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The Impact of GHG Emission Trading System on Air Transport Industry and Implication in View of Regulatory Policy

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규제정책의 관점에서 바라본 온실가스(GHG) 배출권거래제가 국내 항공운송산업에 미치는 영향

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ABSTRACT

The emission trading system implemented in Korea is a system in which the government allocates or sells emission rights by setting the emission allowable amount to economic players subject to the emission trading system, allowing companies to freely trade shortfall or extra money through the emission trading market. Korea also had implemented its first emission trading system scheme period of time from 2015 to 2017. As a result of the first planning period in which total of seven Korean airlines were targeted, the emission amount was about 5.51 million KAU, while the quota amount was only about 4.85 million KAU, about 116% of the actual quota was emitted and Domestic airlines have incurred additional costs of about 10.7 billion won. Due to ICAO's implementation of CORSIA, the airlines are expected to have to shoulder additional costs because purchasing exceed quota will be increased in order to offset excess emissions not only on domestic but also on international routes. Thus, this paper had analyzed the characteristics of the carbon trading system of air transport industry and suggested a mix of regulatory policies as an improvement method.

Key Words : 온실가스(Green House Gas), 배출권거래제(Emission Trading System), 할당량(Allowance), 항공사(Airlines), 규제정책(Regulatory Policy)

Ⅰ. Introduction

This study analyzed the characteristics of carbon emission trading scheme applied to the domestic air transport industry and analyzed policy problems considering it. Based on these problems, this paper suggested policy improvement points for strengthening international competitiveness of domestic air transportation industry(Blasing, 2013).

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There is, however, a limit to the existing researches that did not provide insights into the new institutional design from the policy point of view, because it was conducted from the legal point of view or from the economic point of view(Song et al., 2013).

Regarding green house gas(GHG) emissions, the combination of regulatory measures is inevitable due to multiple market failure factors, segmental incentives, and uncertainty of compliance. In addition, the introduction of the GHG emission trading scheme implies the design of a new policy for the Korean government, and its function will be able to work properly in the air transport industry through a combination of various regulatory policy measures(Uherek et al., 2010).

Among the energy sector, the volume of emissions from the transport sector is not large, but the rate of change from the previous year is the highest at 4.8%. The rate of change from 1990 to 2016 is also 178.1%, which means that GHG emissions continue to increase and this trend will continue in the future. Especially, given the expected increase in demand for civilian air transportation such as improvement of people's income level, expansion of int'l overseas routes, fast increase of low-cost carrier, GHG is expected to increase(Kim H.B. and Kim J. K., 2010).

Although it is expected that GHG from aircraft will increase, academia has yet to conduct studies on the calculation of GHG emissions from the aviation sector.

The government enacted and announced guidelines for the management of GHG and energy in accordance with the Framework Act on Low Carbon Green Growth. Under the Kyoto Protocol, the government set a 30% voluntary target for emission reductions and has decided to further strengthen efforts to cope with climate change as the GHG emission reduction target is set at 37%(Uhm and Jang, 2018).

The Ministry of Land, Infrastructure and Transport, which controls the aviation industry in the transport sector, has signed the agreement of "Voluntary Reduction of GHG in the Aviation Sector" in 2010 and responded to climate change and GHG emission regulations. Domestic flights are subject to the national emission trading system in accordance with the GHG emission trading act, and international flights are subject to voluntary reduction in accordance with the agreement. With the Paris Agreement and the implementation of ICAO CORSIA, Korea's mandatory reduction targets have been strengthened, and airlines' efforts to reduce.

Ⅱ. Theoretical Backgrounds

2.1 Types of regulatory policies

The types of environmental regulatory measures can be broadly divided into command-control regulation, market-based regulation, self-regulation, and non-regulatory alternatives. First, Command and Control refers to a method of directly prohibiting or restricting the act of interfering with the realization of social values by exercising a mandate based on legal regulations, administrative orders, or instructions(Baldwin and Cave, 1999), It is easy to see irrationality as a center of excessive regulation (Lee and Choi, 2008).

Secondly, market regulation is a regulatory tool that utilizes market mechanisms and is an excellent method in terms of economic efficiency. The autonomous regulation basically means an self regulation of self-organized groups, and it is an effective regulatory strategy in terms of expertise and efficiency when compared to existing regulations (Baldwin and Cave, 1999). Non-regulatory alternatives such as education and recommendation are more flexible and voluntary than Command and Control regulation.

As a command and control environmental regulation, representative standard regulation is of standard setting, government suggests that such as permission, guidance, inspection and environmental standards for the facilities which cause pollution, and the actors are required to follow these criteria. And the criteria setting can be classified into three criteria setting: design standard, performance standard, and process standard (Gunningham and Sinclair, 1999).

These Command and control regulations are often used as the most basic means of environmental policy because of the relatively clear nature of regulations and the fact that regulatory effects can be seen immediately, even though they are costly. However, in the environmental sector, command and control regulation is limited in that it lacks willingness to voluntarily adhere to environmental policies, excessive economic burden, and incentives for clean technology development (Moon, 2018).

Market-driven environmental regulations are regulatory policies that utilize market mechanisms or economic incentives, such as levies, charges, deposits, subsidies, performance incentives, and emissions trading etc. In the environmental sector, market-driven regulatory instruments can be broadly categorized into three broad categories: broad-based economic instruments, supply-side incentives, and legal liabilities (Gunningham and Sinclair, 1999).

The economic incentive is to mitigate the negative externalities such as environmental pollution by using the economic principles of the market, so that the effect of pollution control can be obtained at a relatively low cost as compared with the command and cortrol regulation, and to promote related technological development and innovation.

The autonomous regulation generally means that the organized group regulates the behavior of its members. The superiority over the traditional command control regulatory approach is efficiency, ease of enforcement and compliance, adaptability of environment change, professionalism, etc.(Baldwin and Cave, 1999). However, the introduction of self- regulation is not always desirable, because self-regulation is controversial in terms of procedural justice and accountability. In order for self regulation to replace government regulations and ensure its effectiveness, institutional design and support are required to ensure fairness and accountability in self-regulation (Lee and Lee, 2010).

2.2 Mix of regulatory policies

2.2.1 Single instrument approach

Early studies of environmental policy have recognized the existence of various environmental policies and have tried to find out the best alternative by comparing and examining various alternatives. In other words, we tried to find out which regulatory methods are more cost effective among various types of environmental regulation such as command-control regulation, incentive regulation, self-regulation. This is also reflected in the process of regulatory policy making in Korea(Lee and Lee, 2010).

Comparing the various regulatory and non-regulatory alternatives and trying to find the single best regulatory alternative. There is a sense that each of these efforts is a complement to each other. In fact, there are a number of different regulatory schemes that can conflict with each other, but complement each other. thus in recent years, discussions on the mix of regulatory measures have been generally accepted (OECD, 2007).

2.2.2 Policy instrument mix

The existing single instrument approach has limitations. Because all tools have advantages and disadvantages, and none of them is a single satisfactory solution to environmental problems. therefore more useful approach is to make use of the advantages of individual mechanisms and to supplement their weak- nesses by using additional means. In other words, a mix of regulatory instruments for specific purposes is required(Gunningham and Sinclair, 1999).

However, it can not be said that policy mix is always superior to a single tool approach. Regulatory blending can also have negative effects. Therefore, when mixing regulatory measures, it is necessary to mix comple- mentary regulatory measures in consideration of the positive and negative relations between them. In general cases of complex environmental issues, the best conditions can not be achieved by applying only one means (OECD, 2007). According to a study by Gunningham and Sinclair (1999), the following are the essentially complementary means of combinations:

First of all, the combination of information-based means and means that are more directly aimed at environmental externality, makes both effective. Environmental labeling provides information that enables relevant decision makers to make informed choices, thus addressing information-related market failures.

Secondly, voluntarism, command and control regulations complement each others. In the case of voluntary agreements, this voluntary agreement appears to be in effect when there is a risk that the government will be able to take regulatory action at any time unless it is through voluntary consultations(Jung, 2004).

In addition, self-regulation and command control regulation of performance standards are essentially complementary. The self regulation is moving from the government to the private autonomous organization of the regulatory enforcement body, and it is necessary to follow-up such as surveillance of whether it is well protected. For example, in the United States, the Environmental Leadership Program is building a transparent system that enables companies to participate and determine their environmental performance levels to reduce regulatory burden while simultaneously monitoring their performances.

In case of command control regulation and supply-side incentives, market instruments are important incentives for research and invention, and therefore, as part of a combination of instruments to encourage innovation. It is also useful to introduce supplementary incentive regulations. In case of command control regulation (or self-regulation) and broad-based economic instruments, if you discipline other aspects, it can be used complementarily. In Australia since 1985, automobile fuel regulations have used technology-based regulations for manufacturers and environmental taxes for consumers. In addition, legal liability (charge), command control regulation, and market-based regulation and monitoring are complementary.

Ⅲ. Emission Trading System

3.1 Kyoto protocol

The Convention on Climate Change is intended to stabilize atmospheric GHG concentrations so that human activities do not

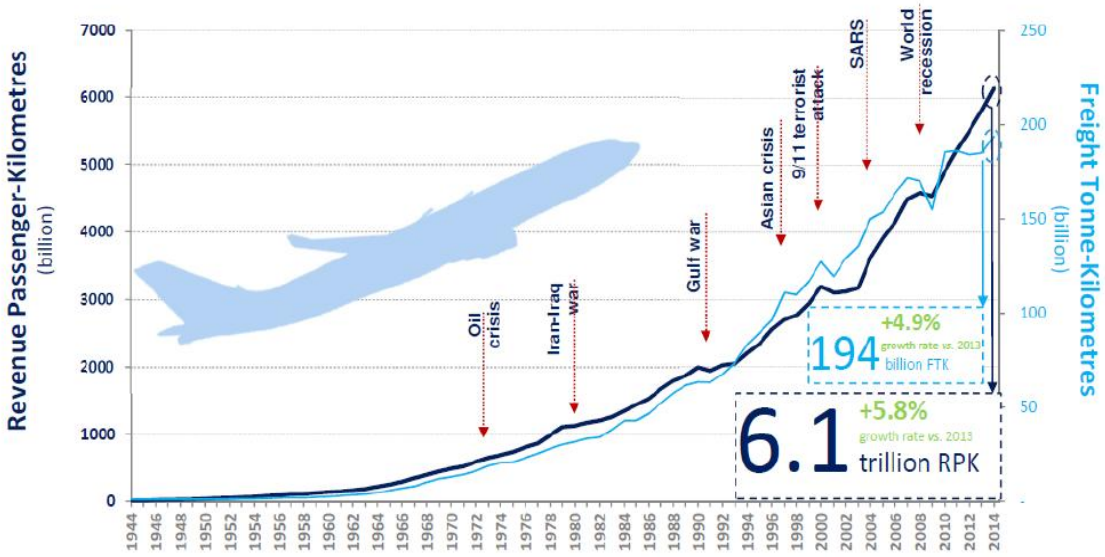

Fig 1. GHG emission and air transport growth(ICAO environmental report, 2016)

pose a risk or adverse effect on the climate system. The basic principles of the Convention on Climate Change are as follows: First, countries around the world have differentiated responsibilities and burdens. Second, Member States take into account the special economic and social situation of developing countries. Finally, it will ensure sustainable growth for all countries by implementing preventive measures against climate change.

The Kyoto Protocol is a concrete measure adopted to implement the Convention on Climate Change. Developed countries (Annex 1 Member States) have agreed to set a binding reduction target for GHG (a total of six types including carbon monoxide). In addition, member countries introduced the Kyoto Mechanism as a new reduction. The Kyoto mechanism means the joint implementation of GHG reduction, the establishment of a clean energy development system, and the introduction of emissions trading system. It is significant that the Kyoto Protocol contains the first international agreement that has been agreed by all nations to directly regulate GHG emissions (international sanctions and responses). With the adoption of the Kyoto Protocol, GHG reductions by major industrialized nations became a major factor.

The implementation period for the Kyoto Protocol was from 2008 to 2012. The evaluation of this period can be said to be unsuccessful in implementing the GHG reduction by country, with the top-down system that first cuts from developed countries. Britain, Germany, and Eastern Europe have achieved most of their GHG reduction targets, while the North American countries such as the US and Canada have failed to meet their targets. China and the United States, one of the largest GHG emitters, did not set their own GHG reduction targets, so the Kyoto Protocol had no effect. In the case of the Republic of Korea, as a non-annex country, there was no obligation to reduce GHG. Thus it was recommended to report only the emission related information (Kumazawa and Callaghan, 2010).

3.2 Paris agreement

In Paris agreement December 2015, countries around the world have led the international community to agree on a new climate change regime since 2020, when the Kyoto Protocol expires. The Paris Agreement is an agreement to jointly address the new climate change regime and aims to keep the rise in average temperature of each states below 2 degrees Celsius by 2100.

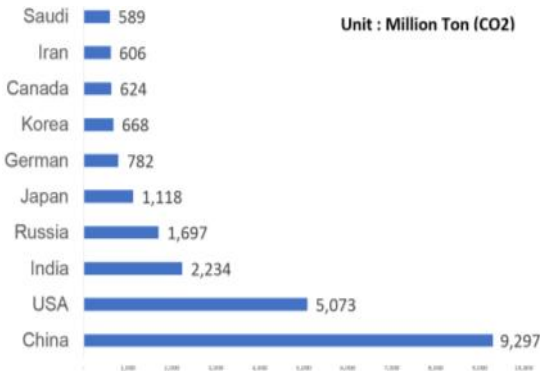

Fig 2. Top 10 GHG Emission Countries, UNFCC, 2017)

The Paris Agreement includes the United States and China, which did not set their own reduction targets in the Kyoto protocol. Unlike the Kyoto Protocol, which had obligations for GHG reduction only in developed countries, the Paris agreement gave legal binding power to all of the 196 member states, including developing countries. Member countries should submit voluntary GHG reduction targets every five years since 2020. Developed countries have agreed to pay about $ 100 billion annually for developing countries' climate change support projects by 2025. It is significant that the Paris Agreement introduced a new international carbon market system, a sustainable development mechanism and a cooperative approach, by improving the Kyoto mechanism(Ollila, 2019).

3.3 ICAO CORSIA

The Kyoto Protocol had stipulated that through the Third General Assembly of the Conference of the Parties to the Framework Convention on Climate Change, the reduction of GHG emissions in the international aviation sector should be cut through the ICAO of UN agencies, not doing by individual countries.

ICAO sought advice from the UNFCC(UN Framework Convention on Climate Change) to reduce GHG emissions in the international aviation sector and the member countries adopted the International aviation sector reduction targets at the 37th International General Assembly (2013) held in 2010. As a result, it was decided to improve fuel efficiency by 2% over the previous year by 2050 and to achieve carbon neutral growth (CNG, Carbon Neutral Growth from 2020 each year. As a concrete means of achieving the CNG 2020, the ICAO has presented first, aircraft green technology standards, second, aircraft operational improvements, third, sustainable alternative fuel development and worldwide reduction implementation mecha- nisms in the 2016 Environmental Report .

At the 39th Session in 2016, the ICAO Assembly adopted the Global Market-Based Measure resolution to offset carbon emissions. The GMBM resolution stated that carbon emissions in the international air transport sector are currently less than 2 percent of the global emissions, but will increase more than three times by 2050. Accordingly, the report says that carbon emissions will be frozen to 2020, and that by 2050, fuel efficiency will be improved by 2% annually(ICAO, 2016).

GMBM is a market-based approach, which judges that it is difficult to neutralize carbon because the reduction target set by member countries through the 37th general assembly is

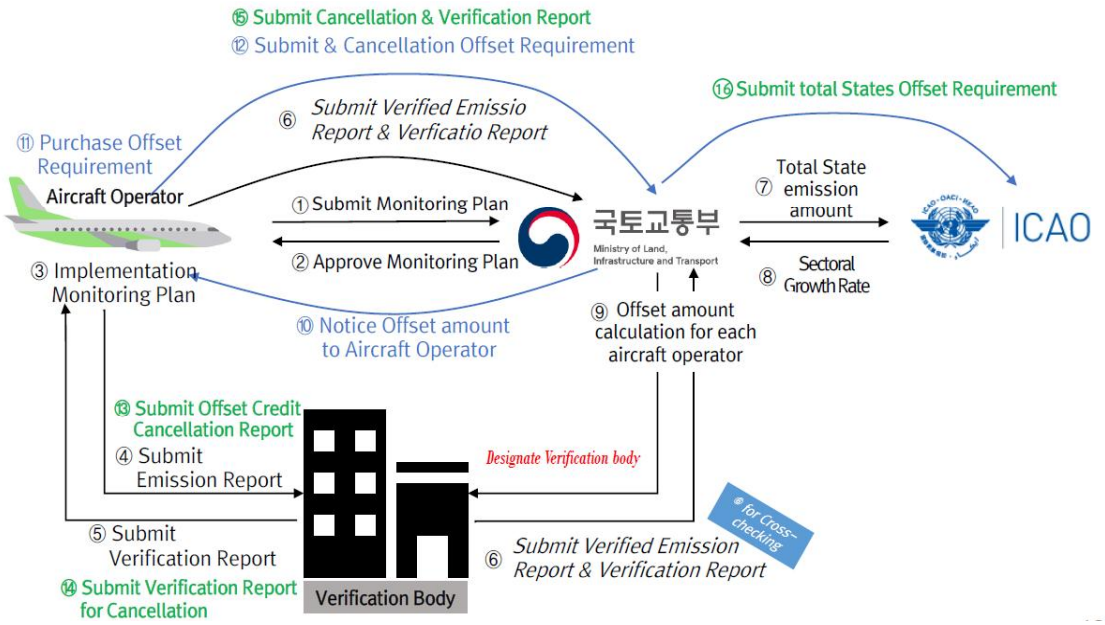

Fig 3. ICAO CORSIA working process(KRIC, Korea Research Institute on Climate Change, 2018)

a non-market-based approach. The first specific implementation suggested by GMBM is the Carbon Offset and Reduction Scheme for International Aviation so called as CORSIA.

ICAO member states participating in CORSIA stipulate that each airline to bear the excess emissions if the total carbon emissions for the year are greater than the average annual total emissions for 2019 and 2020. Airlines that exceed emissions must offset the GHG emission rights by purchasing them from outside systems. The CORSIA only cover international routes operated by airlines. In other words, this system applies to all aircraft operating international lines between CORSIA participants. However, if departure of an international route to which the aircraft connects, or even one country of the country of arrival is a non-participating country of CORSIA, the CORSIA system will not apply to the relevant aircraft. Through the 39th General Assembly, a total of 66 countries including the United States, the EU, China and South Korea, which account for 86.5 percent of the total international air transport performance, expressed their willingness to participate voluntarily. Accordingly, domestic airlines will be required to reduce GHG emissions on international flights through CORSIA from 2021(Yoo, 2018).

3.4 Air transport industry in Korea

Korean central government has introduced "emission trading system" to induce voluntary reductions. The GHG emission trading system allocates the emission credit on an annual basis to businesses that emit GHG.

The system allows business establishments to discharge within their quotas, assess the actual GHG emissions of the sites allocated, and allow business-to-business transactions with respect to the rights of excess or deficiency.

The primary planning period is determined from 2015 to 2017, and the quota by industry is determined through the allocation of industry-specific quota determined by the "National Emission Rights Allocation Plan"

Table 1. GHG emission allowance unit on Airlines (Unit : Ton CO2eq)

1st planning period			2015	2016	2017	Total
Korean Airline	Initial allowance		531,366	518,568	518,718	1,568,652
	Additional allowance	New route	621	2,045	3,226	5,892
		Early reduction	-	79,431	-	79,431
		Safe operation	-	3,627	138	3,765
	Total		531,987	603,671	522,082	1,657,740
Asiana Airline	Initial allowance		311,043	309,026	308,737	928,806
	Additional allowance	New route	-	-	-	-
		Early reduction	-	21,452	-	21,452
		Safe operation	-	2,322	-	2,322
	Total		311,043	332,800	308,737	952,580
Jeju Airline	Initial allowance		191,954	187,311	187,114	566,379
	Additional allowance	New route	-	47,091	43,539	90,630
		Early reduction	-	-	-	-
		Safe operation	-	558	-	558
	Total		191,954	234,960	230,653	657,567
Jin Air	Initial allowance		-	154,032	153,871	307,903
	Additional allowance	New route	-			
		Early reduction	-			
		Safe operation	-			
	Total		-			
Air Busan	Initial allowance		133,684	130,450	130,312	394,446
	Additional allowance	New route	-	22,965	58,967	81,392
		Early reduction	-	-	-	-
		Safe operation	-	-	-	-
	Total		133,684	153,415	189,279	476,378
Eastar Jet	Initial allowance		112,701	109,976	109,861	332,538
	Additional allowance	New route	-			
		Early reduction	-			
		Safe operation	-			
	Total		112,701			
T-way Air	Initial allowance		-	140,940	140,792	281,732
	Additional allowance	New route	-	-	-	-
		Early reduction	-	-	-	-
		Safe operation	-	468	-	468
	Total		-	141,408	140,792	282,200

among "National Emission Rights Allocation Plan" among the allocation target companies belonging to the corresponding industry category.

Industrial sites that are assigned the right to emit GHG must calculate the GHG emissions annually and report it to the Ministry of the Environment after verification by an external specialized agencies(Lee et al., 2016). In addition, it is possible to reduce GHG emissions directly, acquire emission rights through emission trading, and convert the reduction results obtained by implementing GHG reduction projects into emission rights. The target companies for the emission trading system are notified by the Ministry of Environment (No. 2016-158, "16.8.1)" (Park R. M., 2014).

Table 2. Financial impact on air transport industry in Korea (Unit : ton CO2-eq)

KAU	2015	2016	2017	Total
Initial allowance	1,280,748	1,550,303	1,549,405	4,380,456
Additional allowance	621	264,660	206,438	471,719
Sum	1,281,369	1,814,963	1,755,843	4,852,175
Deficit	2015	2016	2017	Total
K A U (a)	1,281,369	1,814,963	1,755,843	4,852,175
Emission (b)	1,744,662	1,879,351	1,887,720	5,511,733
Deficit : (a) - (b)	-463.293	-64,388	-131,877	-659,558
Emission	2015	2016	2017	Total
Domestic routes	1,613,113	1,744,205	1,749,929	5,107,247
Building / Vehicle	131,549	135,146	137,791	404,486
Sum	1,744,662	1,879,351	1,887,720	5,511,733

During the first planning period, total 602 companies were notified to the Ministry of Environment to allocate the emission trading system, and seven of them were identified as Korean Air, Asiana Airlines, Jeju Air, Jin Air, Air Busan, Eastar Airways and Tway Airways. Air Incheon, which transports only air cargo, and Air Seoul, which operates jointly with Air Busan, were excluded from the targeted industries.

Table 1 shows the allocation of GHG emissions granted to seven airlines by the Ministry of Environment. The emissions credits allocated to the seven target airlines were approximately 4.85 million Korea Allowance Unit (KAU) during the first three years, but the actual emissions were found to be about 5.51 million KAU, which was analyzed to be about 16% less than the actual emissions. The quota shortfall (approximately 660,000 tons) presented during the first period should be offset by airlines, and it was found that applying the KAU average of 16,627 won/ton in 2015-2016 would incur an additional cost of approximately 10.7 billion won.

Approximately 10.7 billion additional costs by the seven domestic airlines will be incurred if the seven airlines are able to earn 15,540 flights (5,180 flights per year) or 2,937,140 passengers on domestic flights during the 1st planning period (Gimpo-Jeju average freight rate of 52,275 won for domestic routes in 2015-2016, average operating margin of 6.97% for domestic airlines, and assuming using 189-seater Boeing 737MAX, the latest model in operation in Korea.

When the ICAO CORSIA system is implemented in 2021, domestic airlines will have to purchase offset cancellation rights for excess emissions on international routes that are currently in operation with participating countries of CORSIA, as well as cost burdens due to the current domestic emission trading system. The financial burden will increase. Domestic routes are the only transportation field that are selected for the emission trading system. Therefore, due to the shortage of quota, it will increase the number of purchases. The aviation association and the seven airlines predict if the shortage is to be 660,000tons from 2018 to 2021, additional W14billion will be incurred based on the KAU transaction on exchange unit price in 2017(KRW21,150 per KAU).

Ⅳ. Conclusion

4.1 Summary

The emission trading system implemented in Korea is a system in which the government allocates or sells emission rights by setting the emission allowable amount to economic players subject to the emission trading system, allowing companies to freely trade shortfall or extra money through the emission trading market. The objective of this emission trading system is to induce companies to voluntarily fulfil their obligations by achieving their emission reduction targets on their own or by purchasing surplus emission rights from other companies(Johnson and Gonzales, 2013).

Starting with the first EU-ETS (EU-ETS) in 2005, New Zealand has participated in the emission trading system in 2008, the Regional Greenhouse Gas Initiative (RGI) in 2009, Tokyo in 2010 and Switzerland in 2013(Kim, Yoo and Choi, 2011).

Korea also had implemented its first emission trading system scheme period of time from 2015 to 2017. The introduction and implementation of the emission trading system has an impact on domestic airlines as follows:

First of all, as a result of the first planning period in which total of seven domestic airlines were targeted, the emission amount was about 5.51 million KAU, while the quota amount was only about 4.85 million KAU, about 116% of the actual quota was emitted and Domestic airlines have incurred additional costs of about 10.7 billion won.

Korea is included in the list of countries subject to mandatory cuts as the International Civil Aviation Organization (ICAO) carbon offset reduction system was implemented from 2021. Airlines are expected to have to shoulder additional costs because purchasing exceed quota will be increased in order to offset excess emissions not only on domestic but also on international routes(Kim et al., 2011; Lee et al., 2013).

4.2 Implication

This paper analyzes the characteristics of the carbon trading system of air transport industry and suggests a mix of regulatory policies as an improvement method considering this. Regarding GHG emissions, a combination of regulatory measures is inevitable due to multiple market failure factors, segmental incentives, and uncertainty of compliance. In addition, the introduction of carbon trading schemes means the new policy design of the government of the Republic of Korea, and it will be only able to function properly through a mix of various regulatory policy measures.

Policy analysis results show that for the policy structure of the carbon emission trading system in the air transport industry to function properly, a mix of corporate support policies and carbon tax policies to promote innovation and competition is inevitable.

In order to reduce the uncertainty of compliance and increase the possibility of enforcement, it is necessary to expand the free allocation method After the first phase, until the second phase of the plan, the fines for non-compliance, the government regulations for registration, certification and verification of carbon abatement, and Self supervisory organizations for market monitoring and self-regulation should be combined.

The transparency of the air transportation industry to eliminate unnecessary conflicts in the implementation of the carbon emission trading system, the participation of airlines in policy, and the free access of the private sector to information on carbon emissions by airlines are

also analyzed as important factors. By combining these factors with policies, we can expect to reduce costs and to strengthen the competitiveness of the air transport industry in the global market.

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