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Emissions-Foreign Trade Nexus: Establishing the Need to Harmonize Environment and Economics in RCEP

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Abstract

Regional trade agreements (RTAs), accounting for more than half of the international trade, are aimed at boosting economic growth of participating countries. Economic growth has shown to have a significant impact on carbon emissions. This article investigates the impact of foreign trade on carbon emissions of the member countries of the largest trade bloc, the Regional Comprehensive Economic Partnership (RCEP). The aggregate bilateral trade with members of RCEP during the period 1991-2020 was considered for analysis. The study also examines the impact of foreign trade (between member countries) on economic development, represented by GDP per capita. Dumitrescu-Hurlin panel granger causality test was conducted to understand the impact of foreign trade on GDP per capita and carbon emissions. Results indicate that though foreign trade is heterogeneously granger causing GDP per capita, it also aggravates carbon emissions in RCEP bloc. The study is of significance to the policymakers in the member countries as it provides evidence to include climate impact in trade agreements. The wealthier RCEP member countries can support the green transition of low-income countries through transfer of eco-friendly technologies.

Keywords: foreign trade; trade openness; RCEP; carbon emissions; economic growth

1. Introduction

Economic growth and its impact on carbon emissions have become a major concern for policymakers, academicians, corporate houses, and environmentalists. Trade facilitation agreements targeting economic growth have mushroomed after the General Agreement on Tariffs and Trade (GATT). Regional agreements such as the North American Free Trade Agreement (NAFTA), European Union (EU), ASEAN (South East Asia), and, SAARC (South Asia) have further boosted global trade. Driven by trade blocs, foreign trade has witnessed exponential growth since the 1970s, as shown in Figure 1. According to popular trade theories such as absolute advantage theory and comparative advantage theory, increasing trade enhances growth. Trade agreements have indeed boosted economic growth, particularly in participating developing countries. However, increasing economic growth also leads to environmental degradation and higher carbon emissions as the production units in developing economies are heavily reliant on fossil fuels. The growing literature on the empirical impact of global trade on carbon emissions has sparked debate on the issue among academicians (Antweiler et al., 2001; Shahbaz et al., 2017). The results of these studies have been inconclusive, with the extent of impact varying based on the countries included in the study.

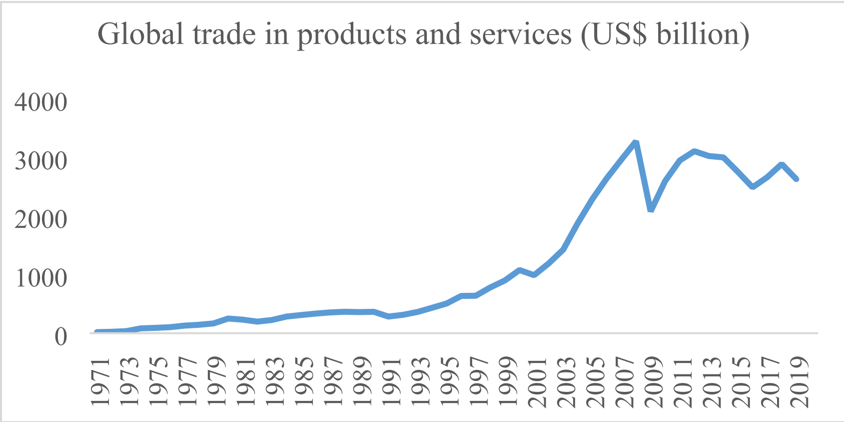

Figure 1: Global trade ($ billion)
Source: World Bank

In this paper, we investigate the foreign trade-emissions nexus of the largest trade bloc, Regional Comprehensive Economic Partnership (RCEP). Initiated by Indonesia in 2011, the RCEP is a free trade agreement signed by 15 Asia-Pacific countries on 15 November 2020 (RCEP, 2022). The agreement covers 10 members of the Association of Southeast Asian Nations (ASEAN) and five of their major trading partners. The members – Australia, Brunei, Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Singapore, South Korea, Thailand, and Vietnam – together accounted for about 30% of the global GDP in 2020. The trade agreement is expected to remove 90% of the import tariffs over the next 20 years. It also aims to unify rules for trade, e-commerce, and intellectual property, to streamline supply chains and reduce transit costs through the bloc. The trade bloc is expected to assist China in enhancing its industrial output (Wardani & Cooray, 2019). One of the largest emitters of greenhouse gases, China's emissions have increased by 170% in the last decade alone (EIA, 2020). This dramatic growth is attributed to high emission intensity and heavy reliance on fossil fuels for production (Liu et al., 2016). More than 70% of the energy generated is through non-renewable sources, primarily coal. RCEP is expected to further boost the scale of production in member countries, including China. Similar to other trade blocs, the environmental impact of RCEP is a concern for both policymakers and academicians.

Although studies have been conducted on the growth-emissions and trade-emissions nexuses, there is no available research on RCEP countries. In this context, this paper examines the long-term impact of foreign trade on carbon emissions in RCEP member countries. Foreign trade's impact on GDP per capita is also studied. Panel data series covering the 15 member countries for the period 1991-2020 is used for the analysis. The period is chosen as the majority of the Asian economies adopted liberal foreign trade policies in the 1990s. After checking for stationarity, Dumitrescu-Hurlin panel granger causality test is conducted to examine the impact of foreign trade on GDP per capita and carbon emissions of RCEP member countries. Finally, we discuss the policy implications of the findings. Our work contributes to the growing literature on understanding the trade-emissions nexus. The impact of international trade on carbon emissions is an essential component in formulating trade policies, especially in developing countries. The findings will therefore provide evidence to focus on sustainable production mix and including transfer of cleaner technology solutions in trade agreements.

After the introduction, the paper is structured in five sections, namely – (2) theoretical framework and the literature review, (3) research methodology, (4) findings, (5) discussion, and (6) conclusion. The next section covers the theoretical framework and literature review.

2. Theoretical Framework and Literature Review

2.1 Theoretical framework: Comparative cost advantage, liberalization, and pollution havens

According to Ricardo's theory of comparative cost advantage, both trading partners gain from focusing on goods with a lower opportunity cost (Ricardo, 1817).With environmental concerns related to industrialization yet to take shape, this theory excluded the long-term impact of such externalities associated with the trade. In the basic case without considering the externalities, we can be sure of both parties' gain. However, once the impact on the external environment is considered, there is no surety of any net gains from trade (Harris, 2004). With an increasing focus on sustainable development, countries are penalizing polluters through environmental taxes, permits, and regulations. However, there is wide disparity between countries in implementing these regulations. This leads to exporting pollution by the wealthier countries by importing goods whose production involves high environmental costs. Hence, international trade is just leading to a transfer of emissions from consuming countries to producing countries, rather than solving the problem (Rothman, 1998). The pollution haven hypothesis (Copeland, 2008) explains international trade patterns while considering their impact on the environment. Strict environmental laws force companies to relocate production to less stringent environmental laws. Developing countries with liberal economic policies and lenient environmental laws have a comparative advantage in the production of such pollution-intensive products.

The conceptual framework developed by trade economists to understand the environmental impact of trade liberalization separates the impact into three independent effects, namely, scale, composition, and technique (Harris, 2004). The first effect refers to the increased economic activity following trade agreements. Increased volumes of trade will boost the scale of production in an economy, which again leads to higher energy use, and hence more environmental damage. The second effect of composition covers the changes in the product mix of a country's production. Foreign trade improves the economic efficiency of countries through allocating resources towards products providing a competitive advantage. The composition effect will have a lower emissions impact if the resources are increasingly allocated to less energy-intensive sectors. This makes it difficult to accurately predict the environmental impact of composition change. The third effect, the technique effect, translates to improvements in energy efficiency through trade. This lowering of emissions in the producing country can be explained in two ways. First, trade provides access to environmentally-friendly technologies that were earlier unavailable in the domestic market or unaffordable for producers. Motivated by access to wider markets, the producers might also develop new sustainable products and technologies for export. Second, the Environmental Kuznets curve (EKC) hypothesis suggests an inverted U-shaped link between economic growth and pollution levels i.e., pollution levels increase with economic growth until a turning point beyond which pollution levels drop (Grossman & Krueger, 1991). With the increase in income that trade brings, societies in the producing countries could demand better environmental quality thereby leading to lower emissions. The transmission process in each of these channels can be expressed as follows:

Table 1: Transmission channels to explain the impact of liberalization on emissions

Component	Transmission process	Impact on emissions
Scale	Liberalization → Increase in production → More energy use → Higher emissions	Increase
Composition	Liberalization → Change in product composition → More/less energy use → Higher/lower emissions	Increase or decrease depending on the product composition
Technique	Liberalization → Transfer of cleaner technologies → Less energy use → Lower emissions Liberalization → Increase in production → Increase in income → Demand for cleaner production → Lower emissions	Decrease

Source: Authors' Analysis

The scale and technique effects have a complementing impact on emissions. The composition effect could have a positive or negative impact depending on the comparative advantage of countries. Hence, the overall impact of trade on carbon emissions depends on the relative strength of each of these components and hence, is unpredictable. However, the existing relationship between foreign trade and emissions could give indications on the impact that trade has on the economies considered.

2.2 Literature on trade openness and carbon emissions

The literature on the impact of trade on carbon emissions is vast and growing (Cole & Elliott, 2003). Empirical and theoretical models have been developed to access the impact of free trade agreements on the environment. Most studies indicate that economic growth leads to a change in carbon emissions. One strand of literature focuses on the validity of the EKC hypothesis (Ang, 2007; Dinda, 2004; Friedl & Getzner, 2003; Managi & Jena, 2008; Saboori et al., 2012). The findings of these studies conducted in different regions show that a higher level of national income need not necessarily lead to improved efforts to reduce emissions. For instance, Holtz-Eakin and Selden showed a steady rising relationship between emissions and economic growth (Holtz-Eakin & Selden, 1995) while Richmond and Kaufman concluded that there is no significant relationship between the two variables (Richmond & Kaufmann, 2006). This economic growth-carbon emission nexus was first investigated by the independent work conducted by Ang (Ang, 2007) and Soytas et.al. (Soytas et al., 2007). The nexus between emissions and GDP growth in the 14 Middle East and North Africa (MENA) countries between 1990 and 2011 found a causal relationship between emissions and GDP growth (Omri, 2013). There have also been country-specific studies on this strand of literature (Zhang & Cheng, 2009). Recent literature extends this nexus to include international trade (Halicioglu, 2009). Similarly, Shahbaz et.al. analysed the data of 105 countries grouping them into low-, medium-, and high-income countries (Shahbaz et al., 2017). The findings indicate an inverted U-shaped nexus between trade and emissions for all the groups. Similar research conducted on 82 developing nations between 1980 and 2012 showed for every percentage increase in trade, the emissions reduced by 0.3% in high-income countries (Sohag et al., 2017). The results of the study are inconclusive for low-income and middle-income countries. Similar results were reported by the work reported by Managi et.al (Managi & Jena, 2008). According to this research, global trade reduced emissions in advanced countries and increased it in non-advanced countries. A contradicting result i.e., emissions decreased with increasing trade, was reported from Chinese provinces covering the data during 1997-2007 (Jayanthakumaran et al., 2012).

To summarize, the findings on studies undertaken to establish trade-emissions nexus is inconclusive. Contradicting results on the impact of international trade on carbon emissions could be because of regional or country-specific characteristics. The importance of regional characteristics in establishing the trade-emissions nexus and the unavailability of research on RCEP countries motivated this study.

3. Data and Methodology

3.1 Data

This section describes the data and methodology used to build an empirical model to establish the relationship between foreign trade and environment of RCEP countries. CO_2 emissions (in kt ton) are used to quantify the environmental damage. CO_2 emissions are considered for the study as it is the principal anthropogenic greenhouse gas against which other greenhouse emissions are typically measured. The sum of exports and imports of individual countries with other member countries, expressed in US$ billion at current prices, is used as a measure of foreign trade. The impact of trade on GDP per capita (in US$ at current prices) is also studied. Natural log transformation is used for all the variables to reduce the dispersion and heteroscedasticity issues.

The panel economic data of 15 countries for the period 1991-2020 is compiled using the World Bank (WB) database. The particular period was chosen as most of the Asian economies adopted liberalization in the 1990s. The definition of the variables used in the study and units of measurement are provided in Table 2.

Table 2: Definition of variables used in the study

Variable	Units	Definition
CO2	Kiloton (kt)	Carbon dioxide emissions. It is expressed as the equivalent weight of elemental carbon.
Foreign Trade	US$ billion	Foreign trade is the sum of imports and exports of a country with other RCEP member countries. Expressed in current prices
GDP per capita	US$	Gross domestic product divided by midyear population

Source: WB Database

3.2. Methodology

Before building the relationship between trade, income levels and carbon emissions, we need to check the existence of the long-term relationship between these variables. We start the analysis by conducting panel unit-root tests to determine the stationarity of the variables considered. Levin-Lin-Chu unit-root test (Levin et al., 2002) is used for this purpose as the test provides better approximations than other stationarity tests. If all the variables considered are stationary either at level or at the first difference, we proceed to check causality using Dumitrescu-Hurlin panel granger causality test. The hypothesis tested are as follows:

H0: Foreign trade granger cause GDP per capita in RCEP member countries

H1: Foreign trade granger cause carbon emissions in RCEP member countries

H2: GDP per capita granger cause carbon emissions in RCEP member countries

The next section discusses the findings of our analysis.

4. Results

The descriptive statistics of the base variables along with that of natural log transformation are provided in Table 3. The descriptive statistics of base variables show the wide variation in these parameters across the member countries.

Table 3: Descriptive statistics

Variable	Mean	Maximum	Minimum	Std. Dev.	Obs.
CO_2 per capita (kt)	6.872	24.244	0.130	6.090	409
Foreign Trade (US$ bn)	170,653	1,478,616	421	239,608	409
GDP per capita (US$)	15,179	68,157	128	17,177	409
CO_2 per capita (natural log)	1.280	3.188	-2.040	1.378	409
Foreign Trade (natural log)	11.033	14.207	6.042	1.689	409
GDP per capita (natural log)	8.626	11.130	4.853	1.673	409

Source: World Bank Database

The first step in the analysis is to check the stationarity of the variables. The results of the Levin-Lin-Chu test are given in Table 5. The null hypothesis of the Levin-Lin-Chu test is that unit-root exists i.e., the data is non-stationary. As shown in Table 4, all the variables are stationary at level or first difference.

Table 4: Results of Levin, Lin, and Chu unit root test at level and first difference

Panels/Series	At level□		At first difference□	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
CO_2 per capita (natural log)	-0.6611 (0.2543)	-0.7733 (0.2197)	-5.2025*** (0.0000)	-4.3052*** (0.0000)
Foreign Trade (natural log)	-4.5277*** (0.0000)	0.3518 (0.6375)	-9.3492*** (0.0000)	-8.6081*** (0.0000)
GDP per capita (natural log)	-2.4589*** (0.0070)	0.3464 (0.6355)	-7.7382*** (0.0000)	-5.9176*** (0.0000)

□Levin-Lin-Chu statistic with the p-value in bracket; ***$p<0.01$

Source: Authors' analysis

The next step in the analysis is to find the optimum lag length for Dumitrescu-Hurlin panel granger causality test. The optimum lag length using different information criteria is provided in Table 5. Following the principle of parsimony, the lag length of two based on the Schwarz information criterion is selected for checking causality.

Table 5: Optimum lag length using various information criteria

Lag	AIC	SC	HQ
0	8.54	8.58	8.56
1	-5.12	-4.96*	-5.06
2	-5.14	-4.87	-5.04
3	-5.24	-4.86	-5.09*
4	-5.25	-4.75	-5.05
5	-5.27	-4.66	-5.02
6	-5.29*	-4.56	-4.99

*Indicates lag order selected by the criterion

Note: AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Source: Author's Analysis

The next step in the analysis is to check causality using Dumitrescu-Hurlin panel granger causality test. The results of causality tests are provided in Table 6. The results indicate two-way causality between foreign trade-emissions per capita and foreign trade-GDP per capita.

Table 6: Results of Granger Causality

Null hypothesis	Statistic (p-value)
Emissions per capita does not homogeneously cause foreign trade	2.3291 (0.0199) **
Foreign trade does not homogeneously cause emissions per capita	7.7271 (0.0000)***
GDP per capita does not homogeneously cause foreign trade	13.5448 (0.0000)***
Foreign trade does not homogeneously cause GDP per capita	4.4139 (0.0000)***
GDP per capita does not homogeneously cause emissions per capita	9.2589 (0.0000)***
Emissions per capita does not homogeneously cause GDP per capita	8.5924 (0.0000)***

Source: Authors' Analysis; ***p<0.01, **p<0.05

The next section discusses the empirical results and policy implications of the analysis.

5. Discussion

The Levin-Lin-Chu unit-root test results in Table 4 show that all the variables are non-stationary at level. All the variables become stationary at first difference. The empirical results show that foreign trade has a causal impact on emissions per capita and GDP per capita in RCEP member countries. The economic activity in RCEP countries hence, lead to an increase in carbon emissions. This significant, positive relationship between trade and emissions in

RCEP countries is a clear indication that trade is leading to an increase in carbon-intensive production in the area. This could also be because of the relocation of dirty industries from wealthier to poorer countries, thereby supporting the pollution haven hypothesis. If the countries maintain the composition mix of goods produced post-RCEP, the resulting increase in trade would lead to an increase in pollution. This significant, positive relationship between foreign trade and emissions is in line with the findings of existing literature (Managi & Jena, 2008; Shahbaz et al., 2017). Following the EKC hypothesis, the significant, positive relationship between income and carbon emissions shows that the region is still in the first half of the inverted U-curve. Following the EKC hypothesis, the enhanced production and the related increase in income post-RCEP are expected to worsen emissions until reaching the threshold point. The positive relationship between emissions and income agrees with the findings of similar research conducted in developing economies (Jayanthakumaran et al., 2012; Omri, 2013). Higher economic activity post-RCEP is expected to increase energy consumption, and hence would lead to higher carbon emissions. This is especially challenging for developing economies as they are still heavily dependent on conventional sources, namely coal. Clean energy sources are still developing in these countries. The foreign trade in these countries is still driven by the export of pollution from wealthier countries. The transfer of energy-efficient technologies and clean energy production to these countries are still in a nascent stage. China, the largest economy within the RCEP, alone accounts for 22% of global energy usage. 71% of the total energy consumption in China is generated by coal.

The causality tests show a bi-directional relationship between the variables i.e., foreign trade granger cause carbon emissions and vice versa. This result confirms the findings of the existing literature (Sun et al., 2019). The findings reaffirm the popular belief that developing economies with lenient environmental policies are treated as pollution havens to which wealthier countries export pollution-intensive production. A regional free trade agreement will support deeper routing of such production to developing economies. Even countries that are not part of the free-trade agreement could route production to the most cost-effective country, following the theory of comparative advantage.

As mentioned in the theoretical framework, the impact of trade on emissions can be analyzed using scale, composition, and technique. From the results, we conclude that in RCEP countries the influence of scale and composition is much higher than the impact of improved technique. With increasing trade, production in these economies is expected to go up. If the increase in production is focused on carbon-intensive goods, pollution will also increase. Cooperation focused on technology distribution enhances environmental quality through improved adoption of greener technologies (Beghin et al., 1995). Adoption of cleaner technologies and energy-efficient processes in RCEP countries has still not yielded emissions reduction. To decrease the impact of trade on pollution, the RCEP countries should change their product composition in favour of environment-friendly products. Also, the negative impact on the environment should be offset through increased adoption of renewable energy and more energy-efficient processes. RCEP member countries should boost foreign direct investment in cleaner technologies.

Post-Paris Agreement, reducing carbon emissions has become a necessity for both developed and developing countries. Hence, the findings of this study strongly point to the necessity of various policy changes for improving environmental quality and ensuring sustainable economic growth in RCEP countries. In addition to re-evaluating the product composition mix, the economies should also develop national policies and regulations on emissions. The policies should encourage and attract greener investments while penalizing polluting industries. The focus should be on promoting technologies that reduce emissions or act as carbon sinks. On the energy front, economies should transition to renewable energy, increasing its proportion of total energy production. Renewable energy projects should be incentivized by offering subsidies, providing cheaper financing options, and developing renewable energy markets. Meanwhile, new coal plants should be discouraged and penalized for polluting. This penalty could be in the form of a carbon tax, carbon credit, or quotas. The additional cost of pollution will reduce the comparative advantage and reduce the transfer of pollution-intensive production. Ecological laws should also be strengthened to discourage polluting industries. Along with technology transfer, trade agreements should empower the governments of member countries to address their environmental concerns.

6. Conclusion

This article investigates the impact of foreign trade on carbon emissions of the member countries of the largest trade bloc, the Regional Comprehensive Economic Partnership (RCEP). The study provides valuable insights into the interplay of trade, economic activity and carbon emissions. However, the authors acknowledge the importance of country-specific macroeconomic dynamics in developing national environmental and trade policies. Future research could enhance the scope of this study, including more macroeconomic variables such as urbanization, innovation, and regulatory framework, in the analysis.

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