Trade, Global Value Chains and Climate Action in the CPTPP

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Abstract: *The current paper examines whether the Comprehensive and Progressive Agreement for Trans-Pacific Partnership could positively impact climate action by analysing its provisions and, linkages of regional and global value chains, trade and carbon dioxide emissions embedded in trade along production chains of the countries that are party to it. It finds that while CPTPP includes provisions that can impact climate action, it is not clear yet whether these have made any impact. Further, empirical analysis confirms that higher global value chain linkages and trade openness leads to lower exports of carbon di-oxide emissions. Lastly, the paper finds the CPTPP countries have been relatively high exporters of CO2 emissions compared to similar other country groups. The paper argues the agreement should include flexible measures in future balancing interests of other issues with climate action, and accounting for differences between countries and sectors, future shocks and, global value chain specificities.*

Key Words: *CPTPP, Climate Change, Global Value Chains, Trade, Trade Policy*
JEL classification code: F13, F15, F18

1. Introduction

Unarguably climate change is considered as the most serious and persistent global threat in the current times. Discussions on and strategies to tackle climate change permeates all walks of economic life now. Climate action – defined as "urgent action to combat climate change and its impacts" - is goal number 13 in sustainable development goals that were adopted by the United Nations General Assembly of the United Nations in 2015 (UNDESA, n.d.).

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) - signed in March 2018 and entered into force in December 2018 for six countries – is a mega free trade agreement (FTA) between 11 countries of the Asia Pacific: Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam (these represent the remainder of the 12 states (after the exit of the United States) that signed the Trans Pacific Partnership Agreement in 2016. Most of the countries of the CPTPP are classified as high-income group countries, the exceptions being Malaysia, Mexico and Peru which belong to the upper-middle income group and Viet Nam, which belong to the lower-middle income group (Hamadeh et al, 2022). The CPTPP was the first mega-FTA to be signed and entered into force. It was followed by the Regional Comprehensive Economic Partnership (RCEP) Agreement, which entered into force in January 2022 and is hailed as the world's largest FTA. Among other issues, the CPTPP includes "clear commitments" to uphold the CPTPP members' respective standards on environment and not to undermine them for commercial gain.

The emergence of regional and global value chains (R-GVCs) is remarkable and one of the most talked about phenomenon in international economic growth and development, currently as these touch upon almost all economic segments, much like climate change. Therefore, it is very

likely the CPTPP will have a substantial effect of R-GVCs of its parties. The literature recognises R-GVCs could potentially have both positive and negative impacts on the environment (World Bank, 2020), while not providing a definitive answer whether the impact of R-GVCs on the environment and climate change, has been positive or negative so far.

The current paper will examine modes and manners in which trade and R-GVC linkages in CPTPP countries could influence climate action to bring about positive changes (e.g. reduction in greenhouse gas (GHG) emissions).

2. Literature Review

Though the relationship between R-GVCs, free trade agreements and climate change is a growing body of research, there are several unanswered questions. Further as the world tries to grapple with increasing global warming and reaching a point of no-return on climate change, different aspects of policies and instruments are being examined to understand how these could contribute to positive climate action. The proposed research will contribute to the current academic literature and understanding on causality between trade openness, R-GVCs and climate action in CPTPP countries, and put forward implications for possible policies as this is still an unexplored area. The literature has been classified into three strands: 1) Trade and Environment, 2) FTAs and Climate Action, and 3) R-GVCs and Climate Action.

1) Trade and Environment

Climate change refers to long-term shifts in temperatures and weather patterns. While climate change can be natural or man-made, since 1800s human activities have caused observable change in temperatures and weather patterns (UN, n.d.). Climate change is a leading cause of environmental degradation (Scheffran et al 2009). Further, air pollution and climate change are intimately connected. In fact, pollutions of all kinds may lead to environmental degradation. Discussions on climate change and climate action currently dominate the discussions and debates related to the environment whereas studies on the environment have other aspects too. Thus, the terms climate action and environmental action are used interchangeably.

There is a growing literature on trade, climate change and the environment. Taylor and Copeland (2013) stated that allowing pollution policy to respond to the changes brought about by trade is essential to our understanding of how international trade affects the environment. Grossman & Krueger (1991) mentioned three separate mechanisms by which a change in trade and foreign investment policy can affect the level of pollution and the rate of depletion of scarce environmental resources, as follows:

1. First, there is a scale effect, that is, if trade and investment liberalisation cause an expansion of economic activity, and if the nature of that activity remains unchanged, then the total amount of pollution generated must increase.
2. Second, there is a composition effect that results from any change in trade policy. When trade is liberalised, countries specialise to a greater extent in the sectors in which they enjoy competitive advantage. If competitive advantage derives largely from differences in environmental regulation, then the composition effect of trade liberalisation will be damaging to the environment.

3. Finally, there is a technique effect, that is the output of pollution per unit of economic product may change.

Several studies have argued that trade would lead to a rise in real income, which should eventually lead to a decline in environmental degradation (e.g. Chernichwan et al, 2016). This theory can be traced to literature on economic growth and environment focus through Environmental Kuznets Curve (EKC) hypothesis, which posits that in the early stages of economic development, environmental degradation will increase until a certain level of income is reached (known as the turning point) and then environmental improvement will take place. This relationship between per capita income and pollution is often shown as an inverted U-shaped curve. This curve is named after Kuznets (1955), - now well-accepted by scholars - who hypothesised that economic inequality increases over time and then after a threshold becomes more equal as per capita income increases (Van Alstine & Neumayer, 2010; Mosconi et al, 2020; Zhang et al., 2017; Balado-Naves et al., 2018; Dong et al., 2018a; Leal and Marques, 2020). Since the CPTPP countries are mostly high-income group countries, following the EKC hypothesis, should be contributing relatively less to climate change and environmental degradation.

A part of the evidence, however, suggests that trade has had an adverse impact on the environment. For example, Weber et al (2021) found average emission-intensity of traded goods is higher than that of final demand and countries which trade more in goods which cause relatively more emissions (dirty goods) are increasing their share in goods traded.

Chernichwan et al (2016) looked at the causality the other way around and found evidence linking tighter environmental regulations to reduced trade flows - this evidence is a clear support for the Pollution Haven Effect.

One the of reasons for contradictory results on trade-emissions linkage is the measure of trade policy used in their empirical exercises. Some studies conclude trade as tool of economic growth that helps to sustain environmental pollution by efficient allocation of resources. These studies mostly incorporated export and import aggregately as a variable of trade openness in their investigation. While there are studies that argue that trade practices deteriorate environmental quality and promote emission beyond borders which is often neglected (Al-Mulali and Ozturk 2015; Balsalobre-Lorente et al. 2017; Nathaniel and Khan 2020). Such studies are more limited and many of these consider the disaggregate impact of import and export on consumption-based emissions (Khan et al. 2020; Knight and Schor 2014; Liddle 2018; Ozturk and Acaravci 2013; Shahbaz et al. 2017; Shahzad et al. 2017). Even within the studies that have taken trade openness as an instrument of trade policy, there are disparities. Some scholars believe that trade openness would produce more carbon dioxide (CO2) emissions due to its positive impact on the production of goods in a country, which requires massive energy consumption and leads to more CO2 emissions (Ertugrul et al., 2016; Ahmed et al., 2017). Some other researchers reached an opposite conclusion on the same question: these indicate that trade openness can reduce CO2 emissions. These scholars argued that trade openness is conducive to expanding the technology spillover effect between global countries, which consequently improves their national energy efficiency (Gozgor, 2017; Ho and Iyke, 2019; Lv and Xu, 2019).

Other factors than trade, have also been considered as contributing to CO2 emissions. These include population (Ghazali and Ali, 2019; Wang et al., 2019; Dong et al., 2020), population aging (Menz and Welsch, 2012; Wang et al., 2017; Yu et al., 2018), natural gas consumption (Alkhathlan and Javid, 2013; Saboori and Sulaiman, 2013; Dong et al., 2018b), and urbanisation (Liu and Bae, 2018; Bai et al., 2019).

2) FTAs and Climate Action

FTAs cover two-thirds of global trade flows and currently are the main conduit of trade diplomacy around the world. These could be seen as an instrument that consolidates tools of trade policy under a single structure with harmonised or integrated rules. Existence of an FTA between sets of countries does not indicate the volume of trade between them as there are factors such as trade creation and diversion effects which in turn are influenced by depth or comprehensiveness of the FTA, FTAs in force with other sets of countries, and so on. However, evidence does suggest FTAs have led to higher trade around the world (Urata and Okabe, 2007; Derosa and Hufbauer, 2007, Breimlich, 2018).

FTAs could be an effective tool for undertaking initiatives on climate action though evidence suggests so far FTAs have had a negative impact on climate change: firstly, tariff reduction on goods through FTAs has led to higher trade in carbon-intensive and environmentally destructive products, such as fossil fuels and timber. Secondly, FTAs are perceived to shrink policy space available to countries for adopting domestic measures. Thirdly, proposals on carbon tariffs or border carbon adjustments are viewed as protectionist (i.e. the concern is that countries may use such provisions to keep out competitors from other countries). The other option for including climate action is through trade talks at the World Trade Organisation (WTO), which has witnessed discussions at its Committee on Trade and Environment, proposals for having an Environmental Goods Agreement and so forth. However not much real progress has been made over various issues including how dispute settlement should deal with climate policy-related disputes or whether proposals for a climate waiver can be misused. Further, cooperation between the WTO and other international climate policy actors has been limited. (Dent, 2021; Leal-Arcas, 2013; Frédéric and Sikina, 2018; Van-Asselt, 2014; EIU, 2019)

The new generation FTAs such as the CPTPP, have made efforts to bring in issues related to the environment in their fold (such as covering issues related to small & medium enterprises and e-commerce) and many such FTAs have included specific chapters on the environment or sustainable development, and/or specific provisions such as explicit limits on fossil fuel subsidies, border adjustment carbon taxes, green public procurement, reduction in GHG emissions and so forth. Overall, there has been a growth in legally-binding provisions on climate action in FTAs in domains such as clean energy development, environmental and technical standards, promotion and liberalisation of trade (through reduction of tariffs and provision of renewable energy subsidies). The impact of such environment-related provisions cannot be immediately discerned as these take years to make their effects felt. However, from the depth of the provisions, some conclusions on their possible effects can be made. Specific or concrete actions are largely missing from these provisions. Further, mostly FTAs rely on cooperation elements, which are on best endeavour basis, and thus are less effective. (Dent, 2021; EIU, 2019)

3) R-GVCs and Climate Action

About 50-70 percent of international trade is currently driven by R-GVCs, which have proved to be vectors of innovation and have the potential to influence climate change in a substantial manner. Since firms in R-GVCs belong to same networks with similar goals, they behave in similar manner as firms which have intra-corporate relationships (World Bank 2020; INTEURI, n.d.).

Depending on the complexity of a particular network, lead firms in R-GVCs could be instrumental in quickly diffusing advanced technologies and know-how on climate action to their suppliers. Lead firms are defined as firms that determine value chain configurations: the way in which the activities of the value chain are spatially arranged within the constraints of product physical and knowledge characteristics. (World Bank, 2020; Blyde, 2020; ScienceDirect, n.d.)

There is a growing literature on the linkages between trade policy, R-GVCs and climate action but many questions remain. Copeland et al (2021) put these succinctly as follows

- How to develop trade policies which target green goods (i.e. goods with lower emission-intensities) that leads to lower overall GHG emissions, e.g. what principles should guide such policies, what drives such policies?
- How could the expansion of R-GVCs and fragmentation of production networks have a positive impact on climate action?
- How to prepare for future climate shocks effectively so as preserve and intensify the current efforts on climate action?

In addition to the pre-existing questions, the COVID-19 Pandemic brought new ones. There have been extensive discussions about shortening of supply chains to minimise disruptions from shocks such as the ones cause by COVID-19. Studies show that increased local production importing from geographically proximate countries offers considerable emissions savings. However, this also depends on emission-intensity of the country's production system and that of transport system associated with R-GVCs (World Bank, 2020; Keane et al, 2020; Blyde, 2020; Mbow et al, 2019).

R-GVCs are now treated as an important instrument in climate action. A recommendation arising out of learnings from COVID-19 is that countries should diversify their economies by seeking new opportunities to create R-GVCs that support lower emission intensities (World Bank, 2022). In addition, the strength of R-GVC linkages is seen as a predictor of the effectiveness of climate action undertaken in those R-GVCs.

The link between instruments of trade policy, R-GVCs and climate action is a complex one. However, given the current urgency to undertake climate action, especially through important and growing phenomena such as R-GVCs and mega FTAs, it is important to understand the manner in which such phenomena have affected or have the potential to affect climate change. Choi (2020) said, mega FTAs such as the CPTPP are expected to consolidate R-GVCs that have emerged as new platforms for national development strategies, and that deep FTAs have the highest impacts on R-GVCs as these improve upon existing rules and include new ones. Chang and Nguyen (2019) found even prior to the entry into force of the agreement the CPTPP countries were deeply integrated in the R-GVCs with strong dependence on one another. The CPTPP agreement is

expected to strengthen such R-GVC linkages among its parties. However along with strengthening of R-GVCs, there will be certain impact of the implementation of the CPTPP on the environment.

Given the importance of the CPTPP, it is imperative to assess whether the CPTPP could make a difference in the matter of climate change. Against this backdrop, in the current paper, causality between trade openness and R-GVC linkages and, climate action in countries of the CPTPP and other comparable regions regions/country groups, and the relative position of the CPTPP countries as CO2 emission exporters are estimated, and recommendations for future policy actions are presented.

3. CPTPP and Climate Action

As noted before, the provisions of an FTA give an indication on the impact of the FTA on an economy even though it takes time to discern the real impact. In this section, the provisions in the CPTPP and other FTAs that could affect climate action have been compared to understand their relative position in this measure. The provisions briefly explained in Table 1 can be summarized as following

- Among the countries, the EU has been a climate-change norms leader and influencer. The EU's FTAs usually have chapters on sustainable development and include a range of measures – some of those chapters are subject to dispute settlement, such as the EU-Korea FTA.
- The US' FTAs have chapters on environment – tend to be comparably lighter than those of EU's and not all are subject dispute settlement.
- Australia-New Zealand Closer Economic Relations (Aus-NZ CER)– one of the most comprehensive economic partnership in the world –mentions cooperation on the environment. Such cooperation elements however have less effectiveness as noted in the Literature Review section.
- The RCEP agreement does not contain any chapter on environment or sustainable development or explicit provisions on environment, renewable energy or climate action. It has established a Committee on Sustainable Growth a Committee on Sustainable Growth "to cover work on small and medium enterprises; economic and technical cooperation; and emerging issues", as part of chapters 14 (small & medium enterprises) and 15 (economic and technical cooperation). Some climate change-related issues could be taken up as part of economic and technical cooperation but there is no clear work programme yet (ASEAN, n.d.).
- The CPTPP has an environment chapter with similar provisions as EU FTAs. It includes a binding and enforceable chapter on the environment including recourse to the broader dispute settlement mechanism under the CPTPP should the countries are unable to resolve the matter through consultation and cooperation (DFAT, n.d.; Canada.ca). There are additional measures such as protection of Ozone layer, 3-step consultation process to resolve disputes; in addition, a chapter that covers energy issues provides for reduction on tariffs on natural gas (but also on refined petroleum).

  Even with such a chapter, as Hailes et al (2018) have argued, there are concerns that the CPTPP would primarily protect interests of investors (primarily transnational corporations) by "limiting the legislative power of future governments, even if they gain a

democratic mandate for change" and that the agreement effectively "underwrites unsustainable patterns of production, transport and consumption based on fossil fuels as the primary energy source".

Table 1: Provisions on Climate Action in the CPTPP and Other major FTAs

FTA and the title of the relevant chapter	Relevant measures in brief
CPTPP *Environment; Natural resources and energy.*	Right to regulate, commit to MEAs, protection of Ozone layer, marine environments, procedures (public awareness, investigations, judicial proceedings etc), public participation & submission, encourage CSR, recognize voluntary mechanisms, cooperation frameworks, biodiversity (preserve knowledge of indigenous/local communities access to genetic resources), invasive aliens species, transition to low emissions/resilient economy, marine capture fisheries (IUU fishing, overfishing etc), conservation (illegal take and trade of wild life), environmental goods and services (incl non-tariff barriers, cooperative projects), environmental committee, consultations, dispute resolution Reduction on tariff on natural gas (but increase on petroleum)
EU-Japan (EU-Jap) *Sustainable Development*	Promotion of sustainable development, right to regulate, implement MEAs, environmental goods and services, climate change mitigation (renewable energy, energy efficient goods & services), promote labelling schemes & voluntary measures, encourage CSR, biodiversity (illegal trade in flora and fauna), sustainable management of forests and trade in timber/products (conservation, illegal logging etc), sustainable fisheries (IUU, comply with UN conventions etc), scientific information, transparency, sustainability impact, cooperation, establishment of committee on trade & sustainable development &, panel of experts, consultations, domestic advisory groups, dialogue with civil society, review of certain articles
EU-Viet Nam *Sustainable Development*	Similar to EU-Jap, additional: upholding levels of protections, working together on sustainable development in various forums and on different issues
EU-Singapore *Sustainable Development*	Similar to EU-Jap; additional – mention of commitments to environmental standards, board on trade and sustainable development
EU-Korea *Sustainable Development*	Similar to EU-Jap; additional - dispute settlement
US-Australia (US-Aus) *Environment*	Levels of protection, application of laws, procedures & public awareness, encouraging voluntary mechanisms, institutional arrangements (dispute settlement), cooperation, consultations, MEAs
US-Korea *Environment*	Similar to US-Aus, additional - mechanisms to enhance environmental performance (such as encouraging voluntary actions, incentives, performance standards), no dispute settlement, public participation, annex on covered agreements
US-Singapore *Environment*	Similar to US-Aus
Aus-NZ CER	No specific provision, cooperation on environment
RCEP	• Does not contain any chapter on environment or sustainable development • Establishes a Committee on Sustainable Growth "to cover work on small and medium enterprises; economic and technical cooperation; and emerging issues":

	it covers chapters 14 (small & medium enterprises) and 15 (economic and technical cooperation) • Has no explicit positive measure for the environment, renewable energy or climate action – some issues may be taken up as part of economic and technical cooperation but no clarity

4. Empirical Analysis

Two questions are probed in this section

1. Do higher R-GVC linkages and trade have a positive impact on climate change?
2. Do the CPTPP countries have relatively higher exports of CO2 emissions than similar other country groups/ regions/ countries?

A fixed effects model has been used to answer these questions. The regression equation is

$$CO2it = \beta 1 + \beta 2 \times R - GVCit + \beta 3 \times Tradeit + \delta i + \mu t$$

$CO2it$ is the dependent variable and $R - GVCit$ and $Tradeit$ are independent variables. i= country/region; t=year; δi and μt are control variables, remaining/unexplained factors for country i in year t.

$CO2it$ is measured by the intensity of CO2 emissions embodied in total gross exports (EXGR_TCO2INT) in country i and year t. There are different measurements of climate change. Since CO2 emissions data is widely available and is the most distinctive measurement of climate change, $CO2it$ has been taken as the dependent variable here. Total CO2 emissions embodied in gross exports (EXGR_TCO2) captures the CO2 emissions embodied in a given domestic industry exports to a partner country. The variable that has been taken here is EXGR_TCO2INT, i.e. the intensity of CO2 emissions, tonne CO2 per million USD, in gross exports of an exporting country c industry i to the importing partner country p. The emissions can come from any domestic or foreign industry upstream in the production chain. Thus EXGR_TCO2INT measures intensity of export of CO2 emissions by a country. Such CO2 emissions may be generated domestically or imported through import of goods and services by a country. The unit is tonne CO2 per million US Dollars (USD). Regions are treated in this measurement as a unit, i.e., EXGR_TCO2 excludes intra-regional trade, as so, intra-region flows are considered as domestic. The data of EXGR_TCO2INT has been sourced from the OECD Carbon dioxide Emissions Embodied in International Trade 2021 edition database.

$R - GVCit$ measures R-GVC linkage in country i and year t. It measured here by domestic value added embodied in final foreign demand (FFD_DVA), which captures the value added that industries export both directly, through exports of final goods or services and, indirectly via exports of intermediates that reach foreign final consumers (households, government, and as investment) through other countries. The measure reflects how domestic industries which lie upstream in a value-chain are connected to consumers in other countries, even where no direct trade relationship exists. The indicator illustrates therefore the full upstream impact of final demand in foreign markets to domestic output. It can be interpreted as export of value added. Like for climate change, there are different measurements of R-GVC linkages, positions and participation. The measure taken here mirrors the CO2 indicator, which includes exports of CO2

emissions as there is a high likelihood of a correlation between exports of CO2 emissions and exports of value-added. FFD_DVA excludes within-region final demand (e.g. for EU28, final demand in non-EU28 only), i.e. as with the CO2 data, regions are treated as a single unit. The data of R-GVC has been sourced from the OECD Trade in Value-added Indicators database.

$Tradeit$ measures trade openness ratio in country i and year t. Trade openness ratio is defined as proportion of total import and export to GDP. As noted in the literature review section, literature on trade openness in extensive but inconclusive. Given the importance of trade in R-GVCs, trade openness has been taken here as an independent variable to understand the causality between trade openness and CO2 emissions (Dong et al 2021).

Tables 2.1, 2.2 and 2.3 contain the regressions statistics and results. There were 168 data points taken for the following the country groups, regions and countries i.e. the countries that are party to the CPTPP (referred to as the CPTPP" in this section), the EU, the G-20, the OECD, the countries that are party to the RCEP ("the RCEP") and the USA. There are overlapping memberships in the different groups (e.g. between the RCEP and OECD; and between the CPTPP, RCEP and G20). A comparison between country groups/ regions with common membership among them will be instructive as a country is typically connected to R-GVCs of a varied nature with different sets of countries, and thus R-GVCs of different country groups/ regions will portray different stories. Data for a period of over 14 years (from 2005 to 2018) has been taken to account for adequate effects and smoothen any major year-to-year differences. It should be noted since data on R-GVC linkages and CO2 embodied in international trade is not available after 2018, the analysis is till 2018. Since R-GVCs take years to develop, results till 2018 should accurately predict the current situation. The equation was tested to ensure that residuals are normal and, absence of heteroscedasticity and multicollinearity.

Table 2.1 Regression Statistics

Multiple R	0.967436
R Square	0.935932
Adjusted R Square	0.932708
Standard Error	744.6819
Observations	168

Table 2.2 Analysis of Variance (ANOVA)

	df	SS	MS	F	Significance F
Regression	8	1.29E+09	1.61E+08	290.341	9.96E-91
Residual	159	88173635	554551.2		
Total	167	1.38E+09			

Table 2.3 Regression Results

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	3814.049	358.989	10.62442	0.00	3105.047	4523.051
R-GVC	-0.00074	9.8E-05	-7.53587	0.00	-0.00093	-0.00054

Trade	-2926.77	828.5299	-3.53248	0.00	-4563.11	-1290.42
CPTPP	6781.676	245.0863	27.67056	0.00	6297.632	7265.721
EU	27.85693	299.6901	0.092952	0.93	-564.03	619.7438
G-20	-519.832	224.4762	-2.31575	0.02	-963.171	-76.492
OECD	-480.149	232.0191	-2.06944	0.04	-938.386	-21.9121
RCEP	4538.031	256.5531	17.68847	0.00	4031.339	5044.722
USA	-1700.28	281.6567	-6.03671	0.00	-2256.55	-1144.01

As per the results, both R-GVC linkages and trade openness are statistically significant and lead to decline in CO2 intensity. CO2 intensity decreases by 2926.77 tonnes per USD million per unit of trade openness ratio and by 0.000074 tonnes per USD million per USD millions of R-GVC linkage. This answers the first question i.e. whether higher R-GVC linkages and trade lead to a decline in CO2 emissions, i.e. have a positive impact on climate change. Therefore, R-GVCs and trade could be viewed as instruments of climate action.

Data for R-GVC linkages and trade openness for country i in year t can be inputted to get the value for the respective CO2 intensity. China has been taken as a base here, so the CPTPP, the EU, the G20, the OECD, the RCEP and the USA are dummy variables which can take value 0 or 1. The results are statistically insignificant for the EU. Therefore, the EU received the same treatment as China, i.e. its value will be zero. So final regression equation based on the above table is as following.

$$CO2it = 3814.049 - 0.00074 \times R - GVCit - 2926.77 \times Tradeit + 6781.676 \times \text{CPTPP} - 519.832 \times \text{G20} - 480.149 \times \text{OECD} + 4538.031 \times \text{RCEP} + 1700.28 \times \text{USA}$$

If, for example, we are going to predict CO2 intensity based on this equation for the CPTPP, then we use the following equation

$$CO2it = 3814.049 - 0.00074 \times R - GVCit - 2926.77 \times Tradeit + 6781.676 \times 0 - 519.832 \times 0 - 480.149 \times 0 + 4538.031 \times 0 + 1700.28 \times 0$$

If we are going to predict CO2 intensity based on this equation for the RCEP, then we use the following equation

$$CO2it = 3814.049 - 0.00074 \times R - GVCit - 2926.77 \times Tradeit + 6781.676 \times 0 - 519.832 \times 0 - 480.149 \times 0 + 4538.031 \times 1 + 1700.28 \times 0$$

The empirical results show that CO2 emissions export intensity in the CPTPP, at 6781.676 tonnes per USD million, has been the highest among the country groups/ regions under consideration here. The conclusion is that the CPTPP countries have been the highest exporters of CO2 emissions

though their exports may include a combination of CO2 produced in the CPTPP countries and CO2 emissions imported through the embodiment of emissions in trade. This answers the second question i.e. whether the CPTPP countries have relatively more CO2 emissions exports than similar other country groups/ regions/ countries. Further, CO2 intensity in China is lower than that in the CPTPP by 6781.676 tonnes per USD million and the RCEP by 4538.031 tonnes per USD million whereas its marginally lower than that in the EU by 27.85693 tonnes per USD million and higher than that in the G-20 by 519.832 tonnes per USD million, the OECD 480.149 tonnes per USD million and the USA by 1700.28 tonnes per USD million.

5. Conclusions

The relationship between trade, R-GVCs and climate change is complex and the evidence on their linkages has been scanty and unclear. However, given the importance of each of these, and the impact of their interaction with each other, the current paper set out to examine their relationship. The CPTPP has added provisions and measures on climate action and was predicted to have a significant impact on R-GVCs but it is not clear yet whether these have had any substantive effect. One reason for this is comprehensive updated data on R-GVCs and CO2 embodied in international trade is not available. The current paper estimates their relationship on the basis of the data available till 2018, i.e. the year in which the CPTPP entered into force. Based on the empirical results, the paper concludes that 1) both higher R-GVC linkages and trade openness, lead to a decline in CO2 export emissions intensity in the countries of the CPTPP and other comparable country groups/ regions/ countries, and 2) though the countries of the CPTPP are mostly high-income group countries, they have been largest exporters of CO2 emissions among the country groups/ regions/ countries under consideration.

Going forward, the CPTPP should include more substantive measures on climate action by undertaking following measures:

1) Ensure the balance of interests does not favour other interests over climate action,
2) Ensure their imports and exports are not dominated by dirty goods, and
3) Pay specific attention to sectoral and country differences in embodied CO2 emissions in trade, in particular the manner in which embodied CO2 is being traded along productions chains.

Given the available data, an estimate on the manner in which countries are trading CO2 emissions in different sectors along their production chains can be made, and appropriate measures can be devised with the aim of reducing embodied CO2 emissions. Any such measures should have appropriate flexibilities to account the following:

1. Particular country situation: whether it is a developing or developed country, and whether it is importing or exporting embodied CO2,
2. Sectoral differences, particularly in terms of embodied CO2 or even GHG emissions – however estimation of such differences would depend on the availability of such data,
3. Future shocks: climate or any other shocks, such as COVID-19, and
4. R-GVC specificities, e.g. the strength of R-GVC linkages between the CPTPP countries.

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