# Emission Convergence

Subjects: Environmental Sciences

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Emission convergence is a fundamental ground for cooperative CO2 emission mitigation.

Regional Comprehensive Economic Partnership | carbon emission convergence | data envelopment analysis | dynamic β-convergence | emission efficiency

## 1. Introduction

The Regional Comprehensive Economic Partnership (RCEP), a free-trade agreement signed in 2020 by 15 Asia-Pacific countries, accounts for more than 30% of the world's population and 29% of the gross world product. It has been attracting increasing interest in its potential impact on global trade flows as well as the ongoing battle against climate change. Regarding its impact on economies, Petri and Plummer [1] estimated that the RCEP may add USD 186 billion in economic benefits to the global economy by 2030. On its impact in climate change mitigation, Kalirajan and Liu [2] suggested that the RCEP may promote the regional flow of renewable energy trade, thus facilitating the fulfillment of its member countries' climate targets.

Notably, the RCEP has provided many channels to promote commodity trade, to facilitate investment, and to protect intellectual properties, among others. However, it has thus far neglected some burning issues, including environmental standards and climatic cooperation. Meanwhile, regional or global cooperative emission mitigation seems to be emerging as a new normal in overcoming climate change. In this context, a collection of climatic actions by the RCEP member countries has already been under intense discussion. For example, Australia, China, New Zealand, South Korea, and Japan have established their domestic carbon emission trading system [3]; Australia and China launched a joint expert group in 2013 to explore the possibility of linking carbon trading markets [4]; some other member countries have set ambitious climate targets–China, Japan, and South Korea have successively pledged their carbon-neutrality target—and are proactively seeking multilateral climatic cooperation. Multilateral climatic cooperation is also advancing worldwide: An EU-wide emission trading system has been in effect for a decade and has been proven to be economically efficient in emission mitigation [5]. California and Quebec's carbon markets have been connected since 2014 [6]. Nordhaus [7] appealed for the building of climate clubs to more effectively curb the surging greenhouse gas emissions. Several studies have been conducted to appraise the possibility and potential gains of climatic cooperation in the RCEP countries, for example, Chang and Li [8] studied carbon pricing in the Association of Southeast Asian Nations (ASEANs), a core regional cooperation organization in the RCEP agreement, and established that an aggressive carbon price in the region may significantly enhance regional energy market integration and promote carbon emission reduction. Based on the

tremendous economic and emission scales of RCEP members, there should be a growing interest in the feasibility of cooperative emission reduction in the RCEP countries.

A fundamental question in negotiations of climatic cooperation is whether emission performance of participating countries and regions will converge over time. If countries' carbon emissions follow a certain growth pattern and will eventually converge to an equilibrium level, then cooperative carbon mitigation through carbon quota allocations is feasible. Otherwise, climatic cooperation, such as a regional integrated carbon emission market, may lead to a substantial transfer of emission rents through emission trading or the relocation of emission intensive industries [9], thereby resulting in big winners and losers in climatic cooperation and making the cooperation unsustainable. Owing to this reason, the Kyoto Protocol has, for example, excluded developing countries from binding abatement commitments.

Particular interest has been given to the convergence of per capita emissions owing to its intuitive appeal to fairness [10]. The empirical evidence of per capita emission convergence is mixed: Most suggest a lack of evidence that per capita emission converges at the global scales [11][12] or in underdeveloped countries [11], while some suggest that a globally or regionally converging process exists [11][13], such as those in the Organization for Economic Co-operation and Development (OECD) countries. Furthermore, the per capita emission approach has been criticized for neglecting some structural characteristics—it considers solely population as a carbon dioxide ($CO_2$) emission driving factor but completely ignores other socioeconomic factors that may affect emission convergence [14]. To tackle the issue, some researchers have developed inclusive eco-efficiency indicators to provide a more comprehensive description of emission convergence. Chen et al. [15] developed an energy–carbon performance index and show its convergence in China's construction industry. Sheng et al. [16] found a similar pattern of convergence for pollutant emission performance indices. Li and Lin [17] developed an energy efficiency index and examine the impact of its convergence on China's regional GDP growth. Yet, this literature has barely paid attention to emission convergence in countries other than China. Hence, the emission evolution pattern of the RCEP countries remains unknown.

## 2. Convergence or Divergence? Emission Performance in the Regional Comprehensive Economic Partnership Countries

Although several Asian countries have pledged their carbon-neutrality targets in 2020 [18], the traditional "pledge and review" climate agreement that implicitly constrains emission reduction activities inside a country's territory may be insufficient to combat climate change [19]. The pressing matter of climate change calls for effective multilateral climatic cooperation to create synergies across borders for a rapid emission reduction. We herein studied the feasibility of cooperative emission mitigation in the RCEP countries through convergence analysis. We adopt a dynamic $\beta$-convergence model to investigate the emission convergence of the RCEP countries and compare emission convergence from different perspectives. Though the $\beta$-convergence model has been widely employed to study regional emission convergence, seldom have papers provided convergence analysis other than per capita emissions [10]. Some have adopted the framework to analyse emission efficiency convergence in Australia [20] or China [16][21]. Here, we provide new evidence of emission convergence for the RCEP countries.

None of the tested country groups show evidence of $\beta$-convergence from a per capita emissions perspective. This finding aligns with other literature [10][22], where evidence of convergence only emerges in the OECD countries or at a state level inside a country's territory—those that have similar economic structure and substantial multilateral trade volume. There may exist a persistent emission gap between the high per capita emissions countries and the low per capita emissions countries. This is ascribed to that the traditional "per capita emission" approach to examine the emission convergence ignores important structural characteristics of an economy [10]. For instance, its underlying egalitarianism value neglects other principles, such as natural resource endowment and economic or environmental efficiency, which is implicitly unfair to efficient emitters. Thus, more scholars have been taking a more inclusive view on carbon emission when considering emission quota allocations or cross-border emission trading [15][23].

Several scholars have proposed emission allocation schemes based on these composite indicators [24][25]. However, an empirical ground for these emission allocation schemes is lacking. Therefore, we construct composite emission performance indicators that consider an array of important socioeconomic factors, including capital stock, energy use, population, and economic outputs (GDP). These composite indicators are based on different principles, i.e., a fairness-based principle or an efficiency-based principle. We examine the convergence of the RECP countries on these emission performance indicators and find that *CEE* and *CPP* show absolute convergence, although *CPR* shows a diverging pattern. The findings imply that these indicators, especially *CEE* and *CPP*, are applicable in regional climate policy cooperation. For example, emission budget allocation can be based on countries' *CEEs* and *CPPs* [24]. Adapting these indicators can lead to less cross-border resources and capital transfer in market mechanisms compared to the per capita emissions approach. Therefore, evidence of the convergence of the *CEE* and *CPP* opens up a new opportunity for developing an integrated $CO_2$ emission allocation and trading scheme in the Asian-Pacific region.

Finally, by examining the influence of export on the convergence of the *CEE* and *CPP*, we find that even though the *EX* has no statistically significant influence on the convergence of the *CEE* and *CPP*, it accelerates their convergence. Thus, the finding suggests that the establishment of the RCEP free trade agreement will further promote the convergence of the *CEE* and *CPP*. Therefore, the establishment of the RCEP trading bloc can further enhance the legitimate development of an integrated emission allocation scheme and trading market in the RCEP countries.

## 3. Conclusive Remarks and Policy Implications

The empirical results show that although the convergence hypothesis does not hold for the per capita emissions, the emission performance indices constructed using the DEA model converge because they consider a set of emission-driving forces. This empirical evidence suggests that although some countries outperformed others at the current state, this performance difference will eventually disappear following the converging process. Thereby, we propose that if a unified emission trading framework is implemented in the RCEP region and an appropriate emission budget allocation principle is adopted, no country will acquire substantial and persistent carbon rent from others. Trading can accelerate regional emission performance convergence. Thereby, the RCEP free trade

agreement may benefit the region's emission performance convergence as it frees regional trade. Thus, climate-ambitious countries in the RCEP agreement should proactively embrace trade openness, leveraging the free trade agreement to not only boost their economies, but also realize cooperative $CO_2$ emission mitigation.

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