

The Effects of European Type Environment Tax and A Proposal of Tax Aiming to Achieve GHG's Reduction in Japan

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Abstract

Several European countries introduced environment tax from early 1990s up to now. In almost all of these countries, the tax revenue is used for the burden reduction of social welfare and pension cost or the establishment of tax neutrality. Thus, CO₂ reduction is mainly made by price effect of taxation. Based on the analyses on factors affecting CO₂ emission in above-mentioned European countries, we could not find full-scale CO₂ reduction effects by the introduction or strengthening of environment tax. Thus, from the viewpoint of CO₂ reduction, the good results are not always obtained in European countries.

The Ministry of Environment in Japan has also discussed eagerly about the introduction of environment tax since early 1990s. Now the first period of Kyoto Protocol has just finished, and Japan needs to cope with the 25% reduction of CO₂ toward 2020 as a next target. For this purpose, new additional measures would be required to be adopted, and the environment tax would be an important candidate option. In this paper, we would like to analyze actual effects of European type environment tax introduced and we also would like to make an appropriate environment tax aiming to achieve CO₂ reduction in Japan.

Based on the results of tax simulations, we conclude that the overseas measures type of environment tax would be reasonable and desirable as an additional measure as the next step of post Kyoto toward 2020 in Japan, because both sizes of carbon tax rate and tax revenue are considered to be quite suitable. It is concluded that the realization of overseas measures type environment tax is one of indispensable solutions for Japan's future.

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1) He was a student in the Master course of the graduate school of economics during from April, 2010 through March, 2013

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1. Introduction

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For this purpose, new additional measures would be required to be adopted, and the environment tax would be an important candidate option. In this paper, we would like to analyze actual effects of European type environment tax introduced and we also would like to make an appropriate environment tax aiming to achieve CO₂ reduction in Japan.

2. Method

2-1 Analyses on European type environment tax

First, we made an analysis on factors affecting CO₂ emission for 9 countries such as Finland, Sweden, Norway, Denmark, Netherland, United Kingdom, Germany, Italy and Switzerland which introduced the environment tax already in Europe, using IEA data [1].

C [CO₂ emission] is classified into the following four factors, U (energy- carbon ratio, C / E [energy consumption]), S (energy intensity, E / GDP [gross domestic product]), G (per capita GDP, GDP / P [population]), and P , as shown in Equation (1).

$$\begin{aligned}
 C &= U * S * G * P \\
 &= (CO_2 / E) * (E / GDP) * (GDP / P) * P
 \end{aligned}
 \tag{1}$$

From Equation (1), we can derive Equation (2);

$$(dC / C) = (dU / U) + (dS / S) + (dG / G) + (dP / P)
 \tag{2}$$

And finally we can get Equation (3);

$$dC = (C / U) * dU \quad (\text{the item on fuel switching})$$

$$\begin{aligned} &+ (C/S) * dS \quad (\text{the item on energy conservation}) \\ &+ (C/G) * dG \quad (\text{the item on economic growth}) \\ &+ (C/P) * dP \quad (\text{the item on population growth}) \end{aligned} \tag{3}$$

Using Equation (3), we can calculate cumulative summation of each item and can estimate corresponding contribution of four factors affecting energy- and industry-related CO₂ emissions.

2-2 Survey on proposals of domestic measures type environment tax in Japan

Second, we surveyed historical discussions of environment tax in Japan centering the proposals of environment tax made by the Ministry of Environment. The Ministry of Environment in Japan proposed the introduction of environment tax in the early 1990s before the adoption of Kyoto Protocol. In this study, we would like to summarize important points of historical discussions and concrete proposals of environment tax made by the Ministry in the long-run. It is the most distinctive that the tax revenue gathered by this environment tax would be planned to use domestic environment measures

Japan finally determined to adopt the global warming measures tax in 2012 by shifting from existing oil and coal tax. In this study, we would like to check specific characters on the representative example of environment tax proposed by the Ministry of Environment in the past and the global warming measures tax finally adopted.

2-3 Analyses on three types of environment tax to achieve 25% reduction target

Third, we compared the three different types of environment tax from the viewpoints such as the size of tax rate, the size of tax revenue and the size of CO₂ reduction.

We took up three different types of environment tax, that is, European type, domestic measures type and overseas measures type. The tax revenue of European type environment tax is all used to reduce social and welfare costs, and therefore the CO₂ reductions are made only by the price effect caused by the taxation. The tax revenue of domestic measures type environment tax is all used to cover total necessary costs of domestic reduction measures such as energy savings, introduction of renewable energies, switching to natural gas and so on. Thus, in this case, the CO₂ reductions are made by the price effect caused by taxation and by the revenue effect caused by covering the cost of domestic measures. The tax revenue of overseas measures type environment tax is all used to cover total costs for obtaining necessary CO₂ reduction credits. In this case, the CO₂ reductions are mainly made by the acquisition of CO₂ reduction credits.

The CO₂ reduction target taken up in this study is 25% reduction in 2020 from the base amount in 1990 which was internationally committed by Prime Minister Hatoyama (then). As the CO₂ emission amount

in 2011 was 1,307 million t-CO₂, the necessary reduction amount to achieve the 25% reduction target is estimated as 361.25 million t-CO₂ by subtracting 945.75 million t-CO₂ in 1990 from the CO₂ emission amount in 2011.

We analyzed the price effect of taxation using the following relations. The general energy demand function could be expressed as

$$E(P) = aY^\alpha P^\beta \quad (4),$$

using the income function Y and the energy price function P. In this equation, “a,” “α,” and “β” are the fixed coefficient, the income elasticity and the price elasticity, respectively. The price elasticity β used in this study was estimated by Amano [2].

Defining the increase of energy price by environment tax as “t,” the energy demand function after taxation is represented as

$$E(P + t) = aY^\alpha (P + t)^\beta \quad (5).$$

The reduction ratio of energy demand by taxation “R” is expressed as

$$R = 1 - E(P + t)/E(P) \quad (6).$$

Arranging equations (4)~(6), we can obtain the following equation:

$$R = 1 - E(P + t)/E(P) = 1 - (P + t)^\beta / P^\beta = 1 - (1 + t/P)^\beta \quad (7).$$

Therefore, the reduction ratio of energy demand by taxation “R” is finally obtained from equation (7) using the price elasticity β, if the increase of energy price “t” can be estimated by setting up the rate of environment tax.

3. Results

3-1 Analyses on European type environment tax

Could the effective results on CO₂ reduction be obtained by the introduction of environment tax in European countries concerned? In this section, we would like to summarize changes in factors affecting CO₂ emission in several concerned countries and to check the reduction effects by the environment tax.

(1) Sweden

Figure 1 shows changes in factors affecting CO₂ emissions in Sweden and movements of carbon tax. Because CO₂ emissions in Sweden increased for four years during 1990 and 1993 in spite of economic recession, we could not confirm that there were the reduction effects of CO₂ emission brought by the introduction of carbon tax. Factors on energy saving and fuel switching both functioned to the direction to increase CO₂ emissions and it is not easy to consider that the incentives to CO₂ reduction would be worked

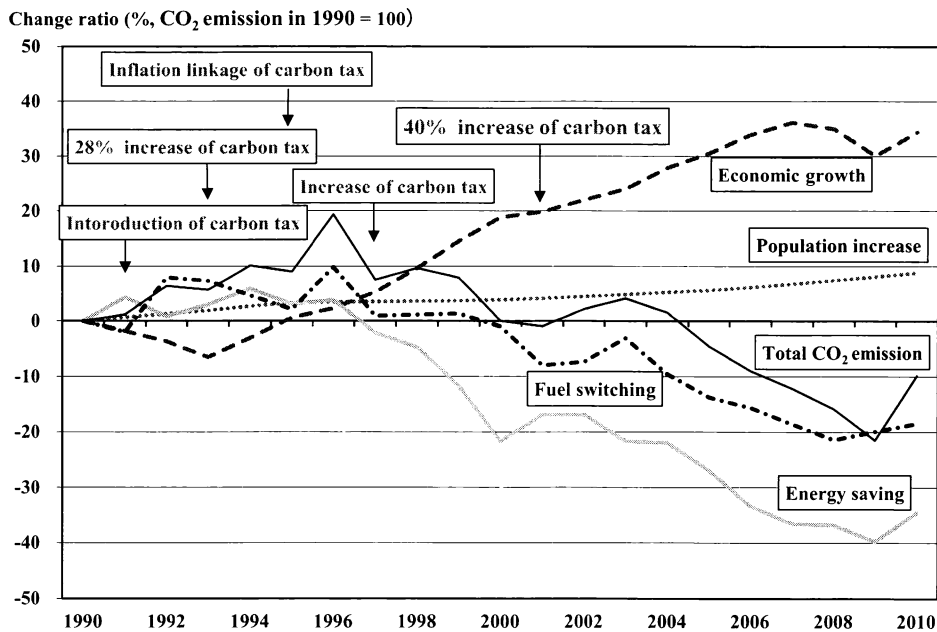


Fig. 1 Factors affecting CO₂ emissions in Sweden and movements of carbon tax

well. The increase of CO₂ emission continued up to 1996 after all.

On the other hand, CO₂ emissions in Sweden changed to a decline trend from 1996 as a turning point. Therefore, it is evaluated that the large increases of carbon tax made from 1997 through 2001 would play a certain role on reducing CO₂ emissions in this period. Especially speaking, it is considered that the carbon tax could play an effective role on CO₂ reduction which was largely affected by the energy saving factor from 1996 and by the fuel switching factor from 2000.

However, we could not confirm whether the carbon tax would fulfill its function continuously on the decline trend of CO₂ emission which kept on up to 2009 or not. Since any large increases of carbon tax were not made afterwards except the automatic rise of carbon tax by the inflation adjustment, it is naturally considered that the reduction effects of carbon tax did not work continuously in the long run.

(2) Norway

Figure 2 shows changes in factors affecting CO₂ emissions in Norway and movements of carbon tax. In the case of Norway, the decrease of CO₂ emission was observed only in 1991 when the carbon tax was introduced, compared with the previous year, but we can clearly recognize from actual changes that the large increasing trend of CO₂ emission had continued up to 1999 after then. In this sense, we cannot confirm that

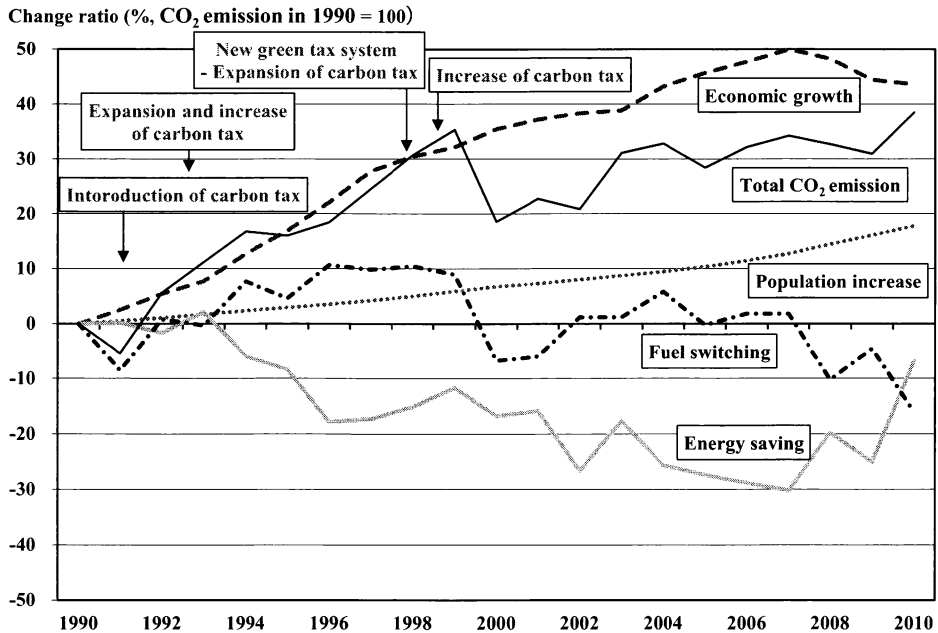


Fig. 2 Factors affecting CO₂ emissions in Norway and movements of carbon tax

the reduction effects of CO₂ emissions would be brought definitely by the carbon tax which was introduced in 1991 and expanded up to 1993. Since 1994, the decline trend of CO₂ emissions affected by the energy saving factor became obvious as shown in Fig.2, and this result suggests that the introduction and expansion of carbon tax might be possible to work as an incentive to reduce CO₂ emissions.

CO₂ emissions in Norway which increased largely up to 1999 showed a decline trend up to 2002 after then, and according to this result, we can consider that the expansion of carbon tax by the adoption of new green tax system in 1998 played a certain role on this reduction of CO₂ emissions. Especially, the carbon tax was considered to work as an incentive to both of the energy saving and fuel switching factors.

However, CO₂ emissions in Norway turned to a increasing trend again since 2003, and this fact means that the reduction effect of CO₂ emission by the carbon tax did not always last continuously in the long run.

(3) Denmark

Figure 3 shows changes in factors affecting CO₂ emissions in Denmark and movements of carbon tax. In the case of Denmark, though the fluctuations of CO₂ emission year by year were quite large, we can recognize that CO₂ emissions in Denmark changed with a large increasing trend for 7 years from 1990 through 1996. Therefore, the introduction of carbon tax in 1992 and the application of carbon tax to the industrial sector in

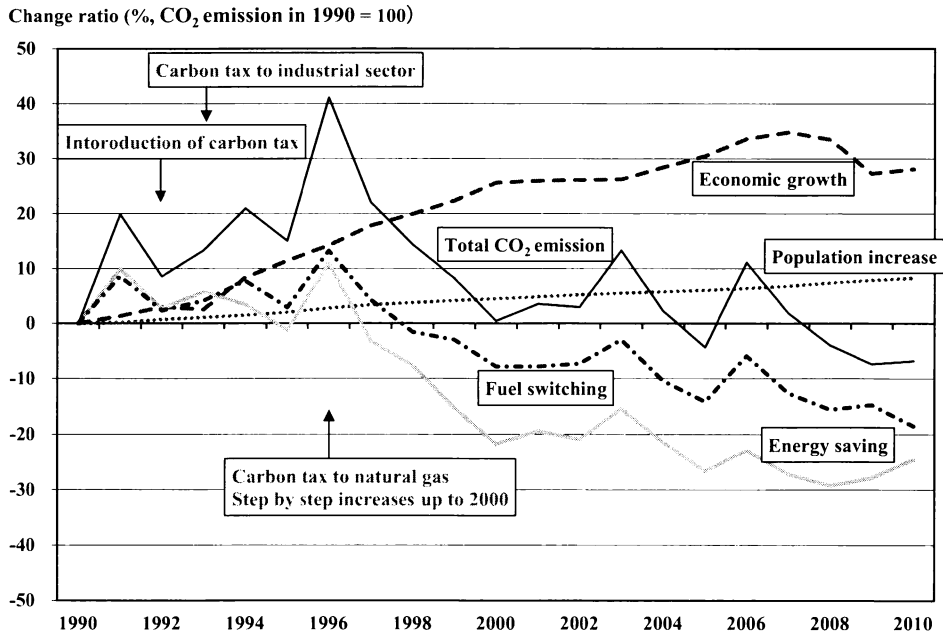


Fig. 3 Factors affecting CO₂ emission in Denmark and movements of carbon tax

1993 would be considered not to bring precise reduction effects of CO₂ emission. However, it is considered that the introduction of carbon tax might work as an incentive for the CO₂ reductions which were affected by the energy saving factor from 1993.

As shown in Fig. 3, CO₂ emissions in Denmark changed to a large decline trend in 1996 as a drastic turning point. Though this result might be caused by the expansion of carbon tax to natural gas, the increase of energy tax was rather considered to give large influences to this reduction mainly, while the rate of carbon tax left as it was. In addition, the step by step increases of carbon tax up to 2000 were also concluded to be affected to the reduction of CO₂ emissions largely. Though the increases of CO₂ emissions affected by the economic growth continued from 1996 through 2000, we can confirm that the energy saving and fuel switching factors both contribute to reduce CO₂ emissions in Denmark largely in the same period.

In the case of Denmark, though we cannot conclude simply because the fluctuations of CO₂ emissions were large after 2000, we can say at least that total CO₂ emissions have a mild decline trend by the contribution of energy saving and fuel switching factors affecting toward the reduction of CO₂ emission. However, the magnitude of reduction was smaller than that in previous five years.

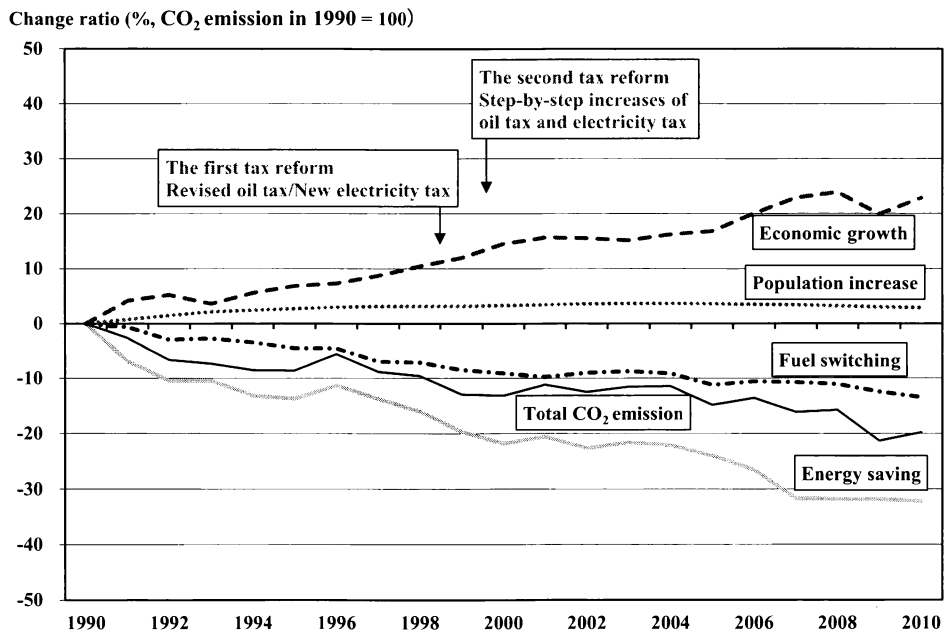


Fig. 4 Factors affecting CO₂ emission in Germany and movements of carbon tax

(4) Germany

Figure 4 shows changes in factors affecting CO₂ emissions in Germany and movements of carbon tax. In the case of Germany, because the energy saving and fuel switching factors worked to reduce CO₂ emission while the economic growth factor affected to increase CO₂ emissions in general, we can find that total CO₂ emission showed a decline trend with a balance of them in the first half ten years from 1990 to about 2000.

After such changes in the first half ten years, the conventional oil tax was revised and the new electricity tax was established under the first environment tax reform in 1999 and the step-by-step increases of oil tax and electricity tax up to 2003 was determined under the second environment tax reform in 2000. However, though total CO₂ emissions decreased compared with the previous year only in 1990 when the tax reform was started, they showed a slight increasing trend from 2000 through 2004. We can also point that CO₂ reductions brought by the energy saving and fuel switching factors were hardly observed in this period. In this sense, we cannot confirm whether the environment tax reforms in Germany played a certain role on the reduction of CO₂ emissions or not.

Up to 2008 after then, total CO₂ emissions in Germany clearly showed a decline trend mainly due to the energy saving factor. In 2009, the economic recession caused by Lehman shock largely contributed to the reduction of CO₂ emission.

Glancing over all changes in 20 years from 1990, we cannot easily conclude that the introduction of environment tax in Germany played a positive role on the reduction of total CO₂ emission definitely.

(5) United Kingdom

Figure 5 shows changes in factors affecting CO₂ emissions in the United Kingdom and movements of carbon tax. The total CO₂ emissions in the United Kingdom had a mild decline trend for four years from 1990 through 1993 mainly due to the influences of the economic recession together with the decreases affected by the fuel switching factor.

For 15 years up to 2007 after then, while the sound economic recovery worked strongly to increase CO₂ emissions, the energy saving factor contributed largely to decrease CO₂ emissions. As a result of balancing both factors, total CO₂ emissions in the United Kingdom was almost leveled off in this period, although the fluctuations were somewhat observed. The fuel switching factor contributed to decrease CO₂ emissions largely in the early 1990s, but after then it contributed to increase CO₂ emissions mildly.

As discussed above, the climate change levy was introduced in the United Kingdom in the middle of the balancing process between the increases by the economic growth factor and the decreases by the energy saving factor up to 2007. It is quite difficult to confirm that the introduction of climate change levy had a

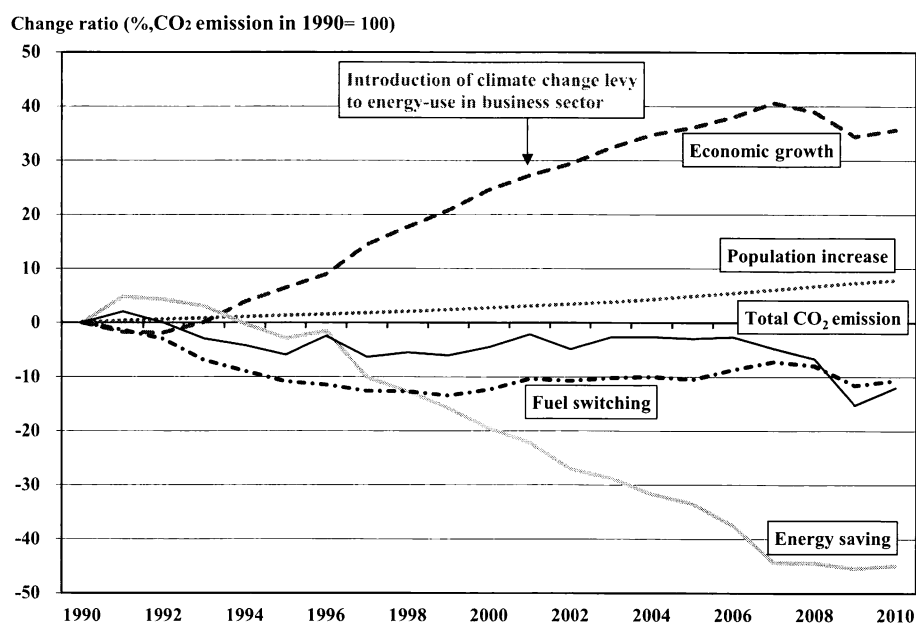


Fig. 5 Factors affecting CO₂ emission in United Kingdom and movements of carbon tax

crucial effect on the reduction of CO₂ emission, as far as we checked the total CO₂ emissions shown in Fig. 5. However, it is considered that the introduction of climate change levy could additionally contribute as an incentive for the CO₂ reduction effect by the energy saving factor which had worked largely before the levy was introduced. Unfortunately, we cannot specify this effect separately.

The total CO₂ emissions in the United Kingdom decreased largely due to the economic recession by Lehman shock started from the second half of 2008.

(6) Ending Summary

In the preceding subsections, we discussed the relations between changes in CO₂ emission and the introduction and expansion of carbon tax for five countries such as Sweden, Norway, Denmark, Germany and the United Kingdom. We also analyzed other four European countries, that is, Finland, Netherland, Italy and Switzerland and obtained the similar results as the former five countries.

Based on the above-mentioned results, we can find that the reduction of CO₂ emission was not actually positioned as the first priority purpose in the case of European type environment tax from the viewpoint of tax revenues used to general financial resources and so on. In addition, the double dividend brought by the reallocation of environment tax revenues was regarded as more important.

However, if European countries introducing the environment tax concentrated to apply tax revenues of environment tax to environment measures by pushing out them entirely, did they achieve far more CO₂ reductions than the actual results in past 20 years which was checked in the preceding subsections? It was afraid that the priority of CO₂ reduction would be positioned at relatively lower level and the procurement of financial resources by the environment tax and effective use of its revenue would have an importance with the first priority in those European countries.

In this section, we discussed the European type environment tax using actual examples of them introduced in several European countries. What kind of differences does the domestic measures type environment tax which has been recommended by the Japanese Ministry of Environment in the past long years, compared with the European type? In the following section, we would like to survey the proposals of environment tax by the Ministry of Environment and to discuss about the global warming measures tax which was finally adopt in 2012 by Japanese government.

3-2 Survey on proposals of domestic measures type environment tax in Japan

Table 1 summarizes historical major discussions and happenings on environment tax mainly made by the Ministry of Environment in the past 20years in Japan. In the first half 10 years from 1991 to 2000, the survey

Table 1 Historical movements on concrete proposal of environment tax in Japan

Year	Major discussions and happenings
1991	Research group on environment tax started a survey and research on environment tax.
1994	Research group published the first survey and research report on "What an environment tax should be."
1994	The Ministry of Environment started the research meeting on "Economical tools such as tax, levy etc. related to environment."
1997	The research meeting published the final report on "Options of environment tax considering global warming issues" and offered a concrete proposal on carbon tax possible to apply.
1998	The Ministry of Environment started the discussion meeting on "Effective uses of economical tools in environmental policy."
2000	The discussion group published the report on "Effective uses of economical tools in environmental policy."
2000	The Ministry of Environment started the discussion meeting on "What a tax for preventing global warming should be."
2001	The discussion group published the report on "Issues on what a tax for preventing global warming should be."
2001	The Ministry of Environment started discussions on environment tax in the special committee on tax system for global warming measures in the Central Council on Environment,
2003	The special committee published the concrete proposal on "Tax system for global warming measures."
2003	The Ministry of Environment started further discussions on global warming measures tax in the comprehensive planning committee in the Central Council on Environment
2004	The Ministry of Environment published the first report on "Concrete proposal on environment tax."
2005	The Ministry of Environment started the special committee on "Survey and research on economic analysis of environment tax" in the Central Council on Environment and published the survey and research report.
2005 ~2009	The Ministry of Environment published the revised report on "Concrete proposal on environment tax" every year.
2008	The Ministry of Environment started the special committee on "Green tax system and its economic analyses" in the Central Council on Environment
2010	The special committee published the intermediate report on "Summary of discussions up to now about economic analyses."
2011	The Ministry of Environment published the concrete proposal on global warming measures tax.
2012	The adoption of global warming measures tax was determined by the Japanese government by shifting from the oil and coal tax.

(Source) National Library, "The situations surrounding the environment tax," (2009) and the Ministry of Environment, "Movements of environment tax up to now," home page of the Ministry of Environment.

Table 2 Specific characters of representative proposed environment tax and global warming measures tax

Items	Representative proposed environment tax	Global warming measures tax
Tax rate	2,400 Yen/t-C (654.5 Yen/t-CO ₂)	Existing rate of oil and coal tax + carbon tax (95Yen /t-CO ₂ in 2012/289 Yen/t-CO ₂ in 2016) Step by step increase up to 2016
Increase of energy price	Gasoline: 1.5 Yen/l Electricity: 0.25 Yen/kWh	Gasoline: 0.76 Yen/l Electricity: 0.11 Yen/kWh
Tax revenue	490 billion Yen	39.1 billion Yen in 2012/262.3 billion Yen in 2016
Account for tax revenue	340 billion Yen Environment measures 150 billion Yen General account	Use to measures such as energy saving, renewable energies and so on
Reduction effect	Total: 4% Price: 0.5%, Revenue: 3.5%	Total: 0.5~2.2% Price: 0.2%, Revenue: 0.4~2.1%
Tax exception	To secure international competitiveness To mitigate drastic changes in industries To care low income level and small industries	To avoid heavy burden in special sectors To secure equality of taxation

(Source) The Ministry of Environment, "Concrete proposal on environment tax in 2004," homepage of the Ministry (2004) [3] and the Ministry of Environment, "Introduction of tax for global warming measures," homepage of Ministry (2010) [4].

and research or discussion working group mainly made special studies related to the environment tax.

In the period from 2001 to 2004, the special committees in the Central Council of Environment officially discussed what the tax system for preventing global warming should be and published several recommendation reports. And after then from 2004, the Ministry of Environment herself published the concrete proposal on environment tax every year, by adding necessary revisions. Finally, Japanese government determined to adopt the global warming measures tax by shifting from the existing oil and coal tax in 2012.

In order to discuss the specific characters of proposed environment tax, we summarized them about the environment tax proposed in 2004 as a representative example and the global warming measures tax finally adopted in 2012 in Table 2.

The most specific character of environment tax by the Ministry of Environment is that the tax revenue gathered by the environment tax would be mainly used for domestic environment measures. In addition, the tax rate is not so drastically high but the reduction effect to CO₂ emission is expected to some extent mainly because of the reduction brought by the revenue effect. Therefore, the Ministry of Environment has strongly recommended the introduction of carbon tax in the past 20 years. In this section, we could discuss about domestic measures type of environment tax fully, which is quite different from European type environment

tax discussed in the preceding section.

3-3 Analyses on three types of environment tax to achieve 25% reduction target

In this section, we would like to discuss three different types of environment tax (European type, domestic measures type and overseas measures type) to achieve Japan's 25% CO₂ reduction target in 2020. The analyzed results of three different types of environment tax are shown in Table 3 and Fig. 6.

Table 3 Comparison of Three Different Types of Environment Tax

		Carbon Tax (European type)	Carbon Tax (Domestic measures type)	Carbon Tax (Overseas measures type)	
				Credit Price (US\$ / t-CO ₂)	
				17 US\$: 1,445 Yen	30 US\$: 2,550 Yen
Carbon Tax Rate	(Yen / t-CO ₂)	38,259.6	11,392	554	958
Reduction by price	(1,000 t-CO ₂)	361,250	170,559	10,374	17,664
Reduction by revenue	(1,000 t-CO ₂)	0	190,691	350,876	343,586
Carbon Tax Revenue	(Billions Yen)	27,138.0	8,080.5	506.8	876.1

In the case of European type of environment tax, the necessary CO₂ reduction is achieved only by the price effects of taxation. The carbon tax rate is reached to the quite high level and the revenue of carbon tax is also reached to the quite huge size, as shown in Table 3 and Fig. 6.

In the case of domestic measures type of environment tax, the necessary CO₂ reduction is almost evenly shared to that caused by the price effect of taxation and to that caused by the revenue effect of covering the necessary cost of domestic reduction measures. The carbon tax rate is still high and the size of tax revenue is also still large, also as shown in Table 3 and Fig. 6.

Finally, in the case of overseas measures type of environment tax, the necessary CO₂ reduction is mainly achieved by the revenue effect of covering the necessary cost of CO₂ reduction credit acquisition under the quite low tax rate. The small part of CO₂ reduction is also caused by the price effect of taxation and the size of tax revenue also remained to the low level.

As discussed already, the analysis of environment tax done by this study does not estimate rigorous and accurate influences and effects brought by environment tax. However, this analysis could provide necessary data for judging the specific characters of three different environment taxes from the whole situation and concluding which type of environment tax should be selected for the purpose of realizing the target of 25% CO₂ reduction from the 1990 level.

European type environment tax corresponds to those introduced in many European countries for the

purpose of revenue procurement and is aiming also to realize a double dividend of environment tax. However, the CO₂ reduction is brought only by the price effect of this tax, and the tax revenue is not basically applied for the sake of realizing the CO₂ reduction target. Therefore, the rate of environment tax reaches to 38,259.6 Yen/t-CO₂, as shown in Table 3 and Fig.6, and the crude oil price goes up to the abnormal level of about three times higher as the result of this taxation.

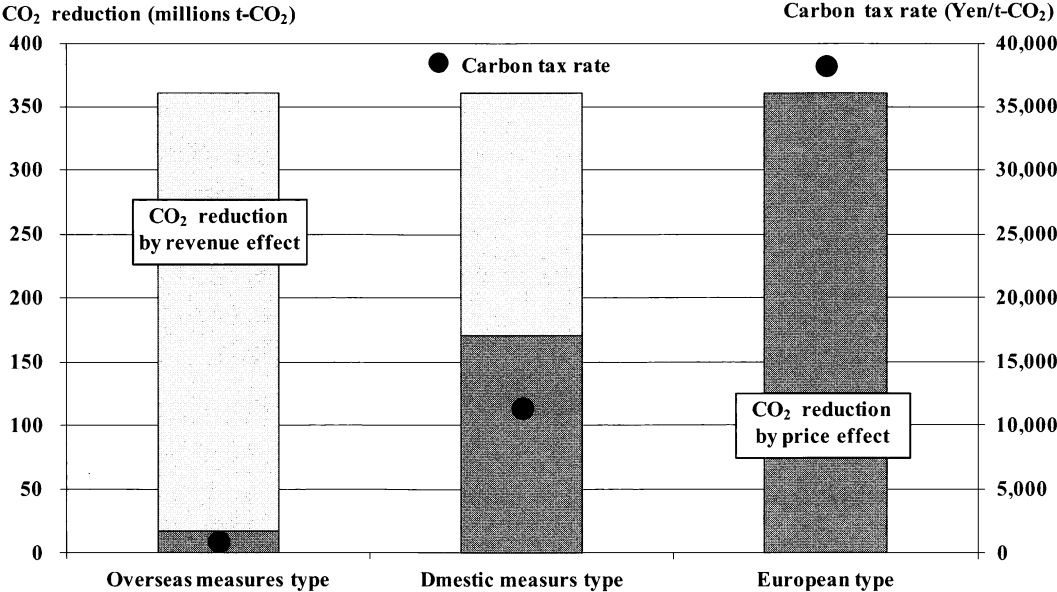


Fig. 6 Necessary tax rate to achieve the reduction target using 3 different types of environment tax

In addition, the size of tax revenue by this taxation would reach to 27.13 trillion Yen and this revenue size is as much as 60% of the revenue size of national taxes for national budget. Such a size of revenue is also abnormal. We cannot imagine at all what kinds of method we have in order to return such a huge revenue by reducing the burden of social and welfare costs practically.

If the main purpose of this taxation is to procure necessary revenue and to realize the double dividend of environment tax and the CO₂ reduction is the secondary purpose to the last end, it would have no problem to determine the appropriate tax rate for gathering the necessary tax revenue. However, if the achievement of CO₂ reduction target is positioned with the first priority, we must conclude that European type environment tax aiming to achieve the CO₂ reduction only by the price effect of taxation is not a suitable tool.

Domestic measures type environment tax corresponds to the tax advanced by the Ministry of Environment for domestic environment measures. This tax is aiming to achieve CO₂ reduction through both of the revenue effect brought by using the tax revenue for domestic environment measures and the price effect by taxation.

Considering that the 25% CO₂ reduction from the 1990 level in 2020 is required the emission reduction of 361.25 million t-CO₂ concretely, it is quite difficult to ensure reduction measures options over 190 million t-CO₂ because domestic environment measures are confronted with the extremely high barrier of reduction cost [5].

For this reason, the CO₂ reduction target is barely achieved by the combination of the revenue effect brought by the quite high rate of environment tax due to the barrier of extremely high reduction cost and the price effect induced by such a high tax rate. Concretely speaking, the rate of domestic measures type environment tax reaches to 11,392 Yen/t-CO₂, as shown in Table 3 and Fig. 6. Though this value of tax rate is merely one third of the obtained rate of European type environment tax, the burden is still heavy because the present crude oil price goes up to the one and half times high level.

The revenue gathered into the government by domestic measures type environment tax reaches to 8,080.5 billion Yen, and this revenue size is 2.78 times larger than that gathered by the gasoline tax for the preparation of road infrastructure at present. Considering the present situations that various criticisms are brought up even to the gasoline tax, it must be concluded that the domestic environment measures made by gathering such an extremely huge revenue to the government would not be agreed by the people after all.

Though the reasonable way could be probably found for the achievement of 6% CO₂ reduction target from the 1990 level committed at the first commitment period of Kyoto Protocol by combining the domestic environment measures with the taxation of environment tax suitably, it is also concluded in this study that it would be quite difficult to find the appropriate measures for the 25% CO₂ reduction from the 1990 level in 2020 by applying domestic measures type environment tax.

Overseas measures type environment tax is that making full use of Kyoto mechanism, and the tax revenue is used for the sake of purchasing CO₂ reduction credits based on Kyoto mechanism and so on. Of course, the CO₂ reduction due to the price effect induced by the taxation of environment tax is also included as a result.

The trading of reduction credits such as EUA, CEA and ERU in Kyoto mechanism is actually made in the EU emission trading market, and checking changes in credit prices for past 5 years, the credit price is estimated as 30US\$ (2,550 Yen) /t-CO₂ at the higher level and 17US\$ (1,445 Yen) /t-CO₂ at the average level [6].

The carbon tax rate required to cover total necessary costs for the purchase of reduction credits is 958 Yen/t-CO₂ at the higher level of reduction credit price and 554 Yen/t-CO₂ at the average level of reduction credit price. The rate of overseas measures type environment tax is largely lowered as compared with that of domestic measures type environment tax, of course, to say nothing of overseas measures type environment

tax.

As expected naturally, the revenue size of overseas measures type environment tax gathered to the government is 860.6 billion Yen at the higher level of reduction credit price and 501.6 billion Yen at the average level of reduction credit price. The revenue size is less than one tenth of the revenue size of domestic measures type environment tax. This revenue size is the same as the size of special account by the global warming measures tax which is shifted from the oil and coal tax and the size of special account by the power sources development promotion tax in the past, and it has enough strong powers of persuasion also from the viewpoint of past experiences.

4. Concluding remarks

Several European countries introduced environment tax in the past. In almost all of these countries, the tax revenue is used for the burden reduction of social welfare and pension cost or the establishment of tax neutrality. Thus, CO₂ reduction is mainly made by price effect of taxation.

Based on the analyses on factors affecting CO₂ emission in above-mentioned European countries, we could not find full-scale CO₂ reduction effects by the introduction or strengthening of environment tax. Thus, from the viewpoint of CO₂ reduction, the good results are not always obtained in European countries.

Based on the results of tax simulations, we conclude that the overseas measures type of environment tax would be reasonable and desirable as an additional measure for the 25% CO₂ reduction required in the next step toward 2020 in Japan, because both sizes of carbon tax rate and tax revenue are considered to be quite suitable.

Comprehensively considering points discussed in this study up to here, it is finally concluded that the adoption of overseas measures tax is the most appropriate among the three different taxes for the purpose of achieving the 25% CO₂ reduction target from the 1990 level in 2020 internationally committed. Since the credits of Kyoto mechanism and so on are used, actual measures of CO₂ reduction are not made in Japan but in overseas with lower reduction cost and larger reduction potential. However, it is considered that we should adopt the reduction measures having higher economics with first priority, because it has no problem to make reduction measures anywhere from the viewpoint of global environmental issues.

Now Japan has various problems such as the revision of energy policy, the revision of nuclear policy and the economic recovery and so on. Therefore, the environment measures, especially CO₂ reduction, are being of secondary importance. However, to break Japan's promise as for the 6% CO₂ reduction from the 1990 level of Kyoto Protocol and the 25 % CO₂ reduction from the 1990 level in 2020 announced by Prime Minister Hatoyama (then) seems to be directly connected with the lowering of Japan's international

confidence. Standing on more flexible viewpoints and concentrating her wisdom, Japan should pursue the solution by which Japan need not lose her international confidence. It is concluded that the realization of overseas measures type environment tax is one of indispensable solutions for Japan's future.

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