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THE JAPANESE CARBON TAX AND THE CHALLENGES TO LOW-CARBON POLICY COOPERATION IN EAST ASIA

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1. Introduction

After more than 20 years of political debate, Japan introduced East Asia's first carbon tax in October 2012. After five years of operation, we provide an early evaluation of the first experiences and possible impacts on East Asia carbon tax cooperation.

To this end, first, we evaluate the design of the Japanese carbon tax, explain the political background, and analyze experiences so far (Section 2 and 3). We apply a sustainability economics framework in order to evaluate the design as well as the economic, environmental and social impacts of the Japanese carbon tax. And we use Public Choice reasoning to explain, in particular, why tax rates were kept at a very low level, and revenues were earmarked to climate policy projects.

The second objective is to show how Japan's decision has affected climate policy instrument choice in other East Asian countries. Due to a close economic relationship between Japan, Korea, China, and Taiwan, international cooperation with respect to climate change mitigation as well as economic policies is imperative. Building on an E3ME-Asia Macro-econometric Model proposed by Lee et al. (2015) following Park et al. (2015), we analyze the economic impacts of the introduction of a carbon tax and compare unilateral and harmonized carbon taxation in four East Asian countries: Japan, Korea, China and Taiwan (Section 4). As the model shows that a harmonized carbon tax produces positive environmental and economic effects, we then analyze the requirements for joint carbon taxation in the East Asian region and draw a sketch of political challenges for energy systems and low-carbon policy for a sustainable future to be expected in Japan.

2. Japanese Climate Change Policy[1]

Japan has been pushing for the adoption of measures to combat climate change since 1997, just after the Kyoto Protocol agreement. The Law Concerning the Promotion of the Measures to Cope with Global Warming became effective in 1998. However, this law required businesses and householders to try to reduce greenhouse gas (GHG) emissions on a voluntary basis without any mandatory market-based instruments like carbon taxes or cap-and-trade. Emission reduction ef-

[1] This section depends largely on Lee, Hector and Ueta (2012) p.2.

forts from businesses depended on the Voluntary Action Plan led by Keidanren, the leading industry group in Japan[2]. Emission reductions from households, on the other hand, have been depending on government-led campaigns such as Cool and Warm Biz, which requests people to limit the use of room cooling and heating devices by dressing appropriately (e.g. no necktie or jacket in hot and humid summer).

In 2009, the Japanese Government submitted the Basic Act on Global Warming Countermeasures to parliament. The Act outlined a mid-term goal to reduce GHG emissions by 25% below the 1990 level in 2020 and a long-term goal of 80% below the 1990 level in 2050. Further goals include raising the share of renewable energy in total primary energy supply to 10% by 2020. Proposals for measures to achieve these targets also included carbon taxes and cap-and-trade. The Committee on Institutional Design for Emissions Trading was established in 2000 by the Ministry of the Environment. It investigated the introduction of a domestic cap-and-trade scheme as the main measure to achieve Japan's greenhouse gas reduction target under the Kyoto Protocol (CIDE 2000). The Ministry of the Environment even ran the Japan Voluntary Emissions Trading Scheme (JVETS) from 2005 to 2012 with ambivalent results (Rudolph 2012). A government committee report later proposed several design options for a mandatory scheme beginning in 2013 and aiming at emission reductions in line with Japan's former 25% reduction target for 2020. However, crucial design issues such as the overall cap size, the possibility of intensity target, and the initial allocation could not be solved. Despite requests to implement a mandatory national cap-and-trade scheme by environmental NGOs and academia, the ruling party at the time, The Democratic Party of Japan (DPJ), called off the implementation of a domestic cap-and-trade scheme on December 17, 2010, mainly due to opposition from Keidanren (Schneider/Rudolph 2013).

Instead of cap-and-trade, the DPJ went for a carbon tax, mainly in order to overcome Keidanren's opposition and at the same time to at least partly fulfill its commitment to GHG reductions. Because of the severe earthquake in March 2011, the implementation was postponed. However, after the 2011 earthquake, there was a determined political push towards the introduction of a carbon tax as a measure for mitigating global warming and saving energy. The tax was officially termed Global Warming Tax, because of its major aim of reducing GHG emissions. Eventually in 2012, the Japanese Fiscal Year (FY) 2012 Tax Reform Revision, which included the Global Warming Tax based on the DPJ's proposal, passed the House of Councilors on March 30. The tax took effect on October 1, 2012.

[2] Keidanren is the most influential general business association in Japan to which 1,281 leading companies and 127 industrial associations belong.

3. The Japanese Global Warming Tax

3.1 Design and Evaluation

The Japanese Global Warming Tax is imposed on the consumption of fossil fuels such as petroleum, natural gas and coal. More specifically, by using the CO_2 emissions factor of each fossil fuel, the tax rate per quantity unit was set in a way that the tax burden equals 289 Japanese Yen[3] per ton of CO_2 emissions. Hence, tax rates vary for each type of fuel and are added on top of the pre-existing Petroleum and Coal Tax, the tax base of which is all fossil fuels. The tax rates were to be raised gradually over three and a half years to be fully implemented by April 2016 (Table 1). Since 2016, the tax rate has been frozen and there is no plan for further increases. Exemptions and refunds are provided for certain fuels such as imported and domestic volatile oil for petrochemical production. In addition, the following measures apply: (1) Supportive measures for cost reduction in fuel production and distribution, stabilization of fuel supply, and energy-savings in logistics and transportation sectors, (2) Supportive measures for depopulated and cold areas.

Table 1: FY 2012 proposed carbon tax rates

Taxable Objects	Original Tax Rate	Carbon Tax		
		From Oct 1, 2012	From Apr 1, 2014	From Apr 1, 2016
Crude Oil and Oil Products (per kl)	2,040 yen	250 yen (2,290 yen)	500 yen (2,540 yen)	760 yen (2,800 yen)
Gaseous Hydrocarbon (per ton)	1,080 yen	260 yen (1,340 yen)	520 yen (1,600 yen)	780 yen (1,860 yen)
Coal (per ton)	700 yen	220 yen (920 yen)	440 yen (1,440 yen)	670 yen (1,370 yen)

Source: MoE (2010)

Revenues are placed in the special account for energy measures to be used for various measures of energy-related CO_2 emissions control, such as energy-saving measures, the promotion of renewable energy, and the clean and efficient use of fossil fuels. Thus, with regard to emission reductions, the budget effect adds to the pure price effect.

The Ministry of the Environment estimated that the price effect and the budget effect would lead to emission reductions of approximately 0.5% to 2.2% in 2020 compared to 1990 or about 6 million to 24 million tons of CO_2.[4] Recently, the Ministry has again estimated CO_2 emission reductions for 2020 and 2030 compared to 2013.[5] The results show that for 2020 the price and budget effect will be -0.2% and -4.2%, while for 2030 the effects will be -0.03% and -7.3%,

[3] 100 Japanese Yen = 0.89 US Dollars (Oct. 17, 2017)
[4] MOE, 'Details of Carbon Tax (Tax for Climate Change Mitigation)', accessed 15 August 2017 at https://www.env.go.jp/en/policy/tax/env-tax/20121001a_dct.pdf.
[5] MOE, 'The Analysis on Environmental Effects of Tax for Climate Change Mitigation' (in Japanese), accessed 15 August 2017 at http://www.env.go.jp/policy/tax/conf/conf01-13/mat02.pdf

respectively. Hence, the Japanese Global Warming Tax These contributes 17.5% in 2020 and 9.1% in 2030 to the CO_2 reduction target of Japan.

While so far there have only been a few independent empirical studies on the effects of the Japanese Global Warming Tax, Lee, Pollitt, and Ueta (2012) modelled the potential economic and environmental effects. They confirmed that the carbon tax will only have a small impact on emission levels but also no significant impact on the Gross Domestic Product (GDP) and employment. However, it is necessary to note that the economic impact of the tax varies across industries. Obviously, the cost effect on high emitting industries will be stronger than on others. Using input-output analysis, Sato (2016) estimated the impacts of the tax on the prices of goods and services by sectors. Not surprisingly, the estimate shows that the tax has some negative impacts on freight, steel, and chemicals-related sectors, while it has little such impacts on real estate, financial, rail transport, education and research sectors. In terms of the effects on households, so far no independent empirical studies are available. The Ministry of the Environment, however, estimates that the tax causes an additional burden to households of about 100 Yen per month for an average household.[6]

Evaluating the above described design based on sustainability criteria (Rudolph, Lenz, Lerch, and Volmert. 2012, Rudolph, Kawakatsu, and Lerch 2014), Japan's carbon tax can be called efficient, effective, and fair to a limited extent. First, and positively, the tax base is relatively broad. Instead of being a truly new tax, it adds a carbon content component to the pre-existing Petroleum and Coal Tax. Basically, Japan has three types of energy-related taxes generally referred to as "energy taxes[7]": (1) taxes that are levied on the import or extraction of fossil fuels, such as the Petroleum and Coal Tax, (2) taxes that are levied on the use of transportation fuels, such as the Gasoline Tax, the Diesel Oil Delivery Tax, and the Aviation Fuel Tax, and (3) the tax levied on electric power or the energy conversion sector, namely, the Electric Power Development Promotion Tax (EPDP). For an added carbon tax this means that there are two options: an addition to the Petroleum and Coal Tax levied "upstream" or an addition to the transportation fuels tax and the EPDP levied "downstream". However, as shown in Table 2, the former covers all fossil fuels, while the latter does not, so that an addition to the Petroleum and Coal Tax guarantees the broadest possible coverage.

[6] MOE, 'Details of Carbon Tax (Tax for Climate Change Mitigation)', accessed 15 August 2017 at https://www.env.go.jp/en/policy/tax/env-tax/20121001a_dct.pdf.

[7] Energy taxes are not directly intended to control various negative externalities resulting from energy uses, such as carbon dioxide emissions. While it is true that these taxes may have contributed to reducing the stress on the environment, Japan's energy taxes' revenues are special-purpose earmarked to usage for e.g. subsidies for the coal and petroleum industry, the construction and maintenance of roads, and the development of electric power facilities centering on fossil-fuel or nuclear power generation.

Table 2: Tax base of existing energy-related taxes in Japan

Point of Taxtaion	Tax Base/Items	Taxable object							
Upstream	Taxa base	Natural gas	Crude Petroleum and Petroleum Products					coal	electricity
	Tax items	Petroleum and Coal Tax							-
Downstream	Tax base	Natural gas	Gasoline	Diesel oil	Kerosene	Heavy oil	Aircraft fuel	coal	electricity
	Tax items	-	Gasoline Tax	Light Fuel Oil Tax	-	-	Aviation Fuel Tax	-	PDEP Tax

Source: Morotomi (2011) p.27, Table1

Second, in order to moderate detrimental economic and social effects, the tax rate starts low and increases gradually. This phase-in is intended to give people and businesses enough time to adjust their consumption patterns. However, even though the tax rate was fully implemented in 2016, it remains considerably lower than carbon prices emerging from most cap-and-trade schemes (US$ 3 / t CO_2 on average) or other carbon taxes (CAN$ 30 /t CO_2 in British Columbia) (World Bank and Ecofys 2016). Hence, the Japanese Global Warming appears to be too low for significantly shifting technology investments or behavior towards cleaner and more efficient energy choices.

Third, Japan's carbon tax is earmarked only to GHG emissions reduction measures. As environmental effects are intended to be achieved by a mix of tax levying and revenue-based subsidies, GHG emission reductions, although small, can be expected even by using a low tax rate. However, focusing revenue use on climate policy measures alone reduces the flexibility to respond to changes in socio-economic circumstances. Still, this flaw does not cause major problems as long as tax rates are low and revenues are small. In fact, revenues from the Japanese Global Warming Tax are estimated to be 39.1 billion yen for 2012 and around 260 billion yen, which accounts for only 0.3% of the general government expenditures, for each year after 2016. However, as soon as tax rates significantly increase, this problem has to be fixed. In addition, the current procedure of revenue spending excludes deliberations by the Japanese parliament and hence raises questions of the financial democracy.

Fourth, detrimental effects of the tax to low-income households are minimized. As described above, the effects of the tax on average households is relatively small due to the low tax rate; and this estimate does not even consider the variety of special measures to reduce the cost burden on low-income households. In addition, low-income households, especially in sparsely populated and cold areas, are protected by supportive measures.

Finally, the administration of the tax is simple. The carbon tax is essentially applied and collected in the same way as the Petroleum and Coal Tax. Moreover, in the case of upstream taxation administrative costs are usually low, because the number of businesses engaging in the extraction, import, and processing of energy resources is small.

3.2 Theory and Practice of Carbon Tax Design

The special design of the Japanese Global Warming Tax can be traced back to the specific societal circumstances and expectations on the effects of the tax. In academia, in the late 1990s the "dualism of environmental taxes" was intensively discussed, which also influenced the political debate on in Japan. In general, taxes are supposed to not affect peoples' choices, but to raise revenue for the government in order to e.g. provide public goods. However, in the case of environmental taxes, major aims are the maximization of economic welfare by internalizing externalities in the Pigouvian case and minimizing the costs of reaching an environmental target in the Baumol/Oates Standard-Price-Approach. Hence, unlike ordinary taxes, revenue-raising is not the primary purpose; rather the purpose is to force people to adjust their behavior to the real cost of using environmental resources. In fact, Pigou himself did not show much interest in revenue spending. Still, in many practical cases, environmental taxes were implemented not only for environmental policy objectives but also for revenue-raising. In addition, people can easily agree on the theory that those who cause environmental problems should pay the extra costs occurring to society (polluter pays principle). Hence, environmental taxes are characterized by a dualistic nature: (1) taxes as a policy instrument for environmental conservation and (2) earmarked taxes for revenue-raising, which burden the causers (beneficiaries) of environmental damages and use the revenues for environmental measures paying respective costs (benefits) (Ueta 1997).

The empirical fact that environmental taxes are dualistic in nature causes calls for a parallel discussion of levying the tax and of using tax revenue. In other words, in environmental tax design, the two major features are the institutional design of how the taxes are levied and that of how to use tax revenues (Ueta 2007). If special emphasis is placed on the price effect, the tax rate will be high; if this is not the case, the tax rate can be low, but then, in order to have environmental effects at all, revenues must be spent for environmental protection measures. Hence policy mixes have to be seriously considered including environmental taxes but also other supportive instruments. Also, the way environmental taxes are imposed largely depends on the economic, social, and political circumstances, and we can also expect to see a wide variety of designs originating from this diversity of circumstances (Kawakatsu and Ueta 2004).

Against these theoretical arguments, consideration of the Global Warming Tax in Japan started in the early 1990s, led by the Ministry of the Environment (MOE). MOE formed a study group, which still exists today and which has considered possible tax system reform. In 1998, the study group already suggested that a possible Japanese carbon tax should have a low tax rate, but that also that the revenues should be solely used for GHG reduction (Environmental Agency 1997).

For economic reasons, the Ministry of Economy, Trade and Industry (METI), in the beginning, expressed opposition to such a carbon tax, but changed its attitude later. In October 2003, MOE and METI agreed on imposing a tax on coal in order to reform fossil fuel taxation and to strengthen the Petroleum Tax. The new tax was then called the Petroleum and Coal Tax. At the same time, the tax rate on electricity (EPDP) was reduced, so that total revenues would not change (MOE 2003). By this tax reform METI intended to enhance the competitiveness of nuclear power and at the same time secure financial resources for acquiring Kyoto Protocol emission credits. For MOE, the major advantage was that they were now able to use tax revenues for reducing GHGs from energy-related CO_2.[8] Both ministries agreed on not calling this reform a carbon tax, although in fact it increased the tax burden on fossil fuels.

The real discussion around a carbon tax for Japan only began in 2004. For FY2005, MOE submitted a tax reform request to the Government Tax Commission, which contained a concrete proposal for an explicit carbon tax. The draft called for a tax rate of 2,400 Yen per ton of carbon. The tax on kerosene and Liquefied Petroleum Gas (LPG) would have been an upstream tax levied on manufacturers and other parties. The tax on coal, fuel oil and other energy was supposed to be self-assessed by large consumers. The tax on electricity and gas would have been a downstream tax, collected by power and gas utility companies from general consumers as a special tax. Hence, this proposal would have created as hybrid tax system. The revenue was estimated to be 490 billion yen annually, 340 billion yen of which were planned to be appropriated to the general budget for defrayal of global warming control measure expenses, while 150 billion yen should have been used for the reduction of social security premiums. The latter element was expected to create a "double dividend"[9], an early idea particularly noteworthy, because in later tax proposal this element was dropped.

The FY2006 tax reform request by MOE did not include a double dividend element. More specifically, all revenues from the proposed carbon tax were supposed to be allocated to the general budget, but then earmarked to global warming control measures. A major reason for that was the public perception that carbon taxes should be earmarked for climate protection measures. According to a Cabinet Office (2007) survey, most people wished revenues from a carbon tax to be spent for GHG reduction measures only. People feared that, if tax revenues were not earmarked, decisions about the revenue used would be made by the government without heeding the voices of taxpayers. On the other hand, however, non-earmarked revenues in the general budget would

[8] Both taxes were earmarked. METI and MOE split the increased revenue of the Petroleum and Coal Tax for activities, projects and R&D for energy savings, renewable energies, Kyoto credits, and so on.

[9] If the revenues are used to reduce other existing distortional taxes, economic efficiency, shown by indicators such as GDP or employment, may be improved further. This is called the 'double dividend of an environmental tax reform', meaning that there are positive effects on both the environment and the economy (Goulder 1995).

allow for the fiscal system to respond flexibly to changes in socio-economic circumstances. The proposed detour of earmarked revenues through the general budget was a way of giving all government ministries a say in the spending decisions on global warming control measures, instead of leaving this to MOE alone, as would have been the case of a special revenue fund administered solely by MOE. While certainly a political prerequisite for a compromise on the carbon tax, this by-pass would have also introduced some flexibility to the revenue spending.

After 2004, MOE, sometimes together with the Ministry of Agriculture, Forestry and Fisheries (MAFF), requested the introduction of a carbon tax with relatively low tax rates, expecting to use the revenues for GHG reduction efforts including forestry carbon sinks. At the political party level, the environmental and agricultural wings of the Liberal Democratic Party (LDP) presented a carbon tax proposal in 2004 which very much resembled the MOE proposal. MOE tried to gain support from influential politicians in the agricultural wing of LDP's Research Commission on the Tax System by offering to provide tax revenue for forestry (Onoda and Schlegelmilch 2015). However, all annual MOE proposals were rejected by METI and industry-friendly LDP politicians because of suspected negative impacts on the economy and an increase of the Petroleum and Coal Tax. These arguments mainly reflected Keidanren's position on a national carbon tax.

On 28th of September 2010, under the umbrella of the Project Team on Tax Reform of the now ruling DPJ, the Subcommittee for Global Warming Tax Consideration was launched. This subcommittee took the role of coordinating between party divisions and related ministries. MOE, at that time, was discussing a carbon tax in the ministry's Committee for a Mid- to Long-term Climate and Energy Road Map and now put more emphasis on the price effect than the revenue effect. On the other hand, the interim report by the Policy Measures Working Group of METI emphasized limits to the price effect on emissions both through a cap-and-trade scheme and through a high-rate carbon tax. Their main argument for that were marginal abatement costs of GHGs being much higher than in other countries such as the USA or EU Member States. METI's working group thus concluded that revenue from a rather low-rate carbon tax should be used for a combination of support measures for technology development and dissemination (METI 2010). Also the DPJ's subcommittee expected the price effect of a carbon tax to be minimal.

In October 2010, the DPJ subcommittee showed that CO_2 emissions could be reduced by 9 to 14 million tons, if the carbon tax revenues of approximately 250 billion yen were used for climate protection measures only. This amount of tax revenue was the minimum needed by DPJ to

achieve their mid- to long-term GHG reduction targets. Hence, in December 2010, in the Government Tax Commission, DPJ finally demanded the tax revenue to be 240 billion yen, which actually meant a significant reduction of the tax rate compared to earlier MOE proposals.[10]

As a result of the multitude of political and economic interest adjustments, Japan not only failed to set a high tax rate, but also failed to achieve a double dividend e.g. by earmarking revenues to social security contribution reductions. However, the significance of using tax revenues for subsidies for energy-related CO_2 emissions control and thus creating a tax-subsidy policy-mix should not be underestimated.

4. Climate policy instrument choice in East Asia

4.1 Status Quo of Low-carbon Policies in East Asia

Despite of the flaws in the Global Warming Tax, it signifies an important step forward in national level climate policy in Japan. However, as climate change is a global issue, a regionally or even globally harmonized carbon tax with the same tax rate would be preferable. This approach is regarded as the most efficient way of reducing the carbon emissions externality, because marginal abatement cost of CO_2 will be the equalized across all countries and industries (Nordhaus 2005). Furthermore, there is hope that a harmonized carbon tax might solve the climate negotiation stalemate as it avoids problems of carbon leakage and industrial competitiveness.

In East Asia, the state and extent of climate-energy-policy reforms for a low-carbon future, however, differs greatly (Lee, et.al. ed., 2015). Still, institutional infrastructure-building, which is instrumental in developing a low-carbon society in East Asia, has been moving forward in recent years. For example, in Japan, in addition to a carbon tax, feed-in-tariffs for renewable energy went into effect in July 2012.[11] Still, despite of the Japanese carbon tax being appreciated for being the first of its kind in East Asia, it does not compare favorably with environmental tax reforms e.g. in Northern Europe.[12] Furthermore, a cap-and-trade scheme has still not taken off in Japan. This delay is mainly due to strong resistance from the Japanese steel and power industry. On the other hand, at least the Japanese low-rate carbon tax is broadly based, does not deepen social injustices, and the tax revenue even act as a money source for low-carbon investments.

[10] For example, in FY 2010 proposal, the tax rate applied to coal was 2,740 yen per ton, which was 670 yen per ton in FY 2011 and 2012 proposals.
[11] Share of renewables excluding large hydro power in total electricity generation increased from 1.4% in 2011 to 4.5% in 2015. It is said that this considerable increase is mainly supported by the feed-in-tariffs.
[12] Here environmental tax reform refers to efforts to introduce a fixed environmental tax (carbon tax or energy tax) and using this tax revenue towards reducing consumption tax, income tax, or corporate employment-related tax, while as a result of which concurrently improving the environment (reducing carbon dioxide, etc.) and activating the economy (increase GDP and employment).

In South Korea, as well, there was strong opposition of to a cap-and-trade scheme from energy intensive industries. However, their influence on the government is not as strong as in Japan. In particular, the South Korean power sector is under strict control of the government, because it holds half of the ownership interests in the companies. In addition, the GHG and Energy Target Management System that manages the annual amount of GHG emissions and the energy consumption of bigger companies had already been implemented before the start of the South Korean carbon market.

As a consequence, in South Korea, the first emissions trading scheme was introduced in Asia at the national level; related laws were enacted in 2012 and went into effect in 2015. The government-led low-carbon green-growth policy of 2009 pushed by South Korea under the previous government of Lee Myung-Bak was a driving force for South Korea's low-carbon economy development (Lee, 2011). However, the effective period of the cap-and-trade scheme was delayed (initially from 2013 to 2015) and the allocation of allowances was expanded in a way that broadly incorporated the views of industry. Still, the South Korean carbon market went into effect in 2015, though in a more industry-friendly form than the initial plan (Lee, 2013a). An energy tax system reform, including the introduction of a carbon tax, however, has been put off without much discussion at the national level.

In Taiwan, as well, the introduction of a carbon tax has been debated by multiple administrations, but has also been met by strong industry resistance and hence has failed. And the same goes for a domestic Taiwan carbon market. This again speaks to the fact that low-carbon policies including carbon taxes have not yet overcome the barrier of real concerns about possible negative effects on international competitiveness.

Climate policy in China took center stage with the finalization of the 12th Five-year Plan in March 2011. The plan is significant in its commitment to energy efficiency and emissions reduction, and is the first one to address climate change as a key issue. With regard to energy and climate change, the plan has four targets that are all designated as binding. These binding targets are to decrease the energy intensity (energy consumption per unit of GDP) and the CO_2 intensity (carbon emission per unit of GDP) by 16% and 17%, respectively, and to increase the share of non-fossil fuel energy in primary energy consumption to 11.4% from the current level of 8.3% over the period 2010 to 2015. China has also been testing local and regional cap-and-trade schemes with mixed success, while the introduction of a national scheme has been postponed several times in the recent past.

In general, the main motivation of East Asian countries to establish a low-carbon energy system by respective policies is to develop next-generation national strategic industries and guarantee

energy security. GHG reductions and environmental improvement tend to be acknowledged as positive side-effects that are obtained more or less incidentally (Lee ed., 2010). Still, as there will be profound changes to the ways in which energy is consumed in East Asia over the next decade, due to lock-in effects, the decisions made in the coming years could result in long-lasting consequences (Lee et al., 2015). Hence, it is of utmost importance for East Asian countries to create an institutional system that properly assesses the social costs and benefits of different power sources in addition to conventional economic gains.

4.2 Carbon Tax Harmonization in Four East Asian Countries

Despite of the political opposition originating mainly from energy-intensive industries in the respective countries, carbon taxes are increasingly gaining attention in East Asia. The major reason is that, technically, it is relatively easy to implement them and administrative costs can be kept low, even in developing countries. Developing countries in particular seek for ways to increase tax revenues in order to be able to provide better public services as their economic development progresses. And, if a carbon tax with an identical tax rate is introduced jointly with other East Asian countries, the environmental effectiveness and the economic efficiency are increased and leakage threats are minimized.

In an earlier paper, Seung-Joon Park et al. (2015) used the E3ME-Asia Macro-econometric Model[13] to quantitatively analyze the environmental and economic effects of environmental tax reforms (ETR) in four East Asian economies: Japan, Korea, China and Taiwan. In the scenarios, the four Asian countries introduce a domestic carbon tax in order to achieve their own respective GHG reduction target pledged in the Copenhagen Accord.[14] Two sets of scenarios are assessed: one set in which each country acts independently, and one set in which there is coordination across the four economies. The taxes are applied to all fossil fuels energy products used in all economic sectors. The tax revenue accrues to the domestic government that introduced the carbon tax, without any international fiscal flows. In order to compare between unilateral and harmonized taxes, there are three carbon tax levels: a zero-carbon tax rate (baseline), an endogenously set carbon tax rate for each country to achieve the national reduction target in 2020 (-N-scenarios), and a harmonized carbon tax rate (-H-scenarios). After 2020, the carbon tax rate is

[13] The original E3ME model was designed by Cambridge Econometrics to assess energy and climate policy in Europe and was later merged with the global E3ME model, which had data for major economies outside Europe. It has now been developed further into the E3ME-Asia model, employing detailed data from East Asian economies. E3ME-Asia is a macro-econometric simulation model based on post-Keynesian economic theory, which allows for imperfect price adjustment, market disequilibrium, and limited rationality of economic actors. Owing to the detailed database about taxes on income, labor, energy, and so on. E3ME-Asia is very suitable for analyzing ETR.

[14] The E3ME-Asia model is global in nature, but the analysis is carried out at the national level. This reflects the policy situation after the Paris agreement with a global framework but national policy responsibilities.

set to increase annually by +1.7% in all scenarios, reflecting the baseline inflation rates from 2020 to 2030 in the E3ME-Asia-Model.

Each government recycles the revenues from the carbon tax by reducing (a) the consumption or value added tax (-C scenario), (b) the income tax (-I scenario), (c) employers' social security contributions (-L scenario); or, (d), there is no revenue recycling at all but an improvement of the national general budget balance (-N- scenario). The recycling will be done on a revenue neutrality basis as long as the revenue of the tax to be reduced is positive.[15]

The model results are summarized in Table 3. If all of the four countries achieve their national CO_2 reduction targets without tax harmonization, the carbon tax rate in 2020 for China, Japan, Korea and Taiwan is 52.44, 153.70, 213.37 and 495.44 ($/t$CO_2$), respectively. These tax rates are endogenously calculated for the ANN scenario and are applied to all other single-country -N- scenarios. It should be noted that, with different revenue-recycling methods, the reductions in CO_2 emissions may differ slightly between the scenarios due to economic effects. According to model results, the economic effects of carbon taxes are modestly negative in 2020 and 2030 in all four economies. The rates of employment also fall slightly in all cases, with the exception of China in 2030, where the demand for investment in renewables create enough jobs to offset other negative economic effects.

Table 3: The ANN scenario: four countries introduce carbon tax to achieve the national target without revenue recycling

ANN scenario	2020				2030			
from baseline (%)	China	Japan	Korea	Taiwan	China	Japan	Korea	Taiwan
Real GDP	-0.9	-1.23	-0.94	-2.13	-0.44	-1.11	-0.41	-2.41
CO_2	-5.35	-11.2	-30.21	-42.34	-9.7	-13.28	-42.44	-51.83
Employment	-0.14	-0.49	-0.39	-2.81	0.01	-0.89	-0.33	-1.61
Consumption	-1.35	-2.46	-3.3	-7.04	-0.79	-2.61	-2.03	-5.25
Investment	-0.95	-0.8	-1.3	-2.08	-0.17	-0.31	-0.66	-3.99
Export	-0.17	0.01	-0.11	0.74	-0.4	-0.4	-0.64	-0.17
Import	0.12	-2.14	-1.93	-2.74	-0.29	-2.49	-2.21	-2.19
Import: Oil & Gas etc.	0.04	0	0	-4.54	0.04	-0.17	0	-3.38
Consumption Price	2.86	3.69	3.91	9.26	1.26	2.41	2.16	5.5
Nominal wage and salaries	1.78	1.45	1.03	2.13	0.76	0.5	0.44	3.52
Carbon Tax Rate ($/t$CO_2$)	52.44	153.7	213.37	495.44	62.07	181.92	252.54	586.41

Source: Park et al (2015), p.128, Table8.2

The harmonized carbon tax rate of 82.09$/t$CO_2$ shown in Table 4 was calculated so that the sum of CO_2 reductions in the four countries is the same as the sum of reductions in the ANN scenario. This tax rate is used in the AHN scenario and, in this scenario, the reduction requirements and economic burdens are substantially eased for Japan, Korea and Taiwan because of China's intensified effort to reduce CO_2 emissions. Although China's reduction of CO_2 emissions only

[15] However, especially in transition countries such as China or Taiwan there are neither comparable income tax nor social security contributions, so the potential for revenue recycling by reducing those is limited. When these tax rates reach zero, the remaining carbon tax revenue is not recycled in the model.

increased by 1.94% (from 5.35% to 7.29%), in absolute terms this change is huge. For China, the direct economic cost of the carbon tax in 2020 is slightly higher in the AHN scenario than in the ANN scenario. In 2030, however, China's economy shows better performance in the AHN scenario than in the ANN scenario, mainly because of increased investment and technological improvements due to the energy shift.

Table 4: The AHN scenario: four countries introduce harmonized carbon tax without revenue recycling

AHN scenario	2020				2030			
from baseline (%)	China	Japan	Korea	Taiwan	China	Japan	Korea	Taiwan
Real GDP	-1.29	-0.59	-0.35	0.13	-0.16	-0.62	-0.12	-0.49
CO_2	-7.29	-6.44	-18.7	-21.07	-15.62	-7.24	-29.41	-38.91
Employment	-0.23	-0.25	-0.15	-0.31	0.06	-0.48	-0.19	-0.48
Consumption	-2.13	-1.29	-1.58	-1.28	-0.96	-1.36	-1	-1.55
Investment	-1.25	-0.42	-0.85	0.08	0.91	-0.24	-0.08	1.04
Export	-0.04	0.19	0.21	1.28	-0.24	-0.22	-0.43	-0.05
Import	0.28	-1.17	-1	-0.11	-0.29	-1.22	-1.24	-0.62
Import: Oil & Gas etc.	0.02	-0.01	0	-1.78	0.03	-0.13	0	-0.87
Consumption Price	4.52	1.94	1.83	1.57	1.65	1.17	1.04	1.83
Nominal wage and salaries	2.77	0.74	0.5	0.44	1.13	0.25	0.17	0.76
Carbon Tax Rate ($/tCO_2$)	82.09	82.09	82.09	82.09	97.16	97.16	97.16	97.16

Source: Park et al (2015), p.128, Table8.3

The results of the harmonized carbon tax and single-country carbon tax are not much different for a country which introduces a single-country carbon tax. For example, as shown in Table 5, in the scenario in which only Japan introduces a carbon tax so as to achieve the national CO_2 target (JNN), the negative impact on main real economic indicators is substantial (e.g. in 2020 -1.25% for real GDP, -2.48% in consumption) because of the fairly high carbon tax rate (153.70 $/tCO_2$). With the lower rate of 82.09 $/tCO_2$, the negative economic impacts in 2020 becomes far smaller. We observe no significant difference in economic values of Japan in JNN, compared to ANN or AHN, respectively.

Japan has enough existing tax revenue from VAT, income tax, and social security contributions to neutralize the carbon tax revenue. If the government recycles the revenue through a reduction of VAT or income tax (JNC, JNI), main economic indicators, such as real GDP, employment or consumption, show a strong double dividend compared to JNN scenarios without revenue recycling. When social security contributions (JNL) are reduced, however, it shows just a weak double dividend. In cases with positive double dividend, economic performance is better in the scenario with a higher carbon tax rate and, thus, higher potential of revenue recycling.

Table 5: Japan - scenarios with a carbon tax rate to achieve the national target with revenue recycling

Japan from baseline (%)	2020				2030			
	JNN	JNC	JNI	JNL	JNN	JNC	JNI	JNL
Real GDP	-1.25	1.45	1.17	-0.7	-0.99	2.8	1.83	-0.19
CO_2	-11.22	-8.42	-9.03	-10.72	-13.2	-9.26	-10.4	-12.36
Employment	-0.5	0.53	0.47	0.09	-0.87	1.23	0.72	-0.19
Consumption	-2.48	2.32	1.46	-1.23	-2.53	3.89	1.92	-0.8
Investment	-0.81	-0.55	0.38	-1.57	-0.28	0.31	1.07	-1.21
Export	0	0.01	0.22	-0.08	-0.19	0.23	0.24	-0.25
Import	-2.16	-0.38	-0.38	-1.92	-2.46	-0.32	-0.71	-2.21
Import: Oil & Gas etc.	-0.01	-0.04	-0.04	-0.02	-0.07	-0.05	-0.05	-0.07
Consumption Price	3.72	-3.19	2.39	2.33	2.31	-3.72	2	0.7
Nominal wage and salaries	1.47	-0.91	2.58	2.1	0.42	-1.17	2.92	0.61
Carbon Tax Rate ($/tCO$_2$)	153.7	153.7	153.7	153.7	181.92	181.92	181.92	181.92

Source: Park et al (2015), p.131, Table8.6

These results indicate that high carbon tax rates are required to achieve national targets for Japan, Korea and Taiwan. In other words, this means that national targets must be fairly ambitious if they are to be achieved through a carbon tax alone. However, the economic burden of reducing CO_2 emission is by no means catastrophic (around 1-2%), even if the required carbon tax rate is high and the revenue is not recycled. If China contributes to a higher share of CO_2 reductions by applying the same tax rates as the other three countries, the economic burden for the other three countries is eased significantly, even if the CO_2 emission reduction amount of all four countries together is the same. And in the case of Japan, the possibility of a positive double dividend is also given by revenue recycling, especially through a VAT reduction. A positive double dividend due to other recycling options is country-specific. Moreover, an ambitious reduction effort does not necessarily translate into a higher economic burden, especially in the case of a strong double dividend in which there are improvements to both environment and economy.

4.3 Challenges to Low-carbon Policies in East Asia

As described above, Park et al (2015) found that a carbon tax or ETR, which has been successfully practiced in some European countries, could also be effective in East Asia, even in the case of single-country implementation. In practice, East Asian countries have already implemented a variety of market-based instruments to reduce CO_2 emissions, but these instruments are still either limited in coverage or set with rates that are too low to have significant impacts. Furthermore, as shown in Table 6, economic growth, greenhouse gas levels and reduction targets, the status quo and targets for renewable energy and nuclear power, and the main low-carbon policies significantly vary between China, Japan, South Korea, and Taiwan.

Table 6: GDP, CO_2 emissions, GHG targets, energy systems and low-carbon policies in East Asia

	item	China (year)	Japan (year)	Korea (year)	Taiwan (year)
GDP	GDP (bn US$)	390 (1990),	3,104 (1990),	270 (1990),	165 (1990),
		9,181 (2013)	4,902 (2013)	1,222 (2013)	489 (2013)
	GDP (per capita US$)	341 (1990),	25,140 (1990),	6,308 (1990),	8,087 (1990),
		6,747 (2013)	38,491 (2013)	24,329 (2013)	20,930 (2013)
CO_2 emission and GHG targets	Energy related CO_2 emission(M CO2ton)	2,461 (1990),	1,095 (1990),	247 (1990),	137 (1990),
		9,437 (2013)	1,235 (2013)	601(2013)	271 (2012)
	INDC 2030 GHG target(%)	2030 would be peak year for CO2 emission and 60~65% reduction per GDP unit	-18.0(comparing to 1990)	-37.0%(BAU)	-50%(BAU)
			-25.4(comparing to 2005)	-21%(comparing to 2010)	-20%(comparing to 2005)
			-26.0(comparing to 2013)		
Renewable energy and nuclear power target	Renewable(% of total electricity)	19.2%(including 17% hydro) (2012)	10.7% (2013),	3.7% (2012),	5.2% (2012),
		15% of primary energy (2020)	13.5% (2020),	10% (2022),	15% (2025)
			22~24.0% (2030)	15% (2035)	
				11% of primary energy (2035)	
	Nuclear (% of total electricity)	1.8% (2010),	29.2% (2010),	32.2% (2010),	19.3% (2010),
		2.1% (2013),	1.7% (2013),	27.6% (2013),	19.1% (2013)
		11GW (2012),	20~22%(2030)	27.8% (2024),	0% (2025)
		200GW (2030)		29% (2035)	
Low-carbon policy	Carbon tax	Not yet; under discussion	289 yen/tCO_2 from 2012	Not yet; under discussion	Not yet; tried but failed
	ETS	Nationally from 2019 (not fixed yet), piloting regional ETS from 2011	Not yet nationally but municipally from 2010 (Tokyo City), 2011 (Saitama Prefecture)	Nationally from 2015	Not yet
	Renewable energy policy	FIT (Feed-in-Tariff)	FIT	RPS(Renewable Portfolio Standard)	FIT

Note: Conventional hydropower is excluded from Korea's renewable targets for 2022 and 2035.

Sources: Websites of World Bank, IEA, IAEA,World Nuclear Association and Lee et al.,2015.

The biggest barrier to accelerating low-carbon policies including carbon taxes in East Asian countries is still the quantitative economic growth paradigm combined with the lack of awareness of the damages caused to the global climate by the use of fossil fuels and of the risks associated with nuclear energy use. It is essential to spread the understanding of approaches to internalize external effects, that is to make polluters fully pay for the damage they cause to the global climate by emitting GHG. External diseconomies of environmental risk and environmental pollution can be addressed through economic means such as a carbon tax or a cap-and-

trade program. The reason for the partial success of market-based approaches to environmental protection in Europe environmental tax system reform in Europe has achieved a certain level of results are political leadership, institution building, and public environmental awareness, which together put significant pressure on polluters to accept the "pain" of higher energy costs (Lee et.al. ed., 2015).

Restructuring the tax system by introducing environmental taxation is important in order to foster a low-carbon society, but reforms of public expenditures (green fiscal reform) are also important. Japan and South Korea, e.g., have reduced the share of government funds subsidizing public projects for conventional fossil fuel energy (power plant construction) and road construction since the early 2000s and have increased the share of funds spent on developing green technologies and the expansion of renewable energy. Both countries' governments have announced that they will develop these areas as strategic sectors that will trigger future national growth.[16] China and Taiwan have also shown considerable interest in developing areas of key importance, including energy conservation and renewable energy promotion. In China, for example, the National Development and Reform Commission (2015) disclosed a power sources mix plan toward 2050. In this road map, as shown in Table 7, the power source share of fossil fuel decreases drastically from 71.8% in 2015 to 9.9% in 2050; meanwhile that of renewables (excluding hydro power) increases rapidly from 5% in 2015 to 63.6 % in 2050. Ambitious carbon pricing including carbon taxes will be required to make this transition in the power sector possible.

Table 7: Power generation in high penetration scenario in China (unit:%)

	2015	2020	2030	2040	2050
Hydro	16.5	15.1	15.1	13.3	14.4
PV	1	2.8	12.6	24.4	28.4
Wind	4	9.3	21.9	34	35.2
Coal	67.5	61.8	38.4	14.5	6.8
LNG	4.3	6.5	4.7	3.8	3.1
others	6.7	4.5	7.3	10	12.1
Total	100	100	100	100	100

Source: National Development and Reform Commission (2015)

The political reality of low-carbon economy tax system reform, however, is less promising. Such reform will continue to be a great challenge, at least in the short run. To make such reforms become reality, it is essential to present a long-term vision for greening public finance to the public and to obtain public support. To achieve this, governments will need to address the economic reliance on fossil fuels and tackle pollution costs through effective and efficient

[16] For Japan, see for South Korea, see Green Growth Committee (2009,2013) and Ministry of Trade, Industry and Energy (2013).

policies. At the same time, they need to steadily provide education and information on the risk of using nuclear energy. This requires strong political leadership, based on firm conviction that is not swayed by short-term economic conditions.

Finally, when pushing low-carbon policies, an important thing to be cautious about is whether the relevant policies in fact strengthen incentives to use nuclear power. The Taiwanese government published a New Energy Policy of Taiwan in June 2014 (Bureau of Energy, Taiwan, 2014). In the plan, a steady reduction of nuclear energy and full-scale promotion of renewable energy were anticipated. There would be no extension of the life span of existing nuclear plants and no more new nuclear plants. In contrast, China and South Korea still position nuclear power as their primary source of power, firmly maintaining the existing nuclear course. Indonesia and Vietnam in Southeast Asia have clarified their intention to promote the use of nuclear energy. In the future, it will be critical for East Asia to build an infrastructure to properly evaluate the real costs of nuclear energy through tightening nuclear energy safety standards and reviewing nuclear risk calculations and laws on liability for damages. Furthermore, most of the countries in East Asia will need to depart from their reliance on fossil fuels by reviewing the various forms of direct and indirect subsidies for fossil fuels.

5 Conclusions

This chapter provided an evaluation of the Japanese carbon tax, its design and results, as well as a political economy explanation of its genesis. And it also broadened the perspective and examined the chances and obstacles of energy systems and low-carbon policies for a sustainable East Asia. We have shown that, first, the Japanese carbon tax has not yet become sustainable, that is efficient, effective, and socially just. Emission reductions are expected to be negligible, efficient market allocation of scarce resources is limited, and current but particularly future generations will continue to carry heavy burdens from negative impacts of climate change and continuing use of nuclear energy. Hence, at current stage the Japanese carbon tax cannot act as the main pillar of Japan's climate and energy policy. Still, although the political and economic situation in Japan remains under serious tension, a sustainable energy-climate policy mix relying mainly on market—based approaches such as a carbon tax or a carbon cap-and-trade scheme is of utmost important and in the long run inevitable.

Second, if the four major East Asian economies of Japan, China, South Korea, and Taiwan introduced a harmonized carbon tax, the effectiveness and efficiency of this policy would be significantly enhanced and the economic burden would be eased for all countries. But even the unilateral introduction of a carbon tax as the main policy instrument to achieve national climate targets would not dramatically hurt the economy. However, those market-based instruments for

climate protection already implemented in East Asian countries are insufficient in that they are either limited in coverage or set at rates too low to have significant impacts. Furthermore, economic growth, greenhouse gas levels and reduction targets, the status and targets of renewable energy and nuclear power, as well as the main low-carbon policies vary greatly amongst these countries, which makes harmonization more challenging. Therefore, as a first step to further progress, institutionalizing a system that properly assesses the social costs and benefits of different power sources is key for being able to argue for reasonable carbon pricing instruments.

Third, in order to achieve a low-carbon economy by applying carbon pricing instruments such as carbon taxes or carbon cap-and-trade, it is essential to present a long-term vision for greening public finance to the general public. While it is unlikely to obtain public support in the short run, governments still need to address the economic reliance on fossil fuels and internalize pollution costs through effective and efficient market-based policy approaches. At the same time, it is important to steadily provide education on the risk of nuclear energy use.

For research, while technical issues about the design and evaluation of efficient and effective market-based approaches to global warming seem to be reasonably well understood, fairness and feasibility questions will dominate future discussions on a sustainable, nuclear-free low-carbon society. Hence, research efforts should reflect this more convincingly.

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