+00**
MENA	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	2.70E+08*	-2.30E+08*	-4.80E+07
	After	-3.80E+07*	-2.30E+08*	-4.80E+07
LAC	**DID**	**-3.10E+08***	**0.00E+00**	**0.00E+00**
	Before	-8.70E+07	0.00E+00	0.00E+00
	After	-2.30E+07	0.00E+00	0.00E+00
SA	**DID**	**6.40E+07**	**0.00E+00**	**0.00E+00**

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SSA	Before	-1.90E+06	0.00E+00	0.00E+00
	After	4.40E+07*	0.00E+00	0.00E+00
	DID	**4.60E+07**	**0.00E+00**	**0.00E+00**

*□ =5%

In terms of CDM's impact, by itself, on the GHG emissions of developed countries, the only significant result was for the EAP region. However, results showed that no change in the total GHG emissions of EAP was caused directly by the implementation of CDM. This means that the countries in the region merely offset their emissions through the CER credits they gained from the CDM projects they were involved in.

As for the impact of ETS on GHG emission levels of developed countries, only the ECA region experienced a decrease in their GHG emissions. Meanwhile, both EAP and NA experienced no change. We found that the reason why GHG emissions of these two regions did not change was due to the global financial crisis, which affected UNFCCC negotiations, and because of the effectivity dates of their cap-and-trade policies. Relative to the ECA region who started theirs in 2005, most countries from the EAP and NA regions started their implementation from 2012 onwards.

Moving on to the DID analysis of CDM and ETS, this would consider countries that have implemented both CDM and ETS. Developed countries in NA and EAP have not experienced any significant impact on their total greenhouse gas emissions (*TGHG*). However, results show that there seemed to be an increase in TGHG in the ECA region after implementing the mechanisms. We found that this could be because the European Union, which a majority of developed ECA countries are members of, is considered to be among the top three emitters of CO2 in the world, mostly from electricity/heat, transportation, and infrastructure.

In regard to developing countries, CDM projects managed to decrease emissions in SEA and LAC. The decrease in emissions could be attributed to CDM projects resuming operations beyond their expected period in said regions. This has mitigated the emissions in those countries, especially if they did not have any proper emissions reduction policies or mechanisms beforehand.

As for the effects of ETS on the greenhouse gas emissions of developing countries, all the regions, namely, EAP, SEA, ECA, MENA, LAC, SA, and SSA, did not experience any changes in their greenhouse gas emission levels amid the ETS implementation. Based on the analysis, among all the developing countries, only five countries adopted the ETS. Because this is very few relative to the number of developing countries, this might not have been enough to cause a significant effect.

As for developing countries that have employed both CDM and ETS, results show that there was no impact on the total greenhouse gas emissions of all regions. This could be because a majority of developing countries have only implemented CDM. In fact, Brazil, Chile, Thailand, Vietnam, and China are the only developing countries known to use CDM and ETS. Not to mention, these countries began to make use of ETS during and after 2012.

Table 2
Results of DID analysis on GDP

Developed				
Region		**CDM**	**ETS**	**CDM and ETS**
	Before	-3.50E+13	-2.50E+13*	-7.20E+12
	After	-3.50E+13*	-2.50E+13*	-7.20E+12
EAP	**DID**	**0.00E+00***	**0.00E+00**	**0.00E+00**
	Before	-1.00E+12	2.10E+11	0.00E+00
	After	-1.00E+12	1.40E+12	-2.30E+09
ECA	**DID**	**4.60E+10**	**1.20E+12**	-2.30E+09
	Before	-5.60E+11*	8.70E+10	-1.50E+11
	After	-5.60E+11*	8.70E+10	-1.50E+11
NA	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Developing				
Region		**CDM**	**ETS**	**CDM and ETS**
	Before	1.60E+12*	0.00E+00	0.00E+00
	After	1.60E+12*	0.00E+00	0.00E+00
EAP	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	4.90E+14	-5.20E+14*	-6.00E+14*
	After	-3.90E+14*	-5.20E+14*	-6.00E+14*
SEA	**DID**	**-8.80E+14**	**0.00E+00**	**0.00E+00**

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ECA	Before	6.20E+10	1.30E+13*	0.00E+00
	After	6.20E+10	1.30E+13*	0.00E+00
	DID	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	-2.80E+14*	0.00E+00	0.00E+00
	After	-2.80E+14*	0.00E+00	0.00E+00
MENA	**DID**	**0.00E+00**	**0.00E+00**	**0.00E+00**
	Before	-1.20E+14	-1.20E+14*	-1.20E+14
	After	1.30E+13	-1.20E+14*	-1.20E+14
LAC	**DID**	**1.30E+14**	**0.00E+00**	**0.00E+00**
	Before	5.30E+12	0.00E+00	0.00E+00
	After	9.90E+11	0.00E+00	0.00E+00
SA	**DID**	**-4.30E+12**	**0.00E+00**	**0.00E+00**
	Before	1.90E+13	0.00E+00	0.00E+00
	After	9.00E+12*	0.00E+00	0.00E+00
SSA	**DID**	**-1.00E+13**	**0.00E+00**	**0.00E+00**

*□ =5%

As for the impact of CDM, by itself, on developed countries' GDP, only EAP received a significant effect. Nevertheless, the implementation of CDM had no effect on the GDP of the region. Although previous literature states that CDM projects increase GDP in the long run, they could have also diverted resources from more productive and profitable investments, hindering the growth of their GDP.

Meanwhile, we found that ETS once again affected only the ECA, causing an increase in their GDP levels, whereas NA and EAP did not experience any change. The effectiveness of the ECA region's cap-and-trade scheme may be attributed to the flexibility of their emissions reduction policy, which adjusts accordingly to any economic or political change. Meanwhile, the no-change effect on the EAP and NA region may have been due to the lack of flexibility in their policy, which was then affected by the aforementioned financial crisis.

As for the impact of CDM and ETS, NA and EAP have not experienced any significant impact on their GDP as well. However, this does not seem to be the case for Europe and Central Asia (ECA), as results show that GDP had decreased. We looked into this and found that the aftereffects of the 2008-2009 global financial crisis could potentially be a contributing factor. The Eurozones and non-Eurozones had varying rates of economic recovery; in fact, Eurozone countries' growth seemed to slow down over the years.

In terms of developing countries, none of the regions experienced any significant effects from implementing CDM. However, the effects did vary across the regions. According to existing studies, different CDM project types have varying effects on employment depending on the sector of employment or the type of CDM project. In LAC, where CDM had a positive impact on GDP, it could be because the CDM projects have increased local employment and government spending. On the other hand, CDM had either a negative or no impact on GDP in all the other regions.

Meanwhile, the ETS implementation did not affect the GDP of those countries in all regions. A possible reason for this is, again, because of the very few developing countries who have implemented the ETS relative to the amount of total developing countries per region. This might not have been enough to cause a significant effect per region.

Finally, the effects of CDM and ETS on GDP in developing countries do not have an impact seeing as how the DID estimation results equate to zero. Again, this could be due to the fact that a majority of developing countries do not make use of ETS.

Panel Regression Results

The findings of the panel data regression model revealed that the effects of the different covariates vary across different regions, both developed and developing, as each country has tackled and distinguished its own path towards economic growth in keeping up with the rapid changes in the global economy. In some instances, these effects may lead the country to experience GHG emission sink, wherein they tend to yield a greater domestic footprint than their contribution to the global (or rest of world) footprint, whereas some could experience GHG emission leakage wherein they tend to yield a greater contribution to the global footprint (or rest of world) in the attempt of diminishing their own domestic footprint (Malik & Lan, 2016).

Accordingly, in our panel regression result analyzing the time effect on the total GHG emissions and GDP has shown that among the regions in the developed countries, none of the regions aligned with the expected outcome of the variables over time have a negative impact on the TGHG emitted. More so, in the case of the developing countries, only the regions EAP, SEA, LAC, and SSA aligned with the a-priori of the study. However, the intercept in some regions, specifically EAP, SEA, and ECA, was found to be statistically insignificant.

Meanwhile, among the regions in the developed country based on the panel data regression model, most of the regions, specifically

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ECA, and NA, aligned with the expected outcome of the variables over time, having a positive impact on the GDP. However, the proxy variable for the time effect in the model for the ECA region was found to be statistically insignificant. In the case of the developing countries, only the regions ECA, LAC, and SSA aligned with the a-priori of the study, although the time effect proxy was found to be statistically insignificant.

Although developed countries have employed a cleaner technology development to mitigate emissions, whereas developing countries have been fostering energy efficiency as a way to reduce emissions, the impact of these attempts is still not enough to overcome the multi-faceted challenges that each country may or have encountered over the years, as energy consumption and GHG emissions only tend to shift from one form to another, thereby, strengthening the theory of externality (Liu et al., 2019; Voigt et al., 2014).

6. CONCLUSION

Although developed countries have employed a cleaner technology development to mitigate emissions, and developing countries have been fostering energy efficiency as a way to reduce emissions, the impact of these attempts is still not enough to overcome the multi-faceted challenges that each country may or have encountered over the years, as energy consumption and GHG emissions only tend to shift from one form to another. In investigating the countries that have the emission trading scheme implemented, it was only those industrialized countries that came from the ECA region that experienced a negative effect on their TGHG and a positive effect on their GDP. Although both came out to be statistically insignificant in the model, the ECA region proved that the ETS crucially contributed to the emission reduction and at the same time improved their economic growth by 2016. Although CDM did not have any effect on the TGHG of developed countries, it has been shown to decrease GHG emissions in developing regions, like LAC and SEA. Additionally, amidst the varying effects of CDM on the GDP of developing countries, it could still help increase GDP through job creation and government spending. Meanwhile, developed countries that have implemented both CDM and ETS had not experienced any significant impacts on their TGHG and GDP except for the ECA region. Furthermore, the GDP and TGHG of developing countries in all regions were not significantly impacted by the two mechanisms as well.

Based on the information gathered and a thorough analysis of the results, we propose the following policy insights:

Integrate Custom Unions in Promoting Emission Reduction Approaches

Upon recognizing the impact of the EU ETS on the ECA region, we acknowledge that if enough resources are allocated to the carbon emission reduction scheme, it may be effective enough to reduce emission levels. Because the employment of an emissions trading scheme would require many resources, developing countries may not have enough capital to allocate to the carbon reduction projects on their own. Given that trade and foreign direct investments (FDI) have provided avenues for production expansion and cater to the existence of distortion in consumption, custom unions among developing countries like the ASEAN economic community, the economic integration among regions, among others, should also work hand in hand in mitigating the emissions of their members as they approach economic development hand in hand.

Resume and Ensure the Continuity of CDM Projects Beyond Their Operating Period

Evident in our study is the implication of ensuring the continuity of the CDM projects established by the countries in certain regions, particularly SEA and LAC, in adhering to the Kyoto Protocol Mechanism. For this reason, the respective national governments are then encouraged to resume and enforce the effectiveness of the projects under CDM as this cannot only diminish their emissions but also spur their local employment depending on the type of project utilized.

Align the Type of CDM Projects by the Material Footprint

Although there are several factors to consider in investigating the components of global emissions, the intensity of the varying intensity of material footprints and the prominence of certain industries in the different areas of a specific country should also be taken into account before employing a particular type of CDM. Given that the effect of existing CDM projects ranges across the regions, aside from the multi-faceted economic development, the types of CDM projects were also considered in analyzing the impact of the said mechanism as a whole.

Implement ETS According to Their Respective Energy Consumption

Similar to that of Australia and New Zealand, putting a cap on carbon emissions can be implemented first in intensive carbon-emitting industries such as power plants. However, the ETS should not only be limited to the GHG emissions covered by the Kyoto Protocol itself. Evidence from the study of Duan and Yan (2019) is China's intensive emission of sulfur dioxide (SO2), giving the country a margin to avoid part of their responsibilities in taking part from the Kyoto Protocol. Thus, instead of putting a cap and levy taxes on carbon emissions, the ETS to be employed should also consider capping and taxing based on the intensity of the particular energy consumption and emission. Furthermore, the fiscal policy implemented should encompass all applicable emissions and have the tax rates vary by the intensity of its usage of the country accordingly.

Provide Patents for Green Innovations and Technology Transfers in Developing Countries

In view of the additional constraints that currently exist for developing countries as the externalities of production are now considered, national governments of the developing countries

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should provide patents for green innovations and technology transfers brought by CDM. By doing so, not only will it incentivize local researchers, but the developing countries can also utilize the right of use for economic development while the developed countries could also gain credits from the respective technology transfers under CDM.

Provide Opportunities for the Unemployed to Work in the CDM Projects

Addressing the employees that were laid off due to the rising labor force and the circumstances that transpired, national governments and custom unions should provide opportunities to the unemployed by training and prioritizing them to work in the CDM projects. More so, another project that should be considered in promoting CDM is building recycling facilities that could be managed by the unemployed as well. That way, the effect of the Kyoto Protocol Mechanism can also trickle down to those in need while mitigating emissions and reducing the impact of pollution as the world aims to diminish the marginal social cost of economic development.

Regarding future research, using the similar scope in our study, we advise that instead of grouping the countries by their respective regions, it is better to group these countries and differentiate them by the intensity range of their emission levels and how the other UN-mandated emission reduction policies may have influenced certain groups to either shift their energy consumption or material footprint over time. We also suggest differentiating the effect of each type of CDM employed as the types of projects can vary from solar, wind, hydro, biomass, and a few more.

Furthermore, we encourage future studies to investigate the Joint Implementation mechanism under the Kyoto Protocol, which was not covered by the study. In line with this, we also recommend investigating the recent years from 2017 to 2021, given that the pilot year for the cap-and-trade scheme only started around 2012–2015 for most countries, excluding the Eurozone countries. Another aspect to investigate is the pre- and post-global financial crisis because it was mentioned by authors like Pearse (2013), and Diaz-Rainey and Tulloch (2018) that the global financial crisis itself did not only cause a delay in piloting the Kyoto Protocol mechanisms for certain countries, but it has also hampered economic development for some, which could have also influenced the GHG levels emitted, the material footprints generated, biomass, and energy consumption.

Additionally, we also propose to future researchers to explore more on the material footprint and energy consumption from a global longitudinal perspective to ascertain whether the sinks or leakages that we referred to earlier does not only happen due to carbon emissions, as it could also be due to the existing administrations or policies. Since Duan and Yan (2019) have inferred that sulfur dioxide pollution is present in China's trade aspect, this brings us to another concern that one can explore on, particularly the specific chemicals emitted aside from carbon dioxide emissions, given that the Kyoto Protocol currently covers carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride, and nitrogen trifluoride. Ultimately, researchers can also consider the aftereffects of how the COVID19 pandemic affected international carbon emission levels.

7. REFERENCES

Adams, S., & Acheampong, A. O. (2019). Reducing carbon emissions: The role of renewable energy and democracy. *Journal of Cleaner Production, 240*. https://doi.org/10.1016/j.jclepro.2019.118245

Ahmed, K., Bhattacharya, M., Shaikh, Z., Ramzan, M., & Ozturk, I. (2017). Emission intensive growth and trade in the era of the Association of Southeast Asian Nations (ASEAN) integration: An empirical investigation from ASEAN-8. *Journal of Cleaner Production, 154*, 530–540.

Al-Mulali, U., Ozturk, I., & Lean, H. H. (2015). The influence of economic growth, urbanization, trade openness, financial development, and renewable energy on pollution in Europe. *Natural Hazards, 79*(1), 621–644.

Bailey, I., Gouldson, A., & Newell, P. (2011). Ecological modernisation and the governance of carbon: A critical analysis. *Antipode, 43*(3), 682–703.

Baumol, W. J., Baumol, W. J., Oates, W. E., Bawa, V. S., Bawa, W. S., Bradford, D. F., & Baumol, W. J. (1988). *The theory of environmental policy*. Cambridge university press.

Ciarli, T., & Savona, M. (2019). Modelling the evolution of economic structure and climate change: A review. *Ecological Economics, 158*, 51–64. https://doi.org/10.1016/j.ecolecon.2018.12.008

Diaz-Rainey, I., & Tulloch, D. J. (2018). Carbon pricing and system linking: Lessons from the New Zealand emissions trading scheme. *Energy Economics, 73*, 66–79. https://doi.org/10.1016/j.eneco.2018.04.035

Duan, Y., & Yan, B. (2019). Economic gains and environmental losses from international trade: A decomposition of pollution intensity in China's value-added trade. *Energy Economics, 83*, 540–554. doi:10.1016/j.eneco.2019.08.002

Gupta, A. (2016). Climate change and Kyoto protocol: An overview. *Handbook of environmental and sustainable finance* (pp. 3–23). Academic Press.

Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review, 45*(1), 1–28. Retrieved May 31, 2021, from http://www.jstor.org/stable/1811581

Liu, D., Guo, X., & Xiao, B. (2019). What causes growth of global greenhouse gas emissions? Evidence from 40 countries. *Science of the Total Environment, 661*, 750–766. https://doi.org/10.1016/j.scitotenv.2019.01.197

Malik, A., & Lan, J. (2016). The role of outsourcing in driving global carbon emissions. *Economic Systems Research, 28*(2), 168–182. https://doi.org/10.1080/09535314.2016.1172475

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Markusen, J. R. (1975). International externalities and optimal tax structures. *Journal of International Economics, 5*(1), 15–29. Retrieved from https://www.sciencedirect.com/science/article/pii/0022199675900252

Muhammad, S., Long, X., Salman, M., & Dauda, L. (2020). Effect of urbanization and international trade on CO2 emissions across 65 belt and road initiative countries. *Energy, 196.* https://doi.org/10.1016/j.energy.2020.117102

Munasinghe, M. (1992). *Environmental economics and sustainable development*. Paper presented at the UN Earth Summit, Rio de Janeiro. World Bank.

Murphy, J., & Gouldson, A. (2000). Environmental policy and industrial innovation: Integrating environment and economy through ecological modernisation. *Geoforum, 31*(1), 33–44. https://doi.org/10.1016/S0016-7185(99)00042-1

Özokcu, S., & Özdemir, Ö. (2017). Economic growth, energy, and environmental Kuznets curve. *Renewable and Sustainable Energy Reviews, 72*, 639–647.

Ozturk, I., Al-Mulali, U., & Saboori, B. (2015). Investigating the environmental Kuznets curve hypothesis: The role of tourism and ecological footprint. *Environmental Science and Pollution Research, 23*(2), 1916–1928. doi:10.1007/s11356-015-5447-x

Pearse, R. (2013). Back to the land? Legitimation, carbon offsets and Australia's emissions trading scheme. *Global Change, Peace & Security, 25*(1), 43–60. doi:10.1080/14781158.2013.758098

Pigou, A. C. (1920). *The economics of welfare.* Macmillan.

Prell, C., & Sun, L. (2015). Unequal carbon exchanges: Understanding pollution embodied in global trade. *Environmental Sociology, 1*(4), 256–267.

Sullivan, G. (2008). Climate change: Cooperation and human security. In: Kurtz L (ed) *Encyclopedia of violence, peace and conflict*, vol 1 A–F, 2nd edn. Elsevier, Amsterdam, Boston, Heidelberg .

Tisdell, C. (2001). Globalisation and sustainability: Environmental Kuznets curve and the WTO. *Ecological Economics, 39*(2), 185–196. https://doi.org/10.1016/S0921-8009(01)00234-8

United Nations Framework Convention on Climate Change. (n.d.). *What is the Kyoto Protocol?* https://unfccc.int/kyoto_protocol

Voigt, S., De Cian, E., Schymura, M., & Verdolini, E. (2014). Energy intensity developments in 40 major economies: Structural change or technology improvement? *Energy Economics, 41*, 47–62.

8. APPENDIX

Table 3
Panel Regression Results for Democracy

	Developed	
	TGHG	**GDP**
EAP	Omitted	Omitted
ECA	2.79E+06	-1.01E+11
NA	9.35E+07	-3.01E+11*
	Developing	
	TGHG	**GDP**
EAP	-2.88E+04	1.85E+11*
SEA	-3.11E+06	-7.95E+12
ECA	-2.23E+05	5.47E+09
MENA	-5.59E+06*	-4.59E+13*
LAC	1.57E+06	1.20E+12
SA	8.35E+05	1.79E+10
SSA	-1.76E+06*	4.63E+10

*□ =5%

Table 4
Panel Regression Results for Net Barter Trade

	Developed	
	TGHG	**GDP**
EAP	2.27E+06*	-4.80E+11*
ECA	-8.82E+04	4.56E+09
NA	-4.71E+06	-1.58E+10*
	Developing	
	TGHG	**GDP**
EAP	-6.37E+04	2.70E+10*
SEA	-6.28E+05	6.25E+12*
ECA	-6.93E+04	1.49E+09*
MENA	1.14E+05*	6.47E+11*
LAC	2.04E+04	6.77E+10
SA	1.33E+06*	2.22E+10

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SSA	2.33E+04	9.08E+09*

*□ = 5%

Table 5
Panel Regression Results for Labor Force Population

Developed		
	TGHG	**GDP**
EAP	6.26E+01*	6.88E+06*
ECA	1.88E+01*	2.19E+05*
NA	1.12E+02*	-3.24E+05*
Developing		
	TGHG	**GDP**
EAP	2.80E+01*	-3.62E+06*
SEA	1.76E+00	-1.22E+07
ECA	4.29E+01*	5.55E+04
MENA	1.02E+01*	-6.31E+07*
LAC	-4.85E+01*	1.89E+07*
SA	-7.81E+00*	-4.25E+05*
SSA	-3.87E-02	-1.13E+05

*□ =5%

Table 6
Panel Regression Results for Urban Population

Developed		
	TGHG	**GDP**
EAP	-2.87E+01*	-3.11E+05
ECA	-2.88E+00	-1.08E+05
NA	-4.53E+01*	2.71E+05*
Developing		
	TGHG	**GDP**
EAP	2.24E+01*	6.97E+06*
SEA	9.34E+00*	7.48E+07*
ECA	-8.78E+00	3.99E+04
MENA	1.32E+01	7.81E+07*
LAC	3.46E+01*	-1.14E+07*
SA	1.60E+01	7.25E+05*
SSA	2.19E+00*	9.32E+05*

*□ =5%

Table 7
Panel Regression Results for Financial Development

Developed		
	TGHG	**GDP**
EAP	-9.74E+06*	5.11E+11*
ECA	-7.87E+04	2.67E+09
NA	-9.95E+05	8.17E+09*
Developing		
	TGHG	**GDP**
EAP	-1.66E+05*	5.14E+09
SEA	9.47E+05*	5.83E+12*
ECA	1.41E+03	7.59E+09*
MENA	-1.56E+04	3.97E+12*
LAC	-2.15E+06*	5.28E+11*
SA	1.15E+06	5.39E+10*
SSA	4.50E+05*	-2.41E+10*

*□ =5%

Table 8
Panel Regression Results for Public Debt

Developed		
	TGHG	**GDP**
EAP	3.65E+06*	6.14E+11*
ECA	-8.06E+05*	3.62E+09
NA	-6.40E+06	-4.02E+10*
Developing		
	TGHG	**GDP**
EAP	-1.58E+04	1.51E+10
SEA	-2.67E+05	6.18E+11

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ECA	-6.48E+05*	4.42E+08
MENA	1.58E+05	2.00E+12*
LAC	1.23E+05	1.44E+11
SA	-2.84E+05*	4.11E+10*
SSA	-3.04E+03	-2.73E+09

*□ =5%

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