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Establishing the fair allocation of international aviation carbon emission rights

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Abstract

To identify potentially unfair use of international aviation carbon emission rights in different countries, this paper presents a carbon Lorenz curve and Gini coefficient, constructed on the basis of historical cumulative international aviation CO_2 emissions per capita. The study follows a methodology adapted from the research into fair income allocation. The results of these calculations show that there has been vast unfairness surrounding international aviation carbon emissions in the past, and that this unfairness has been partially hidden by a delay in accumulative start dates. A solution to this problem, allowing fair allocation of carbon emissions, is the key to building a mechanism for the reduction of global international aviation emissions. This study proposes a fair method for allocating emission rights, based on a responsibility-capacity index. Taking a goal of carbon-neutral growth by 2020 as an example, the degree of carbon emission reduction expected from different countries by 2021 is calculated using the proposed method.

Keywords: Aviation carbon emission rights; Fair allocation; Carbon Lorenz curve; Carbon Gini coefficient; Responsibility-capacity index

1. Introduction

Carbon emissions from the aviation industry currently account for 2.0%–2.5% of global yearly anthropogenic carbon emissions. Following the rising demand and rapid growth in the aviation industry, emissions from this sector have increased by 98% from 1990 to 2006, and are expected to account for 10% of global greenhouse gas emissions caused by human activities by 2050 unless measures are taken (ICAO, 2010). As a major source of upper-air greenhouse gases, the aviation industry is faced with enormous pressure to reduce emissions. However, the aviation industries of different countries are currently at different stages of their development cycles, and the total international aviation carbon emissions differ considerably from the carbon emissions per capita in different countries. These differences may be solidified by unfair allocation schemes, which can lead to market distortion in the development of national aviation industries. Therefore, with the rights of aviation carbon emissions becoming increasingly limited, it is now imperative that a method is developed to measure and evaluate the fairness of the allocation of international aviation emission rights and thereby distribute aviation carbon emission rights in a fair and reasonable way.

The issue of fairness of carbon emission rights among different countries has been strongly debated since at least 1992, when the United Nations Framework Convention on Climate Change treaty was signed. Over the past hundred years, developed countries have typically generated a large

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number of carbon emissions as a result of industrialization, while developing countries have historically generated fewer emissions, although this is expected to increase in response to future industrial development. Therefore, the intentionally fair principle of common but differentiated responsibilities and respective capabilities was proposed as part of the United Nations Framework Convention on Climate Change, signed in 1992 and the Kyoto Protocol, signed in 1997. However, due to differences in interests and interpretations by different countries, agreement on the specific meaning and applicability of this fairness has yet to be reached by the international community. In current international aviation market-based mechanism schemes, including both the existing European Union Greenhouse Gas Emission Trading Scheme or the preliminary market-based mechanism scheme of the International Civil Aviation Organization, the allocation of carbon emission rights is mainly dominated by developed countries, and the fair allocation of the responsibilities and obligations of aviation emission rights for all countries remains a major focus of debate. Thus, research into the fairness of international aviation carbon emission rights allocations is crucial.

2. The principle of fair international aviation carbon emission rights allocation

The principle of fair international aviation carbon emission rights incorporates different aspects, including justice, equality, and equity. The principle involves two major types of fairness, intra-generational fairness and inter-generation fairness (Chen, 2012; Zheng and Liang, 2011; Lu, 2013; Pan and Zheng, 2009).

Intra-generational fairness refers to equal rights in the demand for a good living environment and the use of natural resources among people of the same generation, regardless of any differences in nationality, race, gender, level of economic development, and culture (Zheng, 2002). Historically and presently, intra-generational unfairness of environmental issues is seen as an extremely serious problem. Through a calculation of the international aviation CO_2 emissions per capita, there are huge differences in CO_2 emissions of different countries, and especially between developed and developing countries; this leads to intra-generational unfairness. The top 20 countries for CO_2 emissions in 2011 are listed in Table 1, which shows significant differences between the CO_2 emissions of different countries. For example, emissions per capita of the United States are seven times those of China, and those of European Union are nine times those of China. Intra-generational fairness is closely related to the level of economic development and should be translated into equal aviation carbon emission rights for all.

In contrast, inter-generational fairness refers to equal rights in the use of natural resources, enjoying a clean environment, and ensuring the survival and development of current and future generations. In essence, it is a problem rooted in the inter-generational allocation of natural resources (Wu et al., 2009; Grübler and Fujii, 1991). Historical changes in the emission responsibilities of developed countries should be considered

Table 1
International aviation CO_2 emissions per capita in 2011, including the top 20 countries in 2011.

Area	Emissions (Mt CO_2)	Population (million)	Emissions per capita (t CO_2)	Ranking
28 EU members	131.21	507.78	0.26	7
United States	64.72	312.04	0.21	10
China	35.79	1,351.20	0.03	19
Russia	19.04	141.93	0.13	13
Singapore	18.33	5.18	3.54	1
Japan	18.30	127.83	0.14	12
India	12.23	1,241.49	0.01	20
Thailand	12.02	69.52	0.17	11
Korea	11.99	49.78	0.24	8
Australia	10.17	22.76	0.45	5
United Arab	9.80	7.89	1.24	3
Mexico	8.12	109.22	0.07	15
Malaysia	7.58	28.86	0.26	6
Saudi Arabia	6.63	28.08	0.24	9
Brazil	6.36	196.66	0.03	18
Qatar	4.66	1.87	2.49	2
Switzerland	4.47	7.87	0.57	4
Canada	3.60	34.48	0.10	14
Iran	3.55	74.80	0.05	16
Turkey	3.45	73.95	0.05	17

Date source: CO_2 Emissions from Fuel Combustion (2013 Edition), IEA, Paris.
Note: The 28 EU members are as a whole, and the data from China include Hong Kong and Macau, but not Taiwan. In 2011, these countries account for 84% of total global CO_2 emissions.

when considering inter-generational fairness. Despite the relatively recent development of the international aviation industry, there have always been large gaps in cumulative emissions between different countries, and these differences are even larger between the cumulative emissions per capita. Table 2 shows the top 20 international aviation cumulative CO_2 emissions per capita during 1971−2011. The international aviation historical cumulative CO_2 emissions per capita of the United States are 16 times those of China, and those of the European Union are approximately 20 times those of China, thus indicating serious inter-generational unfairness in international aviation CO_2 emissions. This disparity is closely related to the relative stages of economic and aviation development in different countries. As the economy and aviation industry was established earlier in developed countries, their historical emissions are higher than those in developing countries. In contrast, the historical emissions of developing countries are currently relatively low, but may be expected to grow rapidly in the future. Therefore, the historical emission responsibilities of developed countries and the future growth in demand for emissions for developing countries should be fully considered when allocating aviation emission rights.

There are two important principles guiding the fair allocation of carbon emission rights (Ringius et al., 2002; He et al., 2009). First is the principle of culpability, measured by the role the relevant parties play upon causing a problem. Thus, according to the principle of culpability, if a problem is created by the actions of a person, it is a fair practice that the responsibility to solve the problem lies with that person.

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