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Quantitative Analysis of the Monopolistic Power of Economies in Transition in the International Emissions Trading

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ABSTRACT

The purpose of this study is to analyze the possibility of the monopolistic behavior and the influences of the monopolistic power that can be exercised by a supplier of emissions rights in the international emissions trading market quantitatively. Considering the Kyoto Protocol, because the marginal abatement costs of greenhouse gases (GHG) are extremely different among countries, emissions trading is one of the indispensable methods to achieve the targets certainly and cost-effectively, especially for developed countries. However, because only economies in transition has an excess amount of emissions rights and can be a net seller in the trading market assumed under the Kyoto Protocol, there is possibility that the trading market becomes an imperfect competition market owing to the monopolistic power. In this study, an applied general equilibrium model, the GTAP-E model, is used for the simulation analysis. The analysis is based on the present Kyoto Protocol framework and economies in transition is thought to be the region exercising the monopolistic power. Since the model is static, the year 2010, the middle year of the first commitment period of the Kyoto Protocol, is considered. Also, only CO_2 is targeted in GHG. Although the GTAP-E model is used, a model with 10 regions and 10 industrial sectors are considered, which is different from the original. Among the regions,

developed countries, except USA and Australia, and economies in transition abate CO_2 emissions using emissions trading.

As a result of the analysis, it is revealed that the relation between the supply of emissions rights by economies in transition and the benefit is an “inverse U-shape curve” and the maximum benefit is brought when the supply amount is about a half of the maximum supply potential. The regional GDP increase is mostly due to the benefit. That is to say, exercising the monopolistic power is economically effective for the region. On the contrary, the world negative influences on emissions abatement efficiency and economy are observed due to the monopoly. When economies in transition supplies emissions rights to maximize the benefit, the world GDP decrease and the increase in the trading price become about 7 times. Moreover, observing the regional influences, GDP decreases in developed countries abating emissions become more than 10 times.

These results give an important policy implication to similar problems when designing the post Kyoto Protocol framework if emissions trading is applied.

Keywords: emissions trading, monopolistic power, Kyoto Protocol, economies in transition, GTAP-E model

INTRODUCTION

Although the first commitment period of the Kyoto Protocol (2008-2012) is soon coming, climate change measures are made little progress globally and achievement of the quantitative goals of the Kyoto Protocol to abate greenhouse gases (GHG) emissions is far for most of the Annex B countries ratifying the Kyoto Protocol.

Under the circumstances, since the marginal abatement costs of GHG are extremely different among countries, emissions trading is one of the best methods to abate GHG emissions cost effectively and to achieve the targets as certainly as possible. However, considering the assigned amount to each country under the Kyoto Protocol, a serious problem could occur in the international emissions trading market. It is monopolistic power in the market. As, for example, the assigned amount to Russia is equal to the emissions of the base year although the amount of GHG emissions is considerably decreasing from the base year (UNFCCC, 2006), there is a tendency that “hot air”, an excess amount of emissions rights, is generated in economies in transition as a whole. Therefore, there is possibility that the international emissions trading market becomes an imperfect competition market where the region behaves as a monopolistic supplier of emissions rights[i].

In this paper, the influences of the monopolistic power by the supplier in the

international emissions trading market concerning the Kyoto Protocol are analyzed. Here, economies in transition (EFS in the Table 2 below), which has “hot air”, is considered the monopolist[ii].

There exist some studies pointing out and analyzing the influences of the monopolistic power due to Russia or economies in transition including Russia. However, studies such as Bohringer and Loschel (2003) and Loschel and Zhang (2002) only show the influences on some countries mainly developed countries, and those such as Bernard et al. (2003), Dagoumas et al. (2006), and Den Elzen and de Moor (2002) only show the benefit the monopolist can gain and the influences on the trading price. Also, studies such as Bohringer (2002) only show the summarized results. These studies do not analyze and discuss the influences on the world and countries except the monopolists due to the monopolistic power comprehensively in detail. In addition, although some studies above take account of withdrawal of the United States from the Kyoto Protocol, they treat Australia as a ratifier. Therefore, the influences are analyzed more comprehensively under the structure that the United States and Australia are not in the Kyoto Protocol in this study.

The structure of the following sections is as follows: the method used for the analysis is described in the second section, the results of the analysis are shown and discussed

in the third section, and finally, the fourth section includes some concluding remarks with a brief suggestion about emissions trading when it is introduced in the future as a climate change policy.

THE METHOD FOR THE ANALYSIS

In this section, first, the model used for the analysis is described. Then, the data and the assumptions of the analysis are described.

Applied General Equilibrium Model

In this study, an applied general equilibrium model is used for the analysis. As the model, the GTAP-E model (Burniaux and Truong, 2002) is applied and it is reconstructed using Mathematica 5.2 of Wolfram Research Inc. The GTAP-E model is an extended version of the GTAP model (Hertel, 1996) and it is appropriate to analyze climate change policies and the related topics such as the analysis of this study. As space is limited, the details of the model are not described here. Due to the structural condition of the model, CO_2 emissions out of GHG emissions are targeted in the analysis. Moreover, since the model is static, the year 2010, the middle year of the first commitment period, is the target year of this study.

The present version of the GTAP model, GTAP Version 6, is composed of 57 industrial sectors and 87 regions. However, if a 57 × 87 model was used, it would take considerable time to simulate and the fundamental outcomes of the study could be lost when analyzing the results. Therefore, both the industrial sectors and the regions are aggregated into 10 as a compromise between the computation time and the adequacy of the analysis. Table 1 and Table 2 show the structure of the industrial sectors and the regions used in the analysis respectively. In addition, endowment commodities are aggregated into 4, namely labor, capital, land, and natural resources.

Data and Assumptions

Concerning the data used in the analysis, because the GTAP-E model is based on the GTAP model, the economic data are from the GTAP database. Concerning the CO_2 emissions data, they are calculated base on the energy consumption data of the GTAP database using the method and the parameters of Houghton et al. (1997) and Lee (2002), and then, they are corrected using the CO_2 emissions growth rates from IEA (2004) to make them suitable to analyze the target year. The detail of this process is described in Matsumoto (forthcoming). Table 3 shows CO_2 emissions from each region.

Because the analysis is based on the present situation of the Kyoto Protocol as described, it is thought that only Annex B countries ratifying the Kyoto Protocol (JPN, E_U, KPI, and EFS in Table 2) abate CO_2 emissions and emissions trading is implemented when abating. The rates of CO_2 emissions abatement of the four regions are based on the Kyoto Protocol and are shown in Table 4. However, concerning EFS which is assumed to exercise the monopolistic power, it is considered that it only supplies a certain amount of emissions rights to the trading market and sells them to other regions within the "hot air". The maximum supply potential is 30.27% of the initial emissions of EFS.

RESULTS AND DISCUSSIONS

The results of the analysis are shown in Fig. 1 - Fig. 5. In the figures, the supply amount of emissions rights from EFS (each horizontal axis) is percentages of the initial emissions of EFS and 0% in the left-hand side expresses the situation that EFS does not supply any emissions rights. It is obvious from the figures that the relations between the supply amount and each item indicate different tendencies between Fig. 1 and Fig. 2 - Fig. 5. As Fig. 1 shows the relations between the supply amount and the items related to EFS, the curve of the GDP increase rate is an inverse U-shape, where

the rate is lower at the both ends (the minimum value is 0.055% when the supply amount is 0%[iii]) and is maximum (0.83%) when the supply amount is 15.11%[iv]. The benefit of EFS by selling emissions rights shows a similar shape and the maximum value is 0.80% when the supply amount is 15.39%. On the other hand, concerning Fig. 2 - Fig. 5 which show the relations between the supply amount and the items related to the world, the shapes of the change in world GDP, the change in world CO_2 emissions, and the world CO_2 emissions abatement efficiency[v] are upward-sloping curves, and the shape of the trading price is a downward-sloping curve. Because the larger the supply amount from EFS to the trading market, the less the amount of world CO_2 emissions abatement, Fig. 3 shows a quite natural result. Then, observing the remaining three figures, it is indicated that the larger the supply amount from EFS, the smaller the negative economic influences become and the more CO_2 emissions abatement becomes efficient worldwide. That is to say, from the world perspective, preferable results are brought when EFS does not exercise the monopolistic power and supply its emissions rights as many as possible. On the contrary, from the perspective of EFS, controlling the supply amount leads to its benefit[vi] and also they can bank the remaining emissions rights for the future option. Then, it will be able to use the banked emissions rights by itself or to sell to other countries on favorable

terms by choosing a good opportunity. Due to the monopolistic power, it is proved that negative influences are brought globally, where the GDP decrease rate becomes 6.77 times, the trading price becomes 6.41 times, and the CO_2 emissions abatement efficiency becomes 84.69%. Considering degradation of the total efficiency and the increase in the benefit of EFS, the monopolistic power causes additional losses in the regions abating CO_2 emissions. In fact, as Fig. 6 shows, the less the supply amount, the more GDP decreases in JPN, E_U, and KPI. At the same time, becuase EFS controls the supply, CO_2 emissions abatement increases 5.73 times. This tendency is similar to CO_2 emissions abatement in the three regions as Fig. 7 shows.

Although it is indicated that world CO_2 emissions abatement increases when the monopolistic power is exercised, it is quite unlikely that the remaining emissions rights are cancelled. Therefore, it is reasonable to regard that EFS uses them by itself or sells to other countries. In this case, because the “hot air” is eventually used up, the total amount of emissions abatement is constant. Consequently, the influences on climate change are similar when the “hot air” is finally used[vii].

CONCLUDING REMARKS

In this study, the influences of the monopolistic behavior by economies in transition in

the international emissions trading market are analyzed quantitatively applying the GTAP-E model. It is proved from the analysis that although it will be the best from the viewpoint of the total efficiency when all of the “hot air” is supplied to the market, the emissions abatement will be inefficient when economies in transition exercises the monopolistic power and supplies about a half of the “hot air”. Also, it is likely that economies in transition exercises the monopolistic power regarding the benefit they gain from it.

The results of the analysis refer that when CO_2 (including GHG) emissions trading is introduced as a climate change policy to realize efficient emissions abatement, it is important to pay attention to and to take some measures against problems caused by the monopolistic power. This suggestion must be deliberated when establishing the international climate change policy of the post Kyoto Protocol if emissions trading is applied there. For example, arrangement of assigned amounts and improvement of trading systems are necessary.

Footnotes

i. Carlen (2003) indicates that monopsony would occur if a country demanding a large amount of emissions rights such as the United States entered the international emissions trading market.

ii. Because EFS is composed of multiple countries and regions, strictly speaking, the situation is not monopoly. However, since they are aggregated into one region in this study, the analysis is implemented under the monopolistic condition.

iii. As a matter of course, the benefit EFS gains by selling emissions rights is zero in this case.

iv. In this case, the benefit by selling emissions rights per GDP is 0.80% and it is indicated that selling emissions rights brings a considerably large effect on the GDP increase.

v. CO_2 emissions abatement efficiency means percentage changes in CO_2 emissions per a percentage change in GDP（abatement efficiency = percentage changes in CO_2 emissions / percentage changes in GDP.

vi. In the above result, EFS can gain the largest benefit when it supplies about a half of the “hot air”. It is due to the relation between the increase in the trading price (see Fig. 5) and the supply amount of emissions rights to the market.

vii. Because CO_2 emissions equal to the banked emissions rights will occur in the future accompanying a time lag, climate change and its influences will be delayed. As a result, some surplus time to take measures against climate change and the influences will be generated.

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Table 1. Structure of the Industrial Sectors

	Code	Contents
Energy Sectors	COA	coal
	OIL	oil
	GAS	natural gas
	OLP	oil products
	ELY	electricity
Non-Energy Sectors	AGR	agriculture, forestry & fisheries
	EIN	energy intensive industries (e.g. steel industry)
	OIN	other industries (e.g. food processing)
	TRP	transportations
	SVC	other services (e.g. education)

Table 2. Structure of the Regions

	Code	Contents
Developed Countries in the Kyoto Protocol	JPN	Japan
	E_U	15 EU countries (e.g. U.K.)
	KPI	Other developed countries (e.g. Canada)
Economies in Transition	EFS	Economies in transition (e.g. Russia)
Developed Countries not in the Kyoto Protocol	AUS	Australia
	USA	United States
Developing Countries	CHN	China
	IND	India
	EEX	Energy exporting countries (e.g. Saudi Arabia)
	ROW	Rest of the world (e.g. South Korea)

Table 3. CO_2 Emissions from Each Region (Mt-CO_2)

Region	CO_2 Emissions
JPN	1194.7
E_U	3776.9
KPI	771.9
EFS	3251.7
AUS	413.7
USA	6452.7
CHN	4040.7
IND	1227.6
EEX	4120.9
ROW	2953.0

Table 4. Rates of CO_2 Emissions Abatement

Region	Rates*
JPN	−6
E_U	−8
KPI**	−5.4
EFS**	−1.9

*From 1990 level

**Since KPI and EFS are composed of multiple countries and regions, the rates are the weighted averages of the rate of each country or region included by CO_2 emissions of the country or region.

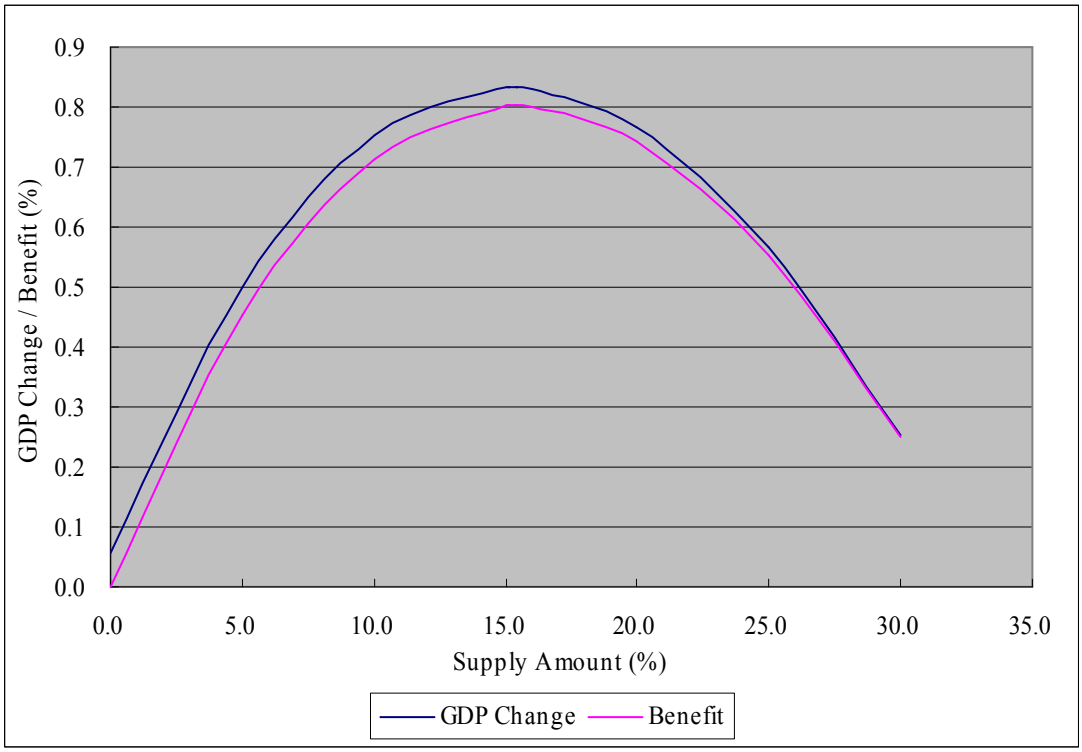

Fig. 1. A Relation between Supply Amount of Emissions Rights from EFS (%) and Change in GDP of EFS (%) / Benefit of EFS by Selling Emissions Rights per GDP (%)

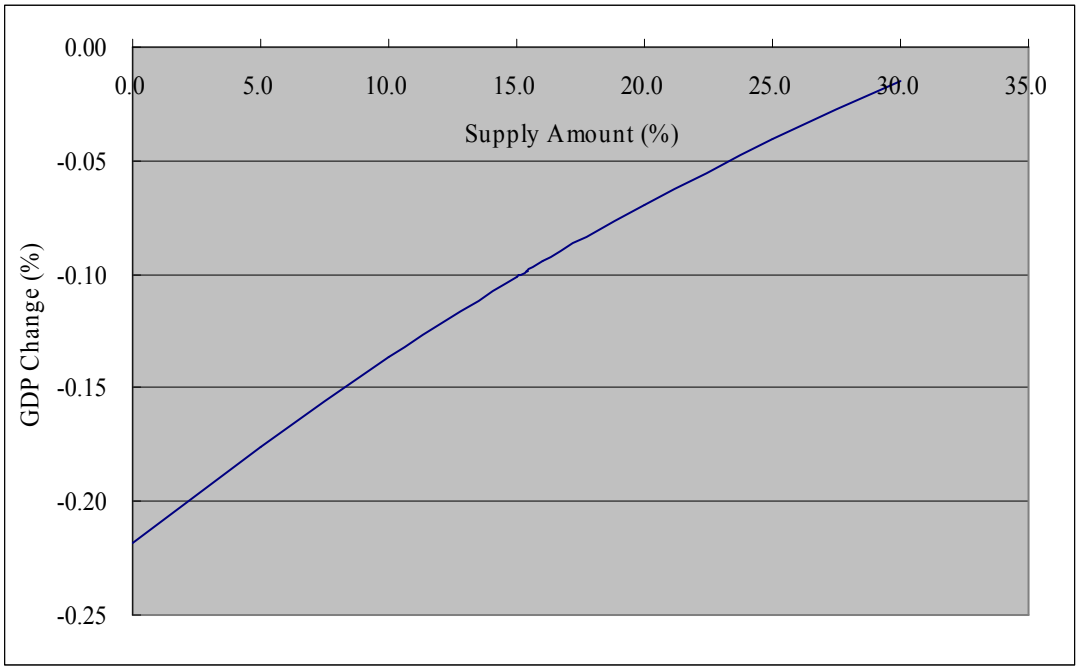

Fig. 2. A Relation between Supply Amount of Emissions Rights from EFS (%) and Change in World GDP (%)

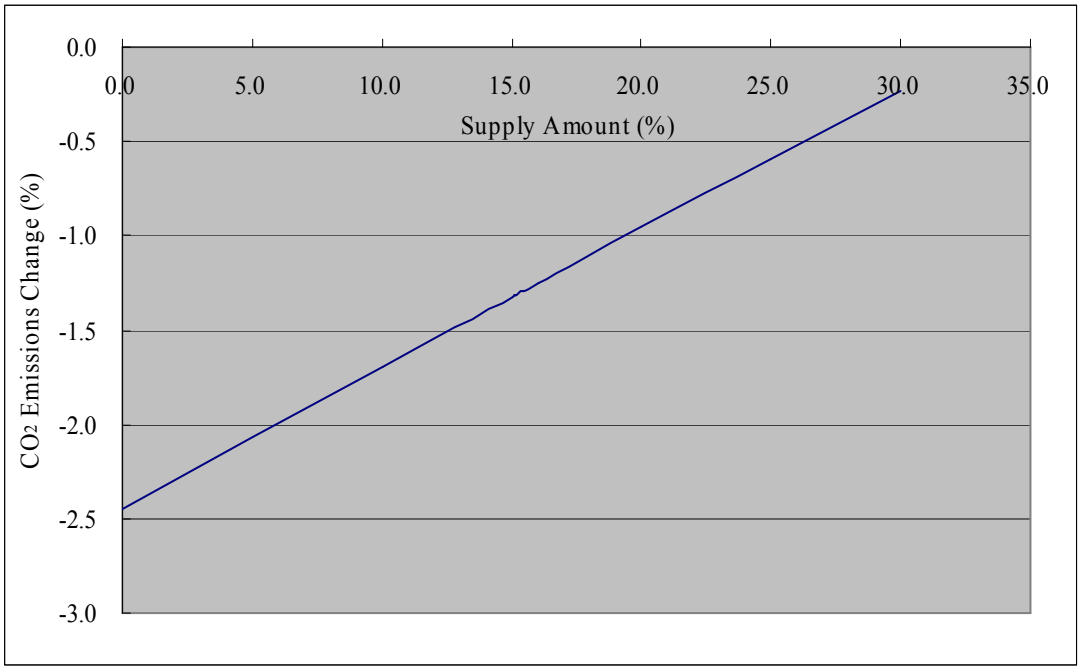

Fig. 3. A Relation between Supply Amount of Emissions Rights from EFS (%) and Change in World CO_2 Emissions (%)

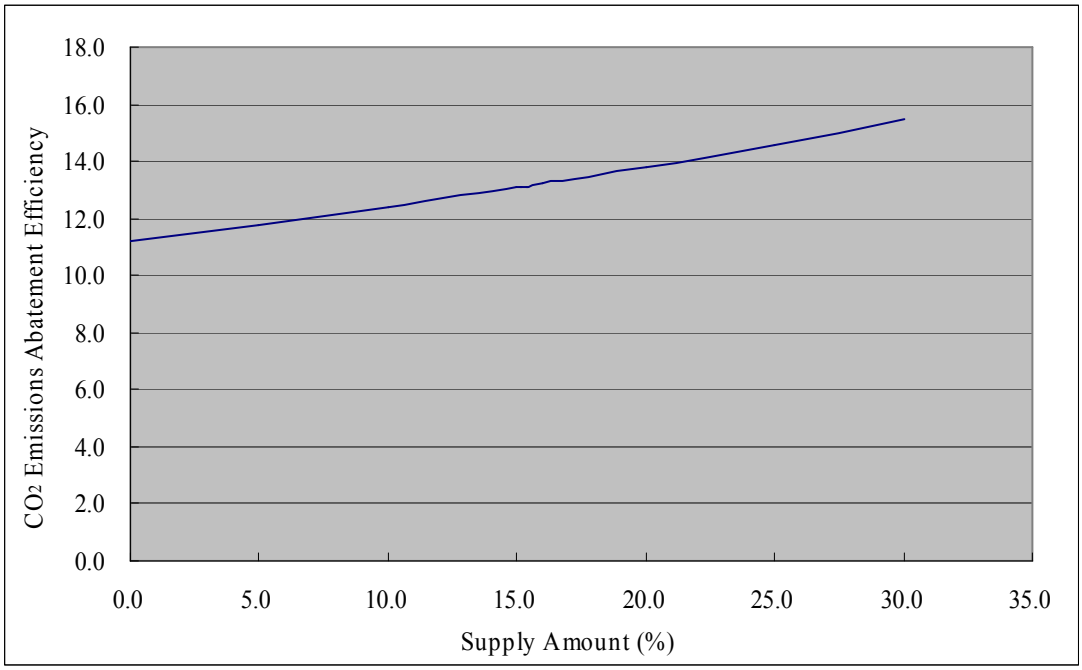

Fig. 4. A Relation between Supply Amount of Emissions Rights from EFS (%) and World CO_2 Emissions Abatement Efficiency

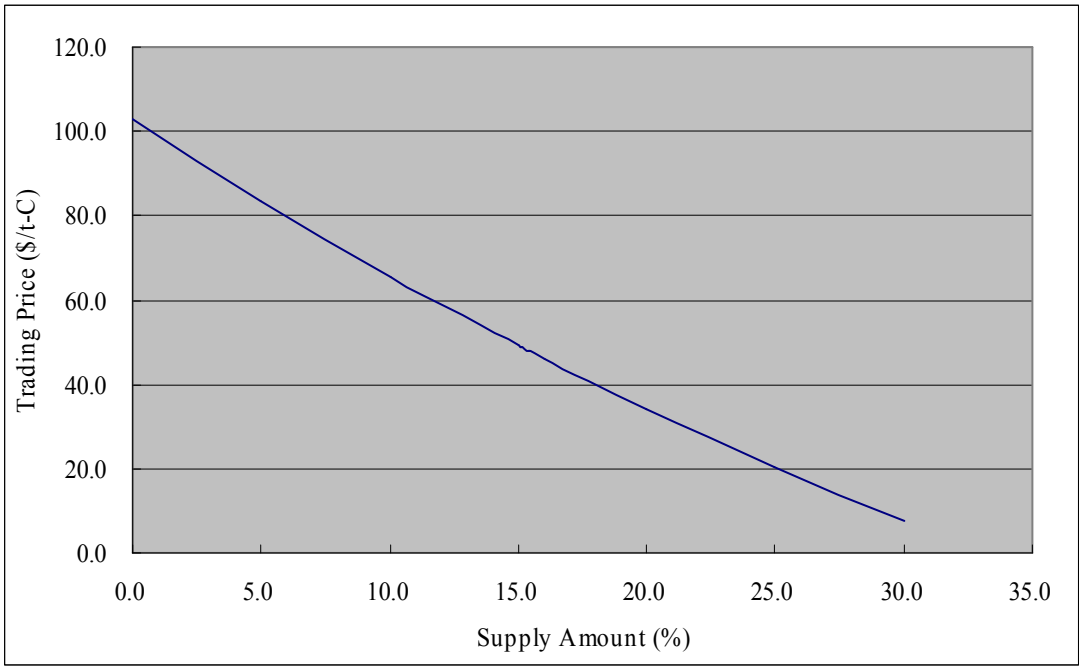

Fig. 5. A Relation between Supply Amount of Emissions Rights from EFS (%) and Trading Price ($/t-C)

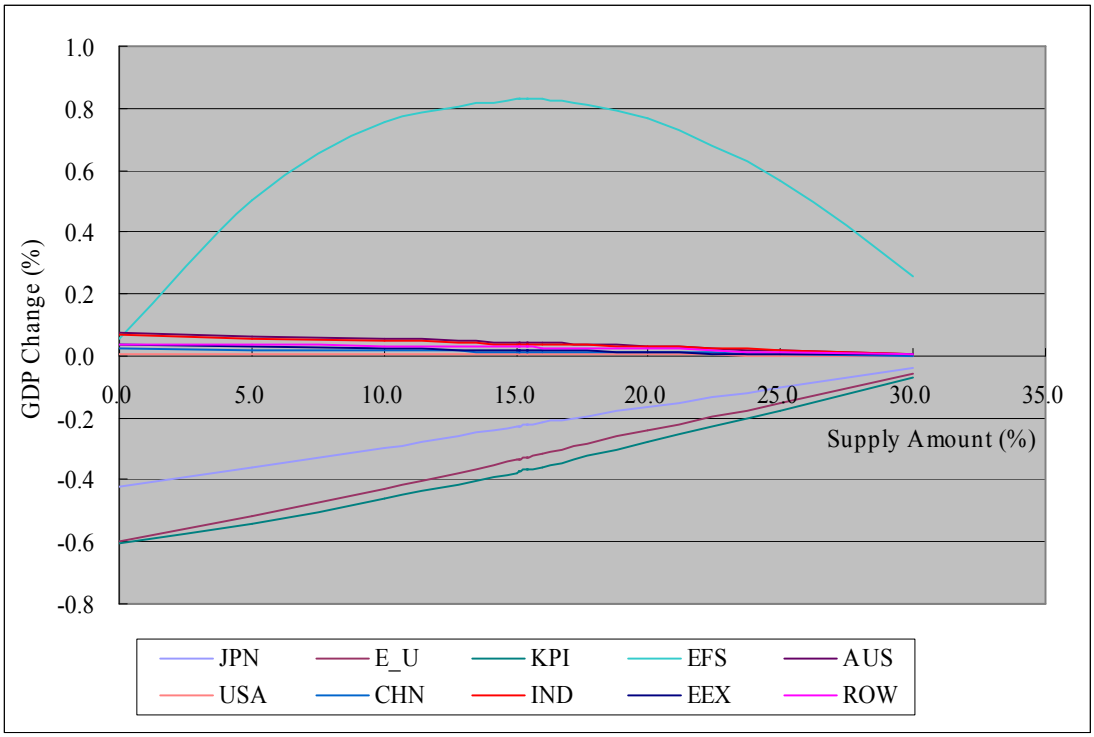

Fig. 6. Relations between Supply Amount of Emissions Rights from EFS (%) and Changes in National GDP

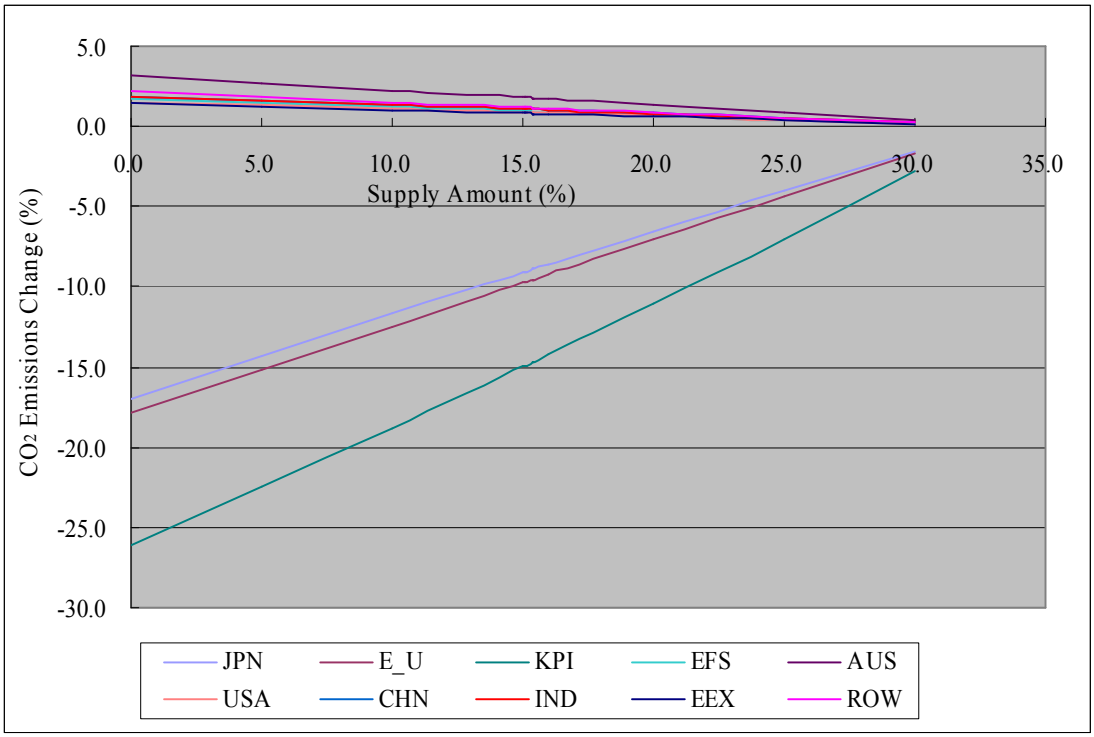

Fig. 7. Relations between Supply Amount of Emissions Rights from EFS (%) and Changes in National CO_2 Emissions