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국제학박사학위논문

**Modernization of trade agreements
for green subsidies:
An Empirical Analysis**

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Abstract

The purpose of this study is to assess whether the WTO rules should be modernized to provide more policy space for green subsidies. The study will consider the justification for such subsidies based on empirical analysis on its environmental and trade effects, and analyse how current trade and environmental rules govern green subsidies. And then this study will suggest ways to improve trade rules so as to avoid trade disputes. The thesis proceeds in seven sections: Section II discusses definition of green subsidies and how they are used in countries. Section III and IV discusses why the use of green subsidies are justified. It analyses environmental and trade effects of green subsidies using various empirical estimations. Section V details how international economic and environmental law govern green subsidies. Section VI analyses whether the modification of trade rules can have positive environmental effects. Section VII is the conclusion which lays out options for making WTO law more compatible with appropriate green subsidies.

Keyword : Green subsidies, WTO SCM Agreement, Empirical analysis, Trade effects

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I. Introduction

It is largely uncontested that climate change is possibly the greatest sustainable development challenge presently facing the international community. The 1992 United Nations Framework Convention on Climate Change (UNFCCC) and more recent Paris Agreement represent the global response to this challenge, with the main goal of reducing greenhouse gas (GHG) emissions concentrations in the atmosphere and holding the increase in the global average temperature to below the threshold of 2 °C or 1.5 °C above preindustrial levels. To that end, there is broad acceptance that an urgent and far-reaching transformation in the energy system will be required replacing conventional, ‘brown’ or ‘dirty’ energy with renewable, ‘green’ or ‘clean’ energy, given that fossil sources currently account for 80% of the global total primary energy supply and 60% of global greenhouse gas (GHG) emissions. In this regards, the use of green subsidies is increasing throughout the world to develop clean energy industries, phase out of fossil fuels, and to promote sustainable production and consumption. Renewable energy subsidies have reached USD 140 billion in 2016, even though this is still significantly lower than fossil fuel subsidies (USD 260 billion in that same year).¹

If the green subsidies bring economic effects beyond the borders, the principles of the global trade system apply. The fact that there is a conflict between this international climate change mitigation objective and the WTO subsidy law has become almost common wisdom in scholarships. Indeed, with the support of the

¹ IEA, ‘Commentary: Fossil-fuel Consumption Subsidies Are Down, But Not Out’ (20 December 2017), <https://www.iea.org/newsroom/news/2017/december/commentary-fossil-fuel-consumption-subsidies-aredown-but-not-out.html> (visited December 2018).

government, there is growing consensus in academia about the need to modernize the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement) to broaden policy space for renewable energy.

In this context, the purpose of this study is to assess whether the WTO rules should be modernized to provide more policy space for green subsidies. The study will consider the justification for such subsidies based on empirical analysis on its environmental and trade effects, and analyse how current trade and environmental rules govern green subsidies. When there are problems identified, this study will suggest ways to improve trade rules so as to avoid trade disputes.

The thesis proceeds in seven sections: Section II discusses definition of green subsidies and how they are used in countries. Section III and IV discusses why the use of green subsidies are justified. It analyses environmental and trade effects of green subsidies using various empirical estimations. Section V details how international economic and environmental law govern green subsidies. Section VI analyses whether the modification of trade rules can have positive environmental effects. Section VII is the conclusion which lays out options for making WTO law more compatible with appropriate green subsidies.

II. Definition of green subsidies

Governments use green subsidies for one or more of the following purposes: to enhance public goods, to enhance quasi-public goods such as knowledge-based capital, to redistribute income, to compensate for market failure, and to compensate for government failure (Charnovitz, 2010). Giving subsidies is generally considered part of the domestic policy space of governments. But governments can jointly agree to a mutual reduction of subsidies as they did in the Uruguay Round agriculture and subsidy negotiations.

Some earlier studies have proposed several ways to categorise green subsidies. The Organisation for Economic Co-operation and Development (OECD) has developed a sophisticated framework for categorizing renewable energy transfers. Such subsidies may promote “market-pull” use of clean energy (i.e. consumption of clean energy) or promote the technology push of green energy (i.e. production of clean energy). The OECD framework employs an innovative matrix with the transfer mechanism on the vertical axis and the statutory incidence on the horizontal axis.² The transfer mechanism matches some of the categories of subsidy in the SCM Agreement. What the OECD means by statutory incidence is how the transfer gets mediated in the market. For example, there can be a subsidy to land, labor, capital, knowledge, intermediate inputs, and enterprise income. The OECD matrix is designed to allow for comparisons across sectors, countries, and legal cases. Another way of classifying green subsidies was

² Bahar, Egeland & Steenblik (2013).

proposed by the WTO.³ Four subsidy types are distinguished: Type 1 is a subsidy to reduce environmental externalities, such as pollution, from a firm. Type 2 is a subsidy to promote an external benefit from a firm, such as forestation. Type 3 is a subsidy to defray the cost of compliance with environmental regulation. Type 4 is a subsidy to enhance consumer information about environmental benefits of consuming certain goods. Some overlaps exist, such as between Types 1 and 3.

UNEP (2009) classifies green subsidies based on the ‘mechanisms’ of policies: price and market mechanisms to internalize environmental costs of GHG emissions, financial mechanisms to promote the development and deployment of climate-friendly goods and technologies, and technical requirements to promote the use of climate-friendly goods and technologies. Andrew Green (2006) classified green subsidies based on the ‘objective’ of subsidy policies: (i) subsidies to reduce heavy emitters of greenhouse gases; (ii) subsidies to foster reduced emissions; and (iii) subsidies to foster the use of renewable, cleaner sources of energy, (iv) subsidies to foster carbon sinks; (v) subsidies to foster R&D into climate change and new technology; (vi) subsidies to foster reduced energy use and emissions by individuals.

IEA provides a more detailed classification of environmental policies and measures. It classifies environmental policies to six categories: economic instruments, information and education, policy support, regulatory instruments, research, development and deployment (RD&D), and voluntary approaches.

³ World Trade Organization (2006).

Under the economic instruments, there are three categories: direct investment, fiscal/financial incentives, and market-based instruments. Subsidies is included in the fiscal/financial incentives under the economic instruments. Under this classification, some instruments that would be considered to have subsidy elements are not categorized as a subsidy. For example, a tax relief which would be considered as a subsidy is not categorized under a subsidy. In the same manner, a feed-in tariff mechanism (i.e. a government's payment to encourage the investment of renewable energy) has subsidy elements, but it is not classified as an environmental subsidy.

The study herein, with a broader scope than just renewable energy, develops a new categorisation that distinguishes subsidies based on the 'forms' rather than 'objectives' (Table 1). The 'form' of the subsidy has three criteria: the nature of the donor, recipient, and subsidy. Subsidy donors will be governments or non-governments (e.g. international funds). If the donor is a government, the subsidy will be a direct subsidy. On the other hand, if the donor is non-government, the subsidy will be an indirect subsidy. The recipient will be the producer or the consumer, and the nature of a subsidy will be financial or non-financial. Based on this criteria, I classified the green subsidies as Table 1.

Table 1. Classification of green subsidies

	Recipients	
	Producers	Consumers
Direct financial subsidy	Grants, Funds, and Loans Tax credits for producers Investment Tax Credits (ITCs) Production Tax Credits (PTCs)	Direct payments for consumers Tax credits for consumers
Indirect financial subsidy	International funds subsidies for producers Private subsidies Government entrusted or directed subsidies	
Direct non-financial subsidy	Regulatory Measures for Producers Green procurement rules Local Content Requirements Renewable Portfolio Standards Feed-in-tariff Border Measures (e.g. Tariff Measures, Quotas)	Regulatory Measures for Consumers
Indirect non-financial subsidy	Green Certificate White Certificate	N.A

A direct financial subsidy to producers is to give a certain amount of money to firms or sectors, which results in a profit growth or cost-cutting. This category includes government's tax credits for producers, investment tax credits, production tax credits (PTCs), grants, funds, and loans. Well-known examples of cost-relief incentives are Investment Tax Credits (ITCs) and Production Tax Credits (PTCs). ITCs give favourable tax treatment to firms and individuals who are investing in RE electricity. ITCs reduces income taxes for qualified RE producers based on capital investment in renewable energy projects. Compared to ITCs, the PTCs reduces income taxes for qualified RE producers based on the electrical output of grid-connected renewable energy facilities. Government's offer of preferential low-cost credit lines and partial risk guarantees to commercial or development banks to encourage their lending or investment to renewable energy project developers by reducing their technology and policy risks can be also a direct financial subsidy. Another example can be Australia's Renewable Energy Venture Capital Fund which makes equity investments in early-stage renewable energy companies to help them overcome capital constraints, develop technologies, increase skills and forge international connections. Poland's Energy Loan also provided low interest rate and long-term repayment to the RE producers so that they can lower the cost of equipment production or expand manufacturing capacity.

A direct financial subsidy to consumers is to give a certain amount of money to consumers to encourage them to consume environment friendly products. This category includes direct payments, tax exemptions or credits to consumers. For example, in Argentina and China, consumer subsidies have been offered as rebates in electricity bills to encourage consumers to substitute renewable energy for fossil fuel.

Direct non-financial subsidy includes regulatory measures for producers. Although regulatory incentives do not have fiscal support such as financial subsidies, they produce the equivalent 'effects'. Regulatory incentives are commonly used in the environmental policies, for example by government's mandating minimum quantity or price requirements. As Luca Rubini (2012) stated, "from an economic perspective, regulatory measures are instruments of subsidization if they produce similar effects to subsidies, i.e. interfere with costs and prices, relocating resources from one sector to another."⁴ Examples are green procurement rules, local content requirements, renewable portfolio standards, and feed-in-tariff. A feed-in-tariff (FIT) is a government's support for the guaranteed electricity purchase prices of renewable energy to encourage the adoption of renewable energy sources. As producing renewable energy costs more than producing fossil fuel energy, the excess costs are supported by government under the FIT. FITs differ vastly in their structure and pricing mechanisms. The two main types are one that provides a fixed tariff (an overall remuneration) or alternatively the other that provides fixed premiums on top of the electricity market prices.⁵ The most important distinction is that a fixed tariff sets a fixed price independent of electricity market prices, whereas in a fixed premium scheme premiums are paid to the producer on top of the conventional market price. Hence, the premium tariff is a modified version of the commonly

⁴ Luca Rubini, *Ain't Wastin' Time No More: Subsidies for Renewable Energy, The SCM Agreement, Policy Space, and Law Reform*, J Int Economic Law (2012) 15 (2): p 541.

⁵ M.S. Srikar, *Renewable Energy Programmes in the European Union, Japan and the United States: Compatibility with WTO Law*, Working Paper, Centre for WTO Studies (CWS), 27 August 2012, p 22.

used fixed tariff towards a more market-based support instrument.⁶ Besides the fixed purchase price, feed-in tariff policies guarantees the grid connection between power companies and the producers, so that they have to purchase all the renewable electricity from the producers (Mendonça et al.2010). The last incentive that accelerates investment in renewable energy is offering long-term contracts to renewable energy producers. In sum, a feed-in-tariff is a policy tool defined by three key characteristics: guaranteed electricity purchase prices, guaranteed grid access and long-term contracts.⁷ On the other hand, Renewable portfolio standards (RPS) or Quotas is a regulation that requires retail electricity suppliers procure a certain minimum quantity of eligible renewable energy or capacity, measured in either absolute units (kWh or kW) or as a percentage share of retail sales. That is, RPS policies are generally designed to encourage renewable energy supply by mandating a minimum quantity of renewable energy use. While pricing laws like FITs establish the price and let the market determine the quantity, RPS or Quotas work in reverse. The government sets a quantity and lets the market determine the price.

⁶ Arne Klein et al., Evaluation of different feed-in tariff design options –Best practice paper for the International Feed-In Cooperation, 2nd edition, update by October 2008, Fraunhofer ISI.

⁷ Marie Wilke, Feed-in Tariffs for Renewable Energy and WTO Subsidy Rules, ICTSD, 2011. p 1.

III. Theoretical justification for green subsidies

While these green energy sources can attract generous subsidies from government, can this subsidy be justified? This section will show that green subsidies are different from ‘general’ subsidies and why these are justified under economic theory. It starts by considering green subsidies as corrective measures, providing incentives to lower pollution emissions. It then goes on to consider green subsidies as the subsidies for positive externality. Finally it compares green subsidies with environmental taxes.

3.1. Corrective measure

According to economists such as Kyle Bagwell and Robert Staiger (2006) and Alan Sykes (2009), the criteria in the SCM Agreement for distinguishing permissible subsidies from “prohibited” or “actionable” subsidies do not make sense in economic terms. For instance, there is no reason why a policy intervention that is specific is less likely to be an effective means of addressing a market failure than one that is targeted at particular industries or even firms, given that the market may well be distorted already due to past government interventions (Howse, 2010). According to this group of economists, green subsidies are methods to correct the market that has historically been pervasively distorted. According to Sykes (2009, p. 23):

Because the analytical process is myopic, focused only on the details of the particular program being evaluated, a finding that a “subsidy” or “state aid” is present does not establish that the government has done anything...to afford the industry a competitive.

advantage. It is entirely possible that the balance of benefits and burdens may actually impair the competitive position of the industry relative to foreign competitors (whose position is of course affected by the balance of benefits and burdens associated with their own government's actions). Programs that appear to confer "subsidies" therefore may actually offset other disadvantages and serve as useful corrective measures. This observation is nothing more than an application of the familiar theory of the second best, which implies, inter alia, that an action which would distort resource allocation in an otherwise first-best setting may well be constructive in the presence of other offsetting distortions.

The insight of Sykes is central for comprehending the legitimacy of green subsidies. The market into which green subsidies are intervening is one that has historically been pervasively distorted by subsidies provided to producers and consumers of fossil fuels. It is also a market in which existing networks for the distribution and retailing of energy—whether electricity grids or chains of service stations—have been largely designed to favour fossil fuel (Howse, 2010). In this view, subsidies are economically justified as a measure to correct the market that has historically been pervasively distorted. Given that polluting fossil fuels are still mostly cheaper than renewables, clean energy requires green subsidies.

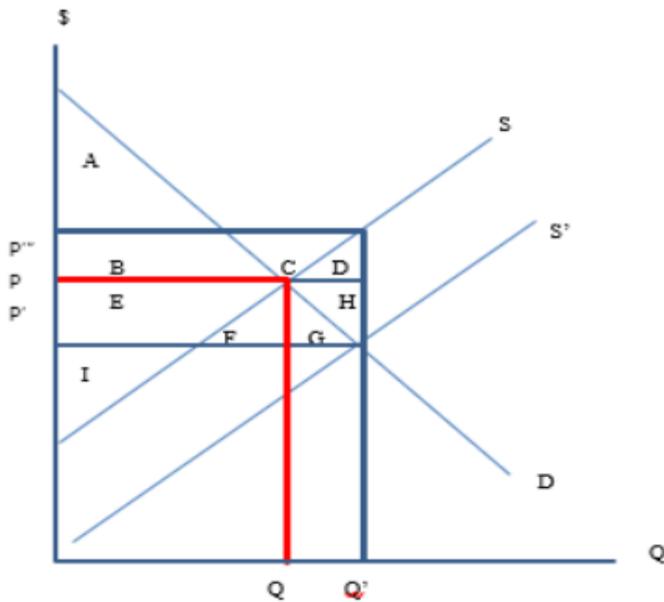
3.2. Positive externality

The free market of energy services does not always work effectively because it does not take into account the relevant social and environmental benefits and costs. Thus, if the costs associated with the risk of policy failure are less than the interests of society dealing with market failures, the government needs to intervene in the energy market to pursue social and environmental goals.

If we do not take into account the social and environmental benefits associated with green subsidies, the green subsidies can be inefficient measure. This can be explained by the simple cost and benefit analysis in what follows. In Figure 1, red price and quantity represent the initial market equilibrium. The welfare in this market is represented by consumer surplus (i.e., A + B) and producer surplus (i.e., E + D). You can use government grants to reduce production costs and increase supply. If the subsidy is equal to the difference between P'' and P', the supply curve shifts from S to S'. In the new supply curve, the price drops to P' and the quantity purchased will be Q'. Consumer surplus and producer surplus can be assessed by the change. Consumers of green energy are better complemented by changes in consumer surplus (i.e., E + F + G), as prices decline and quantity increases. Since the seller's price is equal to market price (P') plus the subsidy (P'' - P'), the price received by the firm increases. Producers of green energy are better off by the change in producer surplus (i.e. B+C), as a result of the increase in the seller's price and the the quantity sold. The overall effect on welfare is the difference between the benefits of the policy and the costs, that is net benefits equal change in consumer surplus plus change in producer surplus minus subsidy payment = -(D +H) < 0. The overall net benefits of a subsidy are negative: the

market participants' benefits are less than the taxpayer's costs. Subsidies are inefficient according to this cost and benefit analysis.

Figure 1. Benefits and costs of green subsidies



However, energy markets can malfunction in various ways. The market fails when everyone does not charge for the production or degradation of public goods (i.e. goods or services that are freely accessible but do not charge explicitly). Clean air is a classic example of public goods. Governments have a responsibility to intervene to prevent air pollution by regulating emissions from energy-related activities. This is because individual polluters do not pay for environmental pollution they cause.

3.3. Comparison with environmental taxes

Taxes on pollution is considered as the alternative instrument to encourage innovation of green technology. By increasing the cost of pollution under the so-called “polluter-pays-principle”, taxes provide incentives to develop innovations as well as incentives to adopt them. Taxes on pollution can yield theoretically similar end results with the subsidy. Similar to the concept of using subsidies to correct positive externalities, the concept of using taxation, sometimes referred to as Pigouvian taxation, is to correct negative externalities (e.g. pollution). Subsidy for positive externalities is symmetrical to environmental tax. As an environmental tax is to internalize the negative externality, environmental subsidy is to internalize the ‘positive’ externality. As the buyers and sellers do not take into account that external cost, the free market generally results in producing goods with a negative externality.

Theoretically, however, optimal environmentally related taxation addresses only one externality: the oversupply of pollution. While taxation should also provide greater incentives for innovation, it does not remove the obstacles to innovation. This justifies the use of other instruments to specifically address those obstacles.

For example, compared to taxation, green subsidies can address capital market failure. A lack of access to capital can prevent some poor and disadvantaged people from making energy-efficiency investments, profitable though they may be. Given that the society can benefit if more people has access to green energy

services, governments can use subsidies to provide the disadvantaged people the access to a reasonably priced minimum supply of green energy. Green subsidies can allow economic agents to overcome a possible lack of access to capital.

The presence of market entry barriers can also justify subsidies. For example, there are high initial costs for developing green technologies and financial risks that could hinder investors. Governments can compensate for these risks by subsidizing certain energy sources or technologies to encourage new energy sources or research and development investments.

In summary, if green energy use helps avoid some environmental pollution, then the positive externalities might make the subsidy payments worthwhile in terms of efficiency. If these positive externalities are not reflected in the costs of goods it leads to a market failure. For example, if subsidies were not given to offset the positive externalities of biomass that absorbs CO₂, the price of biomass would be overvalued. In order to solve the market failure caused by positive externalities, it would be necessary to give subsidies. In this regards, it is important to empirically prove that green subsidies have positive externalities by deterring environmental degradation. This will be discussed in the next section.

IV. Empirical Justifications for Green Subsidies

4.1. Positive Externality

In this section, I would empirically assess the positive externalities of R&D subsidies on the renewable energy, one of the most prominent green energy policy instruments, using various econometric methods. Due to the long-term nature of the climate problem, technological advances are often considered an important part of any solution. However, considering that technology can potentially help solve the climate problem, there are two market failures that lead to underinvestment in climate-friendly R & D: environmental externalities and the public good nature new knowledge. As a result, government subsidies for climate-friendly R & D projects are often proposed as part of a political solution.

Government R&D subsidies would increase the competitiveness of the renewable technology and would therefore have positive effects on the environmental quality. Such positive externalities from R&D subsidies could justify subsidies to R&D.

There is growing evidence that market forces such as higher prices or stringent environmental policies are driving technological change. Popp (2002) documented a dramatic increase in the number of patents on renewable energy technologies during the energy crisis of the 1970s. In recent years, economic climate policy models have paid increasing attention to the links between politics and technology change. Models that explicitly associate technological progress with climate policy show that such linkages reduce the costs of a given policy, with policy levers used to accelerate the development of more climate-friendly technologies. Given the importance of policy-induced technological change, as

well as the political climate that favors R & D subsidies relative to emission control policies, it is useful to consider the potential role of R & D policy. Such policies are interesting because, in the language of economists, markets for new knowledge are imperfect. The spillovers of knowledge prevent inventors from taking full advantage of the social benefits of their innovations. As such, incentives provided by private markets for R & D investment lead to underinvestment in R & D. Policies to address this issue, such as government-funded R&D, R&D tax credits or improved intellectual property rights to help inventors make innovation more profitable, result in higher R & D expenditures and, therefore, more innovation.

Schneider and Goulder (1997), Kverndokk et al. (1997) recently studied the role of R & D policy in the climate policy portfolio. Schneider and Goulder (1997) note that, while it is desirable to postpone much of the reduction in emissions, short-term policies that lead to low-cost emission reductions are less restrictive strategies. One of the reasons for this argument is that such policies stimulate innovation, making future emission reductions less expensive. However, they also find that the mere use of R & D subsidies to achieve these cost reductions is not as effective. While research and development grants correct market failures in the knowledge market, they do not correct environmental market failures and thus do not encourage the adoption of newly discovered climate-friendly technologies. Kverndokk et al. (2004) extend this work by considering both existing and potential new alternative energy technology. Research and development grants increase the use of existing energy technology, but delay the introduction of the latest or even the best technology. Fischer and Newell (2004) compare R & D subsidies and other policies designed to reduce carbon emissions

from the US electricity sector. They rank R & D grants as the least effective at reducing emissions, but do not consider the effect of knowledge spillovers and do not consider the simultaneous use of multiple policies. Outside the economy, articles such as Caldeira et al. (2003) and Hoffert et al. (2002) emphasize the need for R & D to increase the availability of carbon-free energy sources for long-term reductions.

To the best of my knowledge, there are no empirical inquiries on the impact of green R&D subsidies on the environment. However, the importance of green research and development (R&D) investment on environment is gaining momentum. Both policy makers and researchers have been calling for a significant increase in public R&D commitments in the renewable energy field in order to comply with climate mitigation pledges (e.g., Witte, 2009; Del Río, 2004; Reichardt and Rogge, 2014). Over the last two decades public R&D support to renewable energy has increased rapidly in Europe as well as in the OECD area (IEA, 2016). In this regards, this section investigates the consequences of green R&D subsidies on the environmental quality.

4.1.1. Data sources and descriptive statistics

The empirical analysis is based on an unbalanced panel data set containing country-level data, covering 26 countries from 1994 to 2014. Data sources are shown in Table 2. The primary data source is Organisation of Economic Cooperation and Development (OECD) online database. It provides country-level datasets on environmental quality as well as environmental regulation. The

data on R&D subsidies on renewable energy sources are collected from International Energy Agency (IEA) online database. The data is merged by unique country identifiers (i.e. ISO code). Summary statistics are shown in Table 3. The whole sample includes 401 observations. Absolute values are converted to natural logarithms.

Table 2. Data source and description of variables

Category	Units	Source
Dependent		
Greenhouse gas from energy	Tonnes of CO2 equivalent, thousands	OECD
Total emissions of carbon dioxide	Tonnes of CO2 equivalent, thousands	OECD
Main explanatory variable		
R&D subsidies on renewable energy	Total R&D in Million USD (2014 prices and PPP)	IEA
Control variables		
Environmental policy stringency index	Index	OECD
Feed-in-tariffs	Index	OECD
Fossil fuel energy consumption	% of total	World Bank
GDP per capita	USD, current prices, current PPP	OECD
Population	Persons	OECD
Trade openness	% of real GDP	OECD

Table 3. Summary statistics of main variables

	Mean	St.d	Min	Max	Obs
Dependent					
Greenhouse gas from energy	593779.5	1295160	30011.47	6285211	401
Total emissions of carbon dioxide	594850.6	1260570	36109.05	6132006	401
Main explanatory variable					
R&D subsidies on renewable energy	3.345	1.679	-4.828	7.779	401
Control variables					
Environmental policy stringency index	2.11	0.86	0.46	4.13	401
Feed-in-tariffs	1.90	1.98	0.00	6.00	401
Fossil fuel energy consumption	75.56	16.16	31.00	98.53	401
GDP per capita	30929.33	10360.05	8608.42	65441.92	401
Trade openness	0.70	0.35	0.19	1.88	401

4.1.2. Variables and Methodology

The dependent variable is environmental quality, for which greenhouse gas emissions (i.e. carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)) from energy sources is used as an indicator. These gases are released during the combustion of fossil fuels, such as coal, oil, and natural gas, to produce electricity. As a robustness check, regressions are also run with total emissions of carbon dioxide.

The main explanatory variable is R&D subsidies on renewable energy. It takes a one-year time lag to take into account that the effect of public subsidies primarily takes place with a time lag. Few empirical studies feature the specific time lag structure of subsidies. For robustness checks, zero year, two years and three years of time lags are also separately estimated.

Other environmental effects are also controlled by including the following variables. GDP per capita is included to control for the impact of economic growth on the environmental quality based on the growth-empirics literature. The impact of green policies other than R&D subsidies are also controlled for by including environmental policy stringency index and feed-in-tariffs policy index.⁸

⁸ The OECD Environmental Policy Stringency Index (EPS) is a country-specific and internationally-comparable measure of the stringency of environmental policy. Stringency is defined as the degree to which environmental policies put an explicit or

Population and trade openness are included to control for scale, technique and composition effects, which are three possible channels whereby a reduction in trade barriers can affect environmental quality according to the conceptual framework for examining the impact of trade liberalization on the environment, which will be briefly discussed in what follows.

According to the conceptual framework for examining the impact of trade liberalization on the environment, there are three possible channels whereby a reduction in trade barriers can affect environmental quality: scale, composition and technique effects. The scale effect refers to the negative impact on environment from the increased economic activity resulting from the liberalization of trade. The presumption is that trade liberalization will increase economic activity and hence energy use. The increase in energy use and economic activity will in turn lead to higher levels of green gas emissions. However, the evidence from the literature also reports that higher incomes could affect environmental quality positively (Grossman and Krueger, 1993; Copeland and Taylor, 2004). This suggests that when assessing the effects of growth and trade on the environment, trade cannot be held responsible for environmental damage (Copeland and Taylor, 2004). A way to reconcile these two opposing

implicit price on polluting or environmentally harmful behaviour. The index ranges from 0 (not stringent) to 6 (highest degree of stringency). The index covers 28 OECD and 6 BRIICS countries for the period 1990-2012. The index is based on the degree of stringency of 14 environmental policy instruments, primarily related to climate and air pollution.

effects of increasing income on environmental quality is to acknowledge that the relationship changes with the level of income. That is, for low income levels, increasing economic activity increases pollution, whereas for higher income levels further increases in economic activity could be linked to better environmental quality, since increasing incomes per capita are usually associated to a greater demand for environmental quality and in turn to beneficial changes in environmental policy. This argument is linked to the so-called Environmental Kuznets Curve (EKC), which hypothesises the existence of an inverted U-shaped relationship between environmental quality and per capita income.

The concept of the Environmental Kuznets Curve (EKC) – the hypothesis of an inverted U-shaped relationship between environmental degradation and the level of economic development– was introduced by Grosman and Krueger (1991) to support their argument that economic growth in Mexico improved, rather than reduced, environmental quality. One year later, the World Bank Development Report popularised the EKC by arguing that greater levels of income per capita do not necessarily harm the environment. They can instead be associated with an increase in demand for more environmental quality and lead to decreases in pollution.

Over the last few decades, numerous empirical studies have tested for the existence of an EKC (See Dinda, 2004; Carson, 2010 and Stern (2004 and 2015) for a summary of the empirical literature). The results obtained mainly depend on the indicator and the sample of countries examined. The basic model uses emissions of CO₂ (or other pollutants) per capita as dependent variable and the main independent variables are the level and the square term of income per capita.

Evidence supporting the EKC is found when the estimated coefficient of the level term is positive and the coefficient of the squared term is negative. Income per capita is usually measured in natural logarithms; in this case the turning point⁹ can easily be calculated. Generally, the EKC hypothesis is more likely to be confirmed for local-impact pollutants rather than for global (Dinda, 2004). Whereas a number of authors empirically verified the inverted-U relationship between income and sulphur emissions (Seldon and Song, 1994; Panayotou, 1997; Stern and Common, 2001); others found that for CO₂ the relationship is monotone or even N-shaped, where degradation initially follows the inverted-U pattern, but then begins to increase again with higher incomes (Martinez-Zarzoso and Bengochea-Morancho, 2004; Dijkgraaf and Vollebergh, 2005; Cole, 2003; Galeotti et al., 2006).

In general, the results obtained are sensitive to the functional form considered (quadratic or cubic specifications are usually adopted) and, mainly, to the model assumptions adopted (Harbaugh et al. 2002). As regards the different environmental indicators used, the literature concludes that for pollutants with local and more short-term impacts a significant EKC is more likely to hold than for global and long-term pollutants (Dinda, 2004; Carson 2010).

According to Carson (2010), the focus should be shifted from exclusively studying the shape of the relationship between pollution and income per capita to investigating the mechanisms and transmission channels that affect the income-

⁹ The turning point gives the level of income per capita after which the relationship turns out to be negative, that is higher levels of income per capita are associated with lower levels of pollution.

environmental quality relationship. Therefore, more comprehensive models that include the influence of policy explicitly should be used in empirical evaluations.

The second effect of trade liberalization on environmental quality is the *technique effect*, which refers to the positive effect that trade liberalization can lead to improvements in energy efficiency, so that the production of goods generates less pollution. The idea is that trade liberalization would lead to the widespread use of cleaner technologies that helps to reduce pollution. Researchers widely agree that trade is responsible for technology transfers and new technology should benefit the environment if pollution per output is reduced. In particular, a reduction in the emission intensity results in a decline in pollution, holding constant the scale of the economy and the mix of goods produced. Recent studies suggest that this effect can in some cases prevail over the scale effect (Levinson, 2015).

Finally, the third effect resulting from reduction in trade barriers and increasing trade that influences environmental quality is the *composition effect*. Trade liberalization results in changes in the comparative advantage and the composition of production in the economies. On the one hand, when the induced change fosters production mainly in clean sectors, then environmental quality increases. That is, the composition effect will be positive to environment if the expanding sectors are less energy intensive while the composition effect will be negative to environment if the expanding sectors are more energy intensive than before. Therefore it is difficult to predict whether the composition effect is positive or negative to environment. When comparative advantage is derived from differences in environmental stringency, the composition effect will

exacerbate environmental pollutions in the countries with relatively lax regulations, which is so called race-to-bottom phenomenon. This phenomenon is also plausible in economic theory. According to the Heckscher-Ohlin (H-O) theory in trade, national will gain a comparative advantage in industries where they are factor-abundant. When we apply H-O model to environment, country with less stringent environmental regulations would be factor abundant in the ability to pollute. Therefore, as Copeland and Taylor discussed a reduction in trade barriers would lead to pollution rises in the country with weak regulation.

As the earlier literature identifies, there exist both positive and negative effects of the liberalisation of trade on the environment, and these effects are controlled by including population, GDP, and trade openness as control variables.

This study uses various panel regression models, with fixed or random effects, as well as dynamic panel regression model and instrumental variables estimation. The basic model (i.e. fixed effect model) can be written as follows:

$$\ln(E_{it}) = \gamma_0 + \gamma_1 \ln(R\&D\ subsidies_{it-1}) + \gamma_2 \ln(GDP\ per\ capita_{it}) \\ + \gamma_3 \ln(POP_{it}) \\ + \gamma_4 \ln(Fossil_{it}) + \gamma_5 (Open_{it}) + \gamma_6 \ln(Stringency_{it}) + \mu_i \\ + \gamma t + n_{it}$$

Where:

- E_{it} , a given environmental indicator for country i at time t .
- $R\&D\ subsidies_{it-1}$, total green R&D subsidies on renewable energy sources, converted from current prices in national currencies to US dollar PPPs in constant 2017 prices using GDP deflators and 2017 PPPs.¹⁰ It takes a one-year time lag to take into account that the effect of public subsidies primarily takes place with a time lag. For robustness checks, zero year, two years and three years of time lags are also separately estimated.
- $GDP\ per\ capita_{it}$, GDP per capita at current US dollars at PPP in country i in year t . GDP per capita serves to capture the hypothesis that environmental quality eventually increases with income.
- Pop_{it} , population in number of inhabitants in country i in year t . Population is included as a proxy for the scale effect.

¹⁰ Purchasing power parities (PPPs) are the rates of currency conversion that eliminate the differences in price levels between countries.

- $Fossil_{it}$, Fossil fuel energy consumption as % of total in country i in year t . Fossil fuel comprises coal, oil, petroleum, and natural gas products.
- $Open_{it}$, the openness ratio measured as the sum of exports and imports divided by gross domestic product in country i in year t . It captures the effect of trade openness which could be positively or negatively affecting environmental quality, as discussed in the previous section.
- $Stringency_{it}$, a country-specific and internationally-comparable measure of the stringency of environmental policy in country i in year t . Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behaviour. It is included to control for the impact of green policies other than R&D subsidies.
- μ_i is the country fixed effects and γ_t is the year fixed effects.

Data for all variables except for the index and share are converted into logarithmic form to minimize their skewness.

A range of models have been estimated, starting with time and country fixed effect model. Controls and variables are subsequently added. The Sargan-Hansen test reveals that fixed effect model is more appropriate (Table 4), but the random-effect panel regressions with the time fixed effect are also used as complements and consistency checks to take into account the cross-sectional information.

Table 4. The Sargan-Hansen test

Random-effects GLS regression		Number of obs = 401				
Group variable: countries		Number of groups = 26				
R-sq:		Obs per group:				
within = 0.7271		min = 4				
between = 0.9999		avg = 15.4				
overall = 0.9989		max = 21				
Corr (u_i, X) = 0 (assumed)		Wald chi2 (7) = 177734.32				
		Prob > chi2 = 0.0000				
Dependent variable: Greenhouse gas emissions						
	Coeff.	SD	z	P > z	[95% Conf. Interval]	
R&D subsidies	0.001	0.003	0.200	0.838	-0.005	0.006
Fossil	0.030	0.016	1.880	0.060	-0.001	0.061
Population	0.003	0.010	0.310	0.755	-0.016	0.023
GDP per capita	-0.023	0.012	-1.980	0.047	-0.047	0.000
Lagged dependent	0.992	0.010	104.380	0.000	0.973	1.011
Feed-in-tariffs	0.000	0.001	-0.070	0.944	-0.003	0.003
Openness	-0.032	0.011	-2.810	0.005	-0.054	-0.010
constant	0.177	0.186	0.950	0.342	-0.188	0.541
sigma_u	0.0093					
sigma_e	0.0387					
rho	0.0544 (fraction of variance due to u_i)					
Test of overidentifying restrictions: fixed vs random effects						
Cross-section time-series model: xtreg re						
Sargan-Hansen statistic 159.171 Chi-sq(7) P-value = 0.0000						

A dynamic model is also estimated, under which we can control for the environmental situation in the same country in the previous year (t-1). The fact that the model is dynamic – meaning that it includes a lagged dependent variable – complicates the estimation procedure substantially. The problem is that the lagged dependent variable is likely to be not strictly exogenous as required in every econometric model to obtain unbiased results. The reason is the following: each year, there is some variation in the dependent variable left unexplained by the explanatory variables. This variation is included in the error term in the respective year. The dependent variable necessarily correlates with the error term in this case so that the error term is not pure “white noise”. This is not a problem when the explanatory variables are not correlated to the error term, meaning when they are exogenous. When a lagged dependent variable is included among the set of explanatory variables, this is not the case. Each year, the variation of the dependent variable left unexplained by the explanatory variables is likely to be around the same level. In other words, the error terms may also correlate with each other – a phenomenon called serial correlation of the residuals. Now the problem is, that the lagged dependent variable is likely to be correlated with the current error term because of its correlation with the past error term. In this case, the assumption of exogeneity of a linear regression model is violated. The lagged dependent variable is said to be endogenous. The consequence is a biased parameter estimate of the effect of previous emissions on current ones and thus biased forecasts of emissions that would have been observed, had there been no geen R&D subsidies.

Several solutions to the problem of the endogenous (often referred to as pre-determined) lagged dependent variable can be considered. What they all have in common is to use instrumental variables to rule out the endogeneity problem. The easiest way is simply to use another lag (say the emissions in year $t-2$) as an instrument. This variable is highly correlated with the next year's value and exogenous as the value in the past can of course not depend on more recent values. These are the two basic requirements of a useful instrument. The different models use different model setups and estimation techniques but the idea of using instruments is the same. A frequently used technique is the so called Arellano and Bond (1991) dynamic panel data model with the generalised method of moments (GMM). This approach is frequently pursued as it uses all available lags available in a certain year of the endogenous variable as instruments. As the name implies, this method uses first differences so all variables (the dependent and the explanatory ones) are transferred into first differences, meaning the difference from year $t-1$ to t . In this regard, dynamic panel data GMM estimation is also used additionally to test the hypothesis.

4.1.3. Empirical results

The main results from fixed effect models on greenhouse gas emissions are shown in Table 5, and detailed results tables are included in Annex (Annex table 1, 2, and 3). The coefficient of main explanatory variable (i.e. green R&D subsidies) is significant in all models (at the 5% or 10% level). It confirms the assumption that green R&D subsidies reduce environmental degradation. The variable *Feed-in-tariffs* shows insignificant coefficient, meaning that this green policy measure does not have a clear environmental effect. The openness variable

shows a positive coefficient, indicating that higher levels of trade do seem to increase concentrations of pollutions. As expected, *fossil*, *GDP per capita*, and *population* show positive and significant coefficients at the 1% level.

The Sargan-Hansen test (table 6) rejects the hypothesis of equality of the FE and RE coefficients ($\chi^2 = 159.171$, $p=0.00$). This calls for adopting FE model, which yields unbiased and consistent estimators, in contrast to the RE model. However, using the FE model would result in a loss of cross-section information (i.e. difference between countries). In spite of potential bias and inconsistency, the RE model overcomes the limitations of the FE model. In this regard, RE model is also used as complements and consistency checks. RE model shows similar results as FE model in overall, showing negative and statistically significant coefficient for green R&D subsidies (table 6).

Table 5. Main results from fixed effect models on greenhouse gas emissions

VARIABLES	RE[1]	RE[2]	RE[3]
R&D subsidies (lagged)	-0.0108** (0.00423)	-0.00796* (0.00409)	-0.0105** (0.00415)
Fossil	1.071*** (0.0697)	1.221*** (0.0781)	1.282*** (0.0804)
Population	1.235*** (0.118)	1.005*** (0.125)	1.164*** (0.137)
GDP per capita	0.130*** (0.0490)	0.142*** (0.0466)	0.109** (0.0476)
Feed-in-tariffs		0.00262 (0.00212)	0.00245 (0.00210)
Openness			0.110*** (0.0394)
Constant	-14.52*** (1.988)	-11.48*** (2.157)	-14.17*** (2.343)
Observations	454	401	401
R-squared	0.641	0.659	0.667
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Table 6. Main results from random effect models on greenhouse gas emissions

VARIABLES	RE[1]	RE[2]	RE[3]
R&D subsidies (lagged)	-0.00943** (0.00477)	-0.00727 (0.00443)	-0.00892** (0.00422)
Fossil	0.991*** (0.238)	1.179*** (0.229)	1.228*** (0.228)
Population	0.939*** (0.0818)	1.008*** (0.0531)	1.041*** (0.0679)
GDP per capita	0.156* (0.0841)	0.176* (0.0949)	0.149* (0.0900)
Feed-in-tariffs		0.00278 (0.00380)	0.00289 (0.00360)
Openness			0.0746 (0.0673)
Constant	-9.456*** (2.149)	-11.71*** (1.942)	-12.26*** (2.020)
Observations	454	401	401
R-squared	0.912	0.908	0.903
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Dynamic panel regressions also confirm the above results: addressing the endogeneity problem, R&D subsidies still have positive effects on the environmental quality while FIT does not show any significant effect, and fossil fuel consumption has negative effects on the environmental quality (Table 7).

Table 7. Dynamic panel regressions on greenhouse gas emissions

VARIABLES	Dynamic[1]	Dynamic[2]	Dynamic[3]
R&D subsidies (lagged)	-0.00574** (0.00281)	-0.00507* (0.00283)	-0.00669** (0.00289)
Fossil	0.517*** (0.0523)	0.651*** (0.0614)	0.695*** (0.0634)
Population	0.324*** (0.0879)	0.210** (0.0957)	0.318*** (0.104)
GDP per capita	0.0572* (0.0327)	0.0451 (0.0326)	0.0252 (0.0333)
Lagged dependent	0.686*** (0.0303)	0.663*** (0.0339)	0.656*** (0.0338)
Feed-in-tariffs		0.000999 (0.00147)	0.000911 (0.00146)
Openness			0.0691** (0.0274)
Constant	-4.415*** (1.392)	-2.679* (1.560)	-4.453*** (1.700)
Observations	454	401	401
R-squared	0.843	0.837	0.840
Number of countries	29	26	26

Note: ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

4.1.4 sub-conclusion

This section has examined the impact of green subsidies on the environmental quality. As the main explanatory variable, R&D subsidies on renewable energy sources and the index for the regulations on feed-in-tariffs are used. As the dependent variable, environmental quality, for which greenhouse gas emissions (i.e. Carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)) from energy sources is used. Other environmental effects are also controlled by including variables including openness, population, GDP per capita to control for scale, technique, composition, and Kuznet effects. As robustness checks, regressions are also run with total emissions of carbon dioxide, different lags for R&D subsidies. A range of models have been estimated including fixed effect model and GMM estimations. The results are robust: the implementation of R&D subsidies has a positive effect on environmental quality. On the other hand, the environmental effect of feed-in-tariffs was mixed.

4.2 Non-trade distortive effect of green subsidies

The second empirical analysis to test the trade distortive effects of green measures. The green subsidies can be illegal under WTO rules when they have a trade distortive design or when they adversely affect the trade interests of WTO Members. However, it is difficult for a complaining Member to demonstrate the adverse trade effects arising from subsidization, a fact-intensive analysis that panels may find difficult in some cases. Therefore, this section aims to empirically test whether the green subsidy measures have had negative impacts on imports of renewable energy.

4.2.1. Data sources and descriptive statistics

The empirical analysis is based on an unbalanced panel data set containing country-level data, covering 24 countries from 1994 to 2014. Data sources are shown in Table 8. The primary data source is Organisation of Economic Cooperation and Development (OECD) online database. It provides country-level datasets on environmental quality as well as environmental regulation. The data on R&D subsidies on renewable energy sources are collected from International Energy Agency (IEA) online database. The data is merged by unique country identifiers (i.e. ISO code).

Table 8. Data source and description of variables

Category	Units	Source
Dependent		
Imports of renewable energy	kilotonne of oil equivalent	IEA
Main explanatory variable		
R&D subsidies on renewable energy	Total R&D in Million USD (2014 prices and PPP)	IEA
Control variables		
Environmental policy stringency index	Index	OECD
Feed-in-tariffs	Index	OECD
GDP per capita	USD, current prices, current PPP	OECD
Population	Persons	OECD
Trade openness	% of real GDP	OECD

Summary statistics are shown in Table 9. The whole sample includes 401 observations. Absolute values are converted to natural logarithms.

Table 9. Summary statistics of main variables

	Mean	St.d	Min	Max	Obs.
Dependent					
Imports of renewable energy	325.865	476.9179	0.024	2956.75	330
Main explanatory variable					
R&D subsidies on renewable energy	104.083	223.7607	0.308	2391.304	330
Control variables					
Environmental policy stringency index	2.29	0.82	0.46	4.13	296
Feed-in-tariffs	1.85	1.99	0.00	6.00	296
GDP per capita	34843.0	10552.05	18158.3	91809.96	330
Trade openness	0.817	0.447	0.185	3.357	330

4.2.2. Variables and methodology

The empirical setting resembles the setting for the previous regression analysis (i.e. analysis on the environmental effects). The dependent variable is the import of renewable energy, as this analysis aims to analyse whether the green subsidy have any trade distortive effects. According to the IEA, imports and exports comprise amounts having crossed the national territorial boundaries of the country, whether or not customs clearance has taken place.¹¹

¹¹ For more details, see <https://www.iea.org/statistics/resources/balanceddefinitions/>

The main explanatory variable is R&D subsidies on renewable energy which takes a one-year time lag to take into account the time that is required for the effect of public subsidies take place. Similar to the standard gravity setting, GDP per capita and population are included as control variables.

4.2.3. Empirical results

The main results of fixed effect models on imports are shown in Table 10, and detailed results tables are included in Annex. The coefficient of green R&D subsidies is not significant in all models (at the 5% or 10% level), meaning that green R&D subsidies doesn't have any significant effect on the imports of renewable energy. On the other hand, the variable *Feed-in-tariffs* shows significant coefficient, meaning that this green policy measure has a clear trade effect.

Table 10. Impact of green subsidies on imports

VARIABLES	FE[1]	FE[2]	FE[3]	FE[4]	FE[5]
R&D subsidies (lag1)	0.160 (0.103)	0.162 (0.103)	0.164 (0.117)		
Population	13.93*** (2.959)	15.06*** (3.364)	15.82*** (3.939)	17.10*** (3.410)	16.50*** (3.863)
GDP per capita	0.142 (1.069)	0.250 (1.081)	0.0669 (1.171)	0.147 (1.122)	0.0889 (1.138)
Trade openness		0.765 (1.083)	-0.199 (1.232)		-0.382 (1.136)
Feed-in-tariffs			-0.0817* (0.0439)	-0.0815* (0.0415)	-0.0829** (0.0418)
Constant	-232.7*** (48.60)	-252.1*** (55.87)	-265.6*** (66.28)	-287.3*** (56.77)	-276.7*** (64.95)
Observations	319	319	287	296	296
R-squared	0.704	0.704	0.700	0.687	0.687
Number of countries	27	27	24	24	24

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

4.2.4. Sub-conclusion

Energy transition has important implications for international trade. Governments are tempted to design policies to support the development of domestic industries to produce equipment for renewable energy export. However, specific protection of domestic industries could lead to trade policies that potentially violate the non-discrimination principle of SCM Agreement. This situation has already arisen as evidenced by trade disputes brought to the WTO's Dispute Settlement Body. The nature of these trade disputes is mostly complaints about national programs that provide support for the development of renewable energy and preferential use of domestic over imported rival products.

The empirical regression results showed that R & D subsidies have had little trade distorting effect according to the evidence from 24 countries from 1994 to 2014. Of course care should be taken not to overgeneralise it because trade distortions may vary from country to country depending on the amount and type of subsidy. Nevertheless, this is a meaningful finding because this empirical analysis describes what is happening based on direct observation or the evidence collected (i.e. historical data) in this field.

V. International Disciplines on Green Subsidies

Given that some green subsidies are economically and empirically justified, this section analyses whether international trade and environmental regulations recognise this and how they govern green subsidies. Although international trade law and international environmental law are separate bodies of law, they are both part of public international law with its canons of interpretation to avoid conflict of law.¹² Therefore, in applying WTO law, one needs to consider how green subsidies are governed by the international environmental regime.

In this regards, this section firstly looks into the MEAs, and the analysis on trade rules will be followed. Negotiating history of Article 8 (non-actionable subsidies) which was expired in 1999 will be also analysed given that it has a meaningful lesson for the current negotiations on the revival of non-actionable subsidies.

¹² The complexity of the relationship between environmental and trade rules was highlighted in the “Chile — Swordfish” case. At the 2001 Doha Ministerial Conference, members agreed to negotiate on the relationship between WTO rules and the multilateral environmental agreements. These negotiations take place in special sessions of the Trade and Environment Committee. Members have agreed that the scope of these negotiations would be limited to applicability of WTO rules to WTO members that have signed the multilateral environmental agreement under consideration.

5.1. Green subsidies under Multilateral Environment Agreements

Although international environmental law is not codified as crisply as international trade law, there are established sources of law that can be examined, such as UN declarations, multilateral environmental agreements (MEAs), and OECD principles (Charnovitz 2010). There are over 250 multilateral environmental agreements (MEAs) dealing with various environmental issues which are currently in force.

It is noteworthy that some MEAs support the use of some green subsidies. Convention on Biological Diversity (CBD) states that each contracting party “shall” adopt economically and socially sound measures that act as “incentives” for the conservation and sustainable use of components of biological diversity, and the measure can be through the “financial mechanism.” United Nations Framework Convention on Climate Change (UNFCCC) also states that each contracting party shall implement measures such as fiscal incentives to promote research and development of renewable energy. More details can be found in the annex table. Moreover, the UNFCCC Secretariat report (2007) clearly states that green subsidies to promote renewable energy can be an effective way to reduce greenhouse gas emissions, thereby those subsidies should be promoted.¹³ Recent

¹³ UNFCCC Secretariat report (2007) states that “Subsidies to support renewables and energy-efficient technologies can be an effective way of overcoming market barriers to their development and deployment, and helping to reduce greenhouse-gas emissions. In principle, taxing carbon-intensive fuels and activities can be a more economically efficient and practical approach to internalising external environmental costs than subsidising low- or zero-carbon fuels, but may be difficult politically. In practice, targeted subsidies to clean energy can play an important role in mitigating emissions as

Paris Agreement also encourages the contracting parties to implement positive incentive measures for environmental objectives in Article 5.

On the other hand, MEAs also contain norms regarding the trade effects of environmental measures. The OECD Polluter-Pays Principle (PPP) of 1972 is designed "to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment..." Furthermore, the PPP states that: (1) pollution prevention and control measures "should not be accompanied by subsidies that would create significant distortions in international trade and investment" and (2) "Measures taken to protect the environment should be framed as far as possible. in such a manner as to avoid the creation of non-tariff barriers to trade." In 1974, the OECD fashioned a follow-up PPP Recommendation positing the general rule that governments should not bear the costs of pollution control by conferring subsidies or tax advantages, and further providing that when such assistance is granted, it should be limited to well-defined transitional periods and should not create significant distortions in international trade and investment. Similarly, as noted above, the Rio Declaration's Principle 16 encourages the use of economic instruments "without distorting trade and investment." The UNFCCC also contains principles regarding trade impact. Specifically, the Convention states that "Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade."

part of a portfolio of market-based and regulatory measures.”

In summary, MEAs support green subsidies if the measure does not distort trade. Therefore, the pure export subsidy and the LCR subsidy are not supported by MEAs although those are used for the environmental purposes. By contrast, a domestic subsidy that is not embedded in an export can be supported because such a passive measure is not inherently distorting, protectionist or discriminatory.¹⁴

5.2. Green subsidies under the trade rules

Having explained the relevant MEA rules, this part now details how trade rules govern green subsidies. To preview the conclusion, the analysis demonstrates that WTO rules can make many useful green subsidies illegal. This can lead to more trade and environment disputes between countries because many countries may refrain from using MEAs-legitimate environmental measures that could have generated positive environmental outcomes.

¹⁴ This category includes “subsidies to domestic enterprises that cause adverse effects to foreign exporters seeking access to market of subsidizing country, some subsidies to domestic enterprises that export and thereby cause injury to industry in market of importing country, and some subsidies to domestic enterprises that export and thereby cause adverse effects to competing exporters seeking access to third country markets” See Charnovitz (2014)

5.2.1. History of green subsidies under the WTO

5.2.1.1 GATT System

In 1979, green subsidies were first mentioned in Article 11.1 of Subsidies Code as a policy instrument for the promotion of social and economic policy objectives. The Code stated that it does not restrict the right of signatories to use such subsidies to achieve environmental objectives.

The vague concept of green subsidies was fully structured in Article 8 of Agreement on Subsidies and Countervailing Measures (ASCM) under the WTO by devising 'Non-Actionable' sometimes informally called the 'Green-Light' category, which reads as follows:

8.2 Notwithstanding the provisions of Parts III and V, the following subsidies shall be non-actionable:

[...]

(c) assistance to promote adaptation of existing facilities³³ to new environmental requirements imposed by law and/or regulations which result in greater constraints and financial burden on firms, provided that the assistance:

- (i) is a one-time non-recurring measure; and*
- (ii) is limited to 20 per cent of the cost of adaptation; and*
- (iii) does not cover the cost of replacing and operating the assisted*

investment, which must be fully borne by firms; and

(iv) is directly linked to and proportionate to a firm's planned reduction of nuisances and pollution, and does not cover any manufacturing cost savings which may be achieved; and

(v) is available to all firms which can adopt the new equipment and/or production processes.

Until this green-light category was articulated in the WTO agreement, there was a lengthy and complicated negotiation history during the GATT period. There have been many attempts to legalize green subsidies from the beginning of the Uruguay Round subsidy negotiations in 1986-94. Those who supported this view were mainly developed countries such as EC, Switzerland and Canada. The EC argued that green subsidies should be non-actionable because they 'do not confer an advantage' on the recipient, and are unlikely to have any trade distorting effects.¹⁵ On the other hand, the United States opposed to this idea based on a premise that non-actionable subsidies may permit governments to simply redirect or relabel injurious subsidy programmes so as to shift from the prohibited to the permitted category.¹⁶ Basically, the United States advocated strong subsidy

¹⁵ Whereas the s polluter-pays-principle considered 'subsidies to polluters' as conferring an 'advantage', the EC's approach was that the environmental aid 'do not confer an advantage' on the recipient

¹⁶ See Elements of the Negotiating Framework, GATT Doc. No. MTN.GNG/NG10/W/20 (Jun. 15, 1988).

disciplines having tried to broaden the category of prohibited subsidies, and to block the creation for green-light category including green subsidies.¹⁷

The proponents' proposals prevailed at the beginning. Green subsidies were included as the non-actionable subsidy in the first two drafts of SCM Agreement. Similarly, the second and the third revised draft texts also identified green subsidies as non-actionable subsidies.¹⁸ However, the conditions of non-actionability for the green subsidies were more refined. Green subsidies was conditioned on whether such assistance would be granted to promote adaptation of existing facilities to new environmental requirements, or for new equipment that will reduce pollution further than required.¹⁹

¹⁷ The U.S also supported of integration of the developing countries into GATT disciplines. See Stewart, Terence P. 'GATT Uruguay Round: A Negotiating History (1986-1992) (1)', Boston: Kluwer Law and Taxation Publishers, 1993, p844.

¹⁸ See Draft Text by the Chairman, GATT Doc. No. MTN.GNG/NG10/W/38/Rev.2 (Nov. 2, 1990) [hereinafter Cartland III] and Agreement (1990) on Interpretation and Application of Articles VI, XVI and XXIII of the General Agreement on Tariffs and Trade in Draft Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Neogitations, Revision, GATT Doc.No.MTN.TNC/W/35/Rev.1 (Dec. 3, 1990) [hereinafter Cartland IV].

¹⁹ This was suggested by Switzerland in its proposal on November 27, 1989.

After twists and turns, Chairman Dunkel submitted a 'draft final', commonly referred to as the "Dunkel Text", to break the impasse in late 1991.²⁰ In the Dunkel Text, green subsidies have been removed from the types of non-actionable subsidies, which was presumably due to the US opposition. The EC and Canada proposed to change the coverage of the non-actionable subsidies, but as of the end of December 1992 there was no amendment to this text.

Surprisingly, however, green subsidies removed from the Cartland draft were resurrected in ASCM.²¹ This is related to the inauguration of the Clinton administration. The Clinton administration took the position of the United States shortly before completing the Uruguay Round Agreement. Compared to Regan and Bush administrations which tried to strengthen the subsidy regulations in the

²⁰ "In the years since the Uruguay Round began, major changes to GATT were proposed and debated, but by late 1991 negotiations were at an impasse. To break the impasse, GATT's Director General Arthur Dunkel submitted a 'draft final' set of amendments for consideration (called the Dunkel draft) in December 1991." In January, 1992 GATT's members agreed to use the Dunkel draft as a framework for negotiations." U.S. Congress, Office of Technology Assessment, Trade and environment: conflicts and opportunities, OTA-BP-ITE-94 (Washington, DC: U.S. Government Printing Office, May 1992), p24.

²¹ Furthermore, the R&D subsidies coverage was expanded in the ASCM compared to the Dunkel Text.

Uruguay Round, Clinton administration supported the non-actionable subsidies such as subsidies for pre-competitive research.²²

5.2.1.2. Article 8 of WTO SCM Agreement until 1999

Concluding the WTO Agreement on Subsidies and Countervailing Measures, member countries identified some green subsidies as non-actionable subsidies including subsidies for research activities on environment, pre-competitive development activity, and adaptation of existing facilities to new environmental requirement.²³ On the other hand, export subsidies and Local Content Requirement (LCR) subsidies were not legalized under the non-actionable subsidy rule, even though those subsidies on green products could be regarded as technology transfer consonant with international environmental objectives. A basic production subsidy, such as a FIT contract (Charnovitz 2014, p66) also did not meet the terms of Article 8. Nor would many of the other green subsidies such as tax credits, tax reductions, free distribution of emission allowances meet the terms (Lee 2011, pp.87-89).

This green-light provisions of Article 8 expired in 1999. From the beginning, the green-light provisions of Article 8 were provisional for five years, after which

²² Doane, Michael L. 'Green Light Subsidies: Technology Policy in International Trade', *Syracuse Journal of International Law and Commerce*, Spring 1995.

²³ See Article 8 of ASCM

the Committee shall review the operation of those provisions and extend their application, either as presently drafted or in a modified form, for a further period (Article 31 of the ASCM). At the meeting to discuss whether or not to extend the application of Article 8, the views of the Member States continued to diverge. The gap between the member countries could not be eliminated, and finally Article 8 of December 1999 expired.

A prevalent view among the proponents was that the loss of that provision would be viewed as a regressive step, and would reduce the ability of the Agreement to address environmental concerns. In Switzerland's view, WTO would give a rather negative and wrong signal to the public, by 'eliminating the possibility of subsidizing adaptation to new environmental laws.'²⁴ Switzerland further argued that it was probably not so much the more advanced countries, which often had quite strict environmental laws already in place, but rather those countries which would sooner or later also need to address environmental problems by introducing new laws and could in the future take advantage of provisions for such non-actionable subsidies.²⁵ Therefore the Switzerland supported an extension of the Article 8, for instance four or five years. The Switzerland believed it would be premature to change the framework of the Agreement. As there was still a lack of experience in dealing with non-actionable subsidies and there had not been notifications of subsidies referring to Article 8, the Switzerland stated that members needed a period during with the notification

²⁴ Minutes of the regular meeting held on 1-2 November 1999, G/SCM/M/24, WTO Committee on Subsidies and Countervailing Measures, 26 April 2000, para 24.

²⁵ Ibid. para 24.

procedure was functioning in a satisfactory way. The European Union also preferred to continue the provisions for a limited time, arguing that if Article 8 were discontinued, important parts of the structure of the Agreement would be removed from the Agreement as it was currently framed.²⁶ The United States was also in a position to join a consensus to continue the provisions for another limited period of time, as there was little experience in using them, but the delegate of the United States stated that the United States always had mixed views on that provisions.²⁷

On the other hand, most developing countries did not support extension mainly by the reason that Article 8 only included subsidies of interest to developed countries. Also, from the developing countries perspective, lower level of environmental law might be considered as a competitive advantage drawing more foreign direct investments. The Dominican Republic argued that Article 8 were among the most flagrant examples of imbalance in the WTO Agreements. A significant group of developing countries also had submitted proposals to address some implementation problems concerning subsidies.²⁸ For some developing countries, however, one alternative was that they could support an extension, if Article 8 is amended to reflect developing countries' concerns. The delegate of Pakistan stated that Pakistan could be in favor of an extension, if developing countries' concerns were taken into account and Article 8 is amended to include

²⁶ Ibid. para 39.

²⁷ Ibid, para 33.

²⁸ Ibid, para 22.

subsidies that suited the needs of the developing countries.²⁹ The delegate of Brazil also stated that the provisions should be changed to accommodate the concerns of the developing countries. In Brazil's view, for developing countries, it was not easy to use subsidies under the provisions due to resource constraints, and the 'non-specificity' requirement under Article 8.2 (b) made it too expensive to implement.³⁰

5.2.1.3. SCM Agreement from 1999 until present

After the expiry of Article 8, the green subsidies were governed by the general SCM agreement. It is the mainstream view that the SCM obligation is not subject to defense provided by GATT Article 20, GATS Article 14, GATT or GATS security exceptions. Therefore, after the expiration of Article 8, the WTO law on green subsidies is currently the SCM Convention. .

Currently in the Doha Round, divergent views still persist on the green subsidies. After the expiry of Article 8, the EC has paid attention to the issue of green subsidies. In the EC's view, certain subsidies have a positive impact on the environment, and the EC considers that it may be necessary to consider how to

²⁹ Ibid, para 31.

³⁰ Ibid, para 45.

approach subsidies aimed at the protection of the environment.³¹ Australia also sees merit in discussing green subsidies as non-actionable subsidies within the context of the ASCM. The socialist countries of Venezuela and Cuba also defend the revival of the green-light category, and, in particular, not only economic development subsidies, but also green subsidies. In its proposal, Venezuela asserted that ‘the Members should examine measures aimed at achieving legitimate development goals such as regional growth, technology research and development funding, production diversification and development, and implementation of environmentally sound methods of production.’³² On the other hand, for India, the permission of the green subsidies is tilted toward developed countries since only these countries have the financial resources to address environmental needs. Egypt has not made its position clear but posed some questions need to be addressed prior to a further examination of this issue.³³

³¹ WTO Negotiations Concerning the WTO Agreement on Subsidies and Countervailing Measures, Proposal by the European Communities TN/RL/W/30 (21 November 2002).

³² Improved Rules under the Agreement on Subsidies and Countervailing Measures - Non-Actionable Subsidies; Paragraph 10.2 of the Document on Implementation-Related Issues and Concerns, Proposal by Venezuela TN/RL/W/41 (17 December 2002).

³³ Egyptian Paper Containing Questions and Comments on the Contributions Submitted in the Framework of the Doha Negotiations in the Subsidies and Countervailing Measures Agreement, Proposal by Egypt TN/RL/W/57 (10 February 2003).

Furthermore, another important issue in the Doha mandate is the harmonization of WTO laws with trade measures in multilateral environmental agreements (MEAs). India, Canada, New Zealand as well as many other countries stand for the adaptation of Standard Trade Obligations (STOs), which ensure the compatibility of trade measures taken within MEAs with WTO rules. On the other hand, the EU and Switzerland are in positions that WTO laws should be renovated to ensure their compatibility with trade measures in MEAs.

5.2.2. Green subsidies under the SCM Agreement after the expiry of Article 8

If SCM Article 8 were still in force, some of WTO actionable subsidies might be allowed, but the expiry of the non-actionable subsidies clause reduced the policy space that countries had for their environmental measures.

To analyze what subsidies are allowed under the WTO, it is important to first examine the definition of subsidies under the WTO, because the operation of WTO SCM Agreement involves a two-step analysis: whether there is a ‘subsidy’ *within the meaning* of the Article 1 SCM Agreement, and if so, whether or not it is inconsistent with this agreement. With regards to the first definitional question, a ‘subsidy’ should be deemed to exist for the purpose of applying the SCM Agreement only if three cumulative conditions are met: (i) there must be a financial contribution (or income/price support) by a government or public body⁵⁰ (or by a private body ‘entrusted’ or ‘directed’ by a government); (ii) it must confer a benefit; (iii) it must be specific to certain enterprises.

According to the WTO, the definition of a specific subsidy is as follows. The definition contains three basic elements: (i) a financial contribution (ii) by a government or any public body within the territory of a Member (iii) which confers a benefit. All three of these elements must be satisfied in order for a subsidy to exist. The concept of “financial contribution” was included in the SCM Agreement only after a protracted negotiation. Some Members argued that there could be no subsidy unless there was a charge on the public account. Other Members considered that forms of government intervention that did not involve an expense to the government nevertheless distorted competition and should thus be considered to be subsidies. The SCM Agreement basically adopted the former approach. The Agreement requires a financial contribution and contains a list of the types of measures that represent a financial contribution, e.g., grants, loans, equity infusions, loan guarantees, fiscal incentives, the provision of goods or services, the purchase of goods. In order for a financial contribution to be a subsidy, it must be made by or at the direction of a government or any public body within the territory of a Member. Thus, the SCM Agreement applies not only to measures of national governments, but also to measures of sub-national governments and of such public bodies as state-owned companies.

A financial contribution by a government is not a subsidy unless it confers a “benefit.” In many cases, as in the case of a cash grant, the existence of a benefit and its valuation will be clear. In some cases, however, the issue of benefit will be more complex. For example, when does a loan, an equity infusion or the purchase by a government of a good confer a benefit? Although the SCM Agreement does not provide complete guidance on these issues, the Appellate Body has ruled (Canada – Aircraft) that the existence of a benefit is to

be determined by comparison with the market-place (i.e., on the basis of what the recipient could have received in the market). In the context of countervailing duties, Article 14 of the SCM Agreement provides some guidance with respect to determining whether certain types of measures confer a benefit. In the context of multilateral disciplines, however, the issue of the meaning of “benefit” is not fully resolved.

Assuming that a measure is a subsidy within the meaning of the SCM Agreement, it nevertheless is not subject to the SCM Agreement unless it has been specifically provided to an enterprise or industry or group of enterprises or industries. The basic principle is that a subsidy that distorts the allocation of resources within an economy should be subject to discipline. Where a subsidy is widely available within an economy, such a distortion in the allocation of resources is presumed not to occur. Thus, only “specific” subsidies, either *de jure* (legally targeted at a particular industry or enterprise or group of industries or enterprises) or *de facto* (in fact used only or disproportionately by a particular industry, enterprise, or group of industries or enterprises), are subject to the SCM Agreement disciplines. Article 2.1(b) of the SCM Agreement refines the concept of specificity:

Where the granting authority, or the legislation pursuant to which the granting authority operates, establishes objective criteria or conditions governing the eligibility for, and the amount of, a subsidy, specificity shall not exist, provided that the eligibility is automatic and that such criteria and conditions are strictly adhered to. The criteria or conditions

must be clearly spelled out in law, regulation, or other official document, so as to be capable of verification.

Therefore, the definition of a subsidy in the SCM Agreement is a broad one, but not every measure that an observer might consider a subsidy is covered under SCM. In general, for a subsidy to be found to exist, there must be a financial contribution by a government and this contribution must benefit the recipient of the subsidy. Measures that generate financial benefit for a recipient via a government regulation are not a subsidy under SCM rules because there is no financial contribution. In other words, the form of instrument used is a pivotal factor in the SCM Agreement, and just because a measure exerts a market effect equivalent to a subsidy does not transmogrify such measure into a subsidy.

Based on the definition above, there are three types of green subsidies. The first type is environmental measure that fall outside the scope of the subsidy definition. If a measure is outside the scope of this definition, the measure is deemed to be unqualified as a subsidy thereby allowed under the WTO. The existence of subsidies under the SCM Convention requires (a) a financial contribution by a government or public body, (b) a benefit thereby conferred, and (c) a specificity. If the form of the subsidy does not meet these three conditions, this measure is not subsidy under the WTO and is therefore permitted under the WTO.³⁴

³⁴ If a measure is found to be a subsidy, the measure has a status of actionable subsidies or prohibited subsidies. Export subsidies and import substitute subsidies are prohibited subsidies under the SCM. Prohibited subsidies are illegal per se without

Examples of this first type of green subsidies are a non-specific green subsidies i.e. generally available green subsidies; a government's purchase of environmental or ecosystem services; governmental provision of general infrastructure for renewable energy; and the government's research in national labs on environment. Further examples of green subsidies in this category are as below:

- Non-specific subsidies. Generally available subsidies
- a government's purchase of environmental or ecosystem services lies outside the definition of a financial contribution. (e.g. compensation paid to farmers or landowners for maintaining their land's ability to provide ecosystem services (World Bank 2012, p. 23).
- the government can purchase an environmental right, such as a conservation easement, and the purchase of rights (as opposed to the granting of rights) is not a financial contribution³⁵
- the government may purchase environmental goods for its own use (e.g. Government may purchase electric cars without subsidizing the electric car industry.)

showing any adverse effects. (Note that least developed countries designated by United Nations are not applied by the export subsidy discipline.) In comparison, for actionable subsidies to be illegal, a condition of the adverse effects to the interests of other members is required.

³⁵ Charnovitz(2014), p42.

- governmental provision of general infrastructure³⁶
- the government's research in national labs
- the allocation of funds by international agencies or international financial institutions
- government's regulation benefiting a specific industry (e.g the government can mandate greater automotive fuel economy without thereby giving a financial contribution to automotive producers.)³⁷

The second type is WTO-illegal subsidies per se. These are export subsidies and import substitution subsidies. For these subsidies, specificity is presumed and does not have to be proven by the claimant. These subsidies cannot be used even if they improve the environment. An export subsidy is a subsidy contingent upon export performance in law or in fact.³⁸ An import substitution subsidy is a subsidy contingent upon the use of domestic over imported goods.³⁹ These measures are assumed to cause adverse effects on other countries under the WTO.

The third type is the measures that are defined as subsidies under the WTO but are not certain whether the measure is legal or illegal. These are the WTO

³⁶ This carve-out provides important policy space to governments to spend money on major projects that will not constitute a financial contribution even though they do benefit particular enterprises (Bankes, Boute, Charnovitz, Hsu, McCall, Rivers & Whitsitt 2013, pp. 298–300)

³⁷ Charnovitz(2014), p42.

³⁸ SCM Art. 3.1(a).

³⁹ SCM Art. 3.1(b).

actionable subsidies. Unless the actionable subsidies cause adverse effects to either the import-competing or export-competing interests of another WTO member, the measure is allowed under the WTO.⁴⁰ One example is the

⁴⁰ The problem is that the SCM Agreement does not define "actionable" subsidies (Gauthier 2000, p. 180). As a result, an ambiguity exists in the meaning of an actionable subsidy. Two definitional options exist: One is that all specific subsidies are actionable, and the second is that a specific subsidy is actionable (and hence illegal) when it causes adverse effects. In its only decision addressing this issue, the Appellate Body can be read to endorse the second option in stating that "actionable subsidies are not prohibited per se; rather, they are actionable to the extent they cause adverse effects" (Chartnovitz 2010). Commentators take both sides of this debate. For example, Gustavo E. Luengo Hernández de Madrid explains that the category of actionable subsidies includes "those specific subsidies that can be challenged using the WTO dispute settlement system" (Luengo Hernández de Madrid 2007, p. 166). Mitsuo Matsushita, Thomas J. Schoenbaum, and Petros C. Mavroidis write that "Actionable subsidies are defined by default: all government schemes which qualify as subsidies, and which are neither prohibited nor non-actionable, are, in principle, actionable subsidies" (Matsushita, Schoenbaum & Mavroidis 2006, p. 360). On the other hand, Peter Van den Bossche (now on the Appellate Body) writes that "Unlike subsidies and import substitution subsidies, most subsidies are not prohibited but are 'actionable', i.e., they are subject to challenge in the event that they cause adverse effects on the interests of another Member" (Van den Bossche 2008, p. 577). And according to the WTO's Dictionary of Trade Policy Terms, subsidies "may be actionable, and therefore illegal, if they cause injury to the domestic industry of another member, negate other commitments under the GATT, or cause serious prejudice to the interests of another member" (Goode 2007, p. 4).

government's green subsidies for companies that sell services only. Other examples are as below.⁴¹

- Subsidies which does not cause adverse effects. (ex. Government subsidy to an enterprise that sells only services.⁴²)
- For subsidies as the cause of action for serious prejudice based on displacing or impeding an export, when any of the following circumstances exist:
 - (a) prohibition or restriction on exports of the like product from the complaining Member or on imports from the complaining Member into the third country market concerned;
 - (b) decision by an importing government operating a monopoly of trade or state trading in the product concerned to shift, for non-commercial reasons, imports from the complaining Member to another country or countries;
 - (c) natural disasters, strikes, transport disruptions or other *force majeure* substantially affecting production, qualities, quantities or prices of the product available for export from the complaining Member;
 - (d) existence of arrangements limiting exports from the complaining Member;
 - (e) voluntary decrease in the availability for export of the product concerned from the complaining Member (including, *inter alia*, a situation where firms in the complaining Member have been

⁴¹ SCM Art. 6.7

⁴² Charnovitz, p45.

autonomously reallocating exports of this product to new markets);
(f) failure to conform to standards and other regulatory requirements in the importing country.

"Adverse effects" in actionable subsidies is defined in SCM Article 5. Adverse effects include injury to the domestic industry of another Member and serious prejudice. Serious prejudice under SCM Article 5(c) occurs when the subsidy has a displacing, impeding or price-cutting effect on the export interests of a WTO member. The precise rule is spelled out in SCM Article 6. According to one WTO panel, SCM "Article 6.3 does not attempt to define any qualitative or quantitative aspects of the subsidy: its effects-based focus embraces a subsidy of any nature that has the adverse effects enumerated and is therefore 'actionable.'" Both types of subsidies, that is export subsidies and domestic (or internal) subsidies, can have adverse trade effects. For example, Country A's export subsidy and its domestic subsidy can impact export-seeking Country B. Similarly, both Country A's export subsidy and its domestic subsidy can cause trade injury to import-competing Country C.

However, the problem is that as the analysis of adverse effects will always be fact-dependent, many specific subsidies can be challenged under the WTO.⁴³

⁴³ "Most subsidies, such as production subsidies, fall in the "actionable" category. Actionable subsidies are not prohibited. However, they are subject to challenge, either through multilateral dispute settlement or through countervailing action, in the event that they cause adverse effects to the interests of another Member. There are three types of adverse effects. First, there is injury to a domestic industry caused by subsidized imports in the territory of the complaining Member. This is the sole basis

Moreover, many of the most popular green subsidies are in this category (e.g. FIT). Therefore these can refrain governments from using many useful green subsidies.

In summary, as MEAs specifically warn against measures that distort trade, there is no conflict in governing WTO- illegal subsidies. However, a question may arise in governing WTO-actionable green subsidies, because the actionable subsidies are not inherently distorting, protectionist, or discriminatory. The actionable subsidies are supported by MEAs unless they do not cause the adverse effects.⁴⁴

for countervailing action. Second, there is serious prejudice. Serious prejudice usually arises as a result of adverse effects (e.g., export displacement) in the market of the subsidizing Member or in a third country market. Thus, unlike injury, it can serve as the basis for a complaint related to harm to a Member's export interests. Finally, there is nullification or impairment of benefits accruing under the GATT 1994. Nullification or impairment arises most typically where the improved market access presumed to flow from a bound tariff reduction is undercut by subsidization.” See https://www.wto.org/english/tratop_e/scm_e/subs_e.htm

⁴⁴ When a multilateral environment agreement authorizes trade in a specific product between its parties, but ban trade in the same product with countries that have not signed the agreement, this could be found to be incompatible with WTO’s non-discrimination principle known as “most favoured nation treatment”, which requires countries to grant equivalent treatment to the same (or “like”) products imported from any WTO member country.

Five disputes related to renewable energy have been initiated under the SCM, although only two have produced WTO panel and Appellate Body reports that can help clarify the WTO approach towards such types of governmental support. The only two disputes that have produced panel and Appellate Body reports are Canada—Feed-In Tariff Program and Canada—Renewable Energy, brought against Canada by the EU and Japan, respectively.

The same Canadian measures and WTO provisions were at issue in both disputes. Both the EU and Japan challenged a FIT program established by the Canadian province of Ontario in 2009. Like all FIT programs, Ontario's set high, guaranteed, long-term prices at which renewable energy generation facilities could sell their product.⁴⁵ However, Ontario's FIT also required a certain percentage of labor and manufacturing input in order to be eligible for the program. The complainants argued that this eligibility requirement was a local content requirement, and therefore the FIT program was prohibited under SCM Article 3.

The European Union claimed that the measures are inconsistent with Canada's obligations under Article III:4 and III:5 of the GATT 1994 because they appear to be laws, regulations or requirements affecting the internal sale, offering for sale, purchase, transportation, distribution, or use of equipment for renewable energy generation facilities that accord less favourable treatment to imported equipment than that accorded to like products originating in Ontario; that the

⁴⁵ *Canada Panel Reports, supra note 43.*

measures could be internal quantitative regulations relating to the mixture, processing or use of a specified amount or proportion of equipment for renewable energy generation facilities which require that equipment for renewable energy generation facilities be supplied from Ontario sources; and that the measures appear to require the mixture, processing or use of equipment for renewable energy generation facilities supplied from Ontario in specified amounts or proportions, being applied so as to afford protection to Ontario production of such equipment, contrary to the principles of Article III:1 of the GATT 1994.⁴⁶

On the issue whether the measure constitutes subsidies under the SCM Agreement, the Appellate Body upheld the Panel's finding that the measures at issue constituted financial contributions in the form of government purchases of goods within the meaning of Art. 1.1(a)(1)(iii). However, The Appellate Body reversed the Panel majority's finding that the European Union and Japan failed to establish that the challenged measures conferred a benefit. The Appellate Body found that the Panel was mistaken in using the market for electricity generated from all sources of energy as the relevant market for comparison in determining benefit.⁴⁷ The Appellate Body considered that, in defining the relevant market, the Panel should have undertaken an analysis of demand-side and supply-side factors. Such an analysis would have shown that producers of wind- and solar PV-generated electricity did not compete with other electricity producers, because of differences in cost structures and operating costs. This would have led the Panel to conclude that the relevant market for the benefit comparison was the

⁴⁶ Id.

⁴⁷ Id.

market for wind- and solar PV-generated electricity. The Appellate Body, however, was unable to determine whether the challenged measures conferred a benefit within the meaning of Art. 1.1(b), due to the lack of a sufficient factual basis to complete the analysis. As a result, there was no finding as to whether the measures at issue were prohibited subsidies under ASCM Arts. 3.1(b) and 3.2.⁴⁸

The FIT programme at issue was not made subject to WTO subsidy disciplines because the Appellate Body was unable to complete the analysis of whether it constituted a subsidy covered by that agreement in the first place. However, what can be concluded from the analysis above is that both panel and Appellate Body have acknowledged that Ontario's feed-in-tariff scheme was a financial contribution in the form of a 'government purchase of goods' as per Article 1.1(a)(1)(iii) SCM Agreement, so as to not leave much space to states' policies in favor of renewables.

5.2.3. Regional trade agreements

While little progress is being made for the green subsidies in the WTO after the expiry of green-light category provision, RTAs advanced more and more for environment and climate objectives, and trade-related environmental concerns are being integrated increasingly in the regional agreement level. As countries can negotiate environmental commitment that go beyond what has been possible

⁴⁸ Id.

multilaterally, many RTAs provide higher level of protections in dealing with environmental issues than WTO Agreements.

Recent RTAs increasingly incorporate environmental provisions after early 1990s. Before then, RTAs often incorporated environmental issues only in the preamble or general exceptions. It was NAFTA (1994) which firstly included the substantive environmental provisions. This also included a side agreement, the North American Agreement on Environmental Cooperation (NAAEC).

RTAs can be classified into two types in general based on the degree of environmental commitment. First type is the RTAs that incorporate substantive environmental provisions going beyond the WTO standards. WTO's environmental commitments regarding subsidies are the Preamble of the Marrakesh Agreement and GATT Article XX.⁴⁹ An RTA is considered to be included in this first type if it includes not only these two commitments of the WTO but also other substantive environmental provisions going beyond the WTO. The second type of agreements, on the other hand, has environmental

⁴⁹ The preamble states that sustainable development and environmental protection are goals of the WTO and the GATT Article XX sets out that measures are compatible with GATT/WTO rules if they are 'b)...necessary to protect human, animal or plant life or health', and 'g)...relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.'

commitments not going beyond the WTO. If an RTA includes less than the two WTO commitments, it is regarded as the second type.

One of the substantive environmental provisions of RTAs is a provision on ‘legal precedence of MEAs.’⁵⁰ This provision roots from NAFTA in 1994.⁵¹ And presumably under the influence of NAFTA, most RTAs signed by Canada provide this provision.⁵² It provides that obligations of MEAs shall prevail, in case of any ‘inconsistency’ between the provisions and specific trade obligations set out in certain multilateral and bilateral environmental agreements. Most RTAs which include this provision provide a list of MEAs.⁵³ Considering that a conflict between the WTO and MEAs is an unresolved problem, giving legal precedence of MEAs over obligations of RTAs can complicate the situation.

⁵⁰ This provision is not found in type A RTAs.

⁵¹ Article 104 (Relation to Environmental and Conservation Agreements) of NAFTA

⁵² Examples are Canada-Peru FTA in 2009, Canada-Colombia FTA in 2011, Canada-Jordan FTA in 2012, Canada-Panama FTA in 2013, Canada-Honduras FTA in 2014, and Canada-Korea FTA in 2015.

⁵³ For example, lists of NAFTA and Canada-Chile FTA include CITES, Montreal, Basel.

Another one is reaffirmation of the commitment to the Kyoto Protocol.⁵⁴ This provision is found in the recent RTAs signed by EU.⁵⁵ When the commitment to the Kyoto protocol is stated in the RTAs, they reaffirm their commitment to effectively implement in their law the multilateral environmental agreements (MEAs) to which they are party.⁵⁶ And this commitment is backed up by a provision which states ‘nothing in this Agreement shall prevent the Parties from adopting or maintaining measures to implement the MEAs to which they are party’.⁵⁷

⁵⁴ The EU-Colombia-Peru FTA also reaffirms the commitment to CBD and Cartagena protocol. This is also noteworthy because CBD recognizes the sovereign rights of states over their natural resources, and states each party shall take legislative or policy measures through the financial mechanism. Cartagena protocol also urges parties to allocate adequate financial resources for the implementation of the environmental plan.

⁵⁵ EU-Korea FTA, EU-Georgia FTA, EU-Rep.of Moldova reaffirm the commitment to UNFCCC and Kyoto Protocol, and EU-Colombia and Peru FTA does to CBD, UNFCCC, Kyoto Protocol, and Cartagena Protocol.

⁵⁶ Although they do not guarantee ‘legal precedence of MEAs’, when the Kyoto protocol is included in the list of MEAs, but the effect of provisions seems not different.

⁵⁷ For example, EU-Georgia FTA states that ‘the Parties reaffirm their commitment to reaching the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) and the Protocol thereto (Kyoto Protocol). They commit to cooperate on the development of the future international climate change framework under the UNFCCC and its related agreements and decisions.’ See Article 230 of EU-Georgia FTA

In addition, there are other substantive environmental provisions such as ‘enforcement of environmental laws’, ‘environmental co-operation’, ‘consultations and exchange of information on environmental matters’, ‘formal dispute settlement mechanism for environmental matters’, and ‘public participation in environmental matters.’ Some RTAs also contain separate environmental agreements.⁵⁸

In addition to the sheer number of provisions, environmental provisions have also both broadened and deepened (Jinnah and Morgera, 2013). In terms of broadening, following the publication of the 2006 Global Europe Strategy (European Commission, 2006), EU trade agreements have included linkages to a wider number of multilateral environmental agreements. In terms of deepening, US trade agreements have become increasingly specific about the environmental action required, backed up by consultations and dispute settlement procedures in the agreement.

The trend of including environmental provisions has continued also in the mega-regionals, whose ‘deeper’ and more encompassing approach has allowed for the inclusion of environmental and sustainable development considerations. Chapter 20 of the TPP and Chapter 24 of CETA are dedicated fully to environmental issues, and a chapter on trade and sustainable development is the subject of ongoing TTIP negotiations (Frey, 2015; Leal-Arcas, 2015).

⁵⁸ See “Measuring the Degree of Commitment of Environmental Provisions in Regional Trade Agreements”, COM/TAD/ENV/JWPTE/RD(2014)30, OECD, 26-May-2014.

However, extensive environmental provisions in RTAs do not necessarily confer enlarged policy space for ‘environmental subsidies,’ since the policy space is affected not only by environmental provisions but also subsidy provisions. Some RTAs have a provision which states ‘the WTO Agreement exclusively governs the rights and obligations of the Parties regarding subsidies.’ For example, the 2014 Canada-Honduras FTA has both an environmental chapter and an environmental side agreement, but it stated that the subsidies matters are exclusively governed by the WTO Agreement. Therefore, to discuss the policy space for environmental subsidies in RTAs, it is necessary to look not only into environmental provisions but also subsidy provisions.

5.2.3.1. Subsidy provisions of RTAs

In the first level, we can classify subsidy provisions of RTAs into three categories. The first group of RTAs is those RTAs that do not provide any rules on subsidies at all. For example, the North American Free Trade Agreement (NAFTA) does not provide any subsidy provisions. A second group of RTAs contains rules on subsidies which simply governed by the SCM Agreement. For example, Canada-Peru FTA is governed by SCM Agreement regarding subsidies. It states that the rights and obligations of the Parties in respect of subsidies ‘shall be governed by Articles VI and XVI of the GATT 1994 and the WTO Agreement on Subsidies and Countervailing Measures.’ Not only Canada-Peru FTA but most of RTAs

signed by EC/EU or Canada are included in this type.⁵⁹ ⁶⁰ The third are RTAs with specific subsidy provisions. For example, EU-Rep. of Moldova FTA provides its own definition of subsidies.

In the second level, we can analyze in detail on the third type of RTAs. Firstly, of those RTAs with specific provisions on subsidies, there are some RTAs that we consider weaker rules than the WTO. In case of the EU-Georgia FTA and the EU-Colombia-Peru FTA, they only provide a definition of a subsidy. These two FTAs state that the definition of a subsidy follows the definition set out in Article 1.1 of ASCM and be specific within the meaning of ASCM Article 2. They also state that the CVDs rule is also governed by the ASCM. However it does not provide which subsidies are actionable or prohibited.⁶¹ This is compared to EFTA-Albania or Canada-Peru FTA, which explicitly confirm each party's rights and obligations under the SCM Agreement. Under the EFTA-Albania or Canada-Peru FTA, not only the definition but also subsidy rules on prohibited subsidies or actionable subsidies are governed by the WTO. That is, by adopting only a part of subsidy rules from the SCM Agreement, the EU-Georgia FTA and the EU-Colombia-Peru FTA provide more lenient subsidy rules than the WTO. Another case is the EU-Rep. of Moldova FTA. Instead of following the definition

⁵⁹ In case of RTAs signed by EU, most of them include a provision which states 'the provisions of this Chapter are without prejudice to the rights and obligations of a Party under the WTO Agreement, in particular the SCM Agreement.'

⁶⁰ In case of RTAs signed by Canada, most of them include a provision which states 'the WTO Agreement exclusively governs the rights and obligations of the Parties regarding subsidies.'

⁶¹ Although it provides that each party has rights to apply trade remedies in accordance with the relevant WTO provisions, but which subsidies are actionable or prohibited are not provided.

given in ASCM, EU-Rep. of Moldova FTA provides its own definition of ‘state aid’ in the chapter of ‘competition.’ It simply states that the state aid which distorts or threatens to distort competition and which affects trade between the Parties shall be incompatible with the Agreement.⁶² And then it generally states that trade-distorting subsidies are not compatible with the Agreement, adopting EU’s subsidy rules to assess state aid, which are by comparison more generous than that of WTO.⁶³

Secondly, some RTAs have subsidy provisions that support environmental subsidies. The case in point is EU-Singapore FTA and EU-Ukraine FTA. EU-Ukraine FTA has subsidy provisions that permit environmental subsidies under certain conditions. In the first paragraph of general principles of ‘states aid’, the EU-Ukraine FTA simply states that any state aid which distorts competition is incompatible with the Agreement insofar as it may affect trade between the parties. However in the next paragraph, FTA assigns more in providing the lists of allowed state aids, and environmental subsidy is one of such allowed state aids. According to this paragraph, if the environmental subsidy is to comply with the listed mandatory standards, within the implementation period provided, and

⁶² Chapter 10 Competition, Section 2 State Aid, Article 339 General principles and scope

⁶³ Chapter 10 Competition, Section 2 State Aid, Article 340 Assessment of state aid: ‘1. State aid shall be assessed on the basis of the criteria arising from the application of the competition rules applicable in the EU, in particular Article 107 of the Treaty on the Functioning of the European Union and interpretative instruments adopted by the EU institutions, including the relevant jurisprudence of the Court of Justice of the European Union.’

involving adaptation of plant and equipment to meet the new requirements, it can be authorised up to the level of 40 % gross of the eligible costs.⁶⁴

Similarly, subsidy provisions of EU-Singapore FTA⁶⁵ allow subsidies for environmental purposes, but they are explained in the footnote section of the annexes in a more cautious manner.⁶⁶ Similar to the SCM Agreement which divides subsidies⁶⁷ into prohibited subsidies and actionable subsidies, the EU-Singapore FTA categorizes subsidies into prohibited subsidies and ‘other subsidies.’⁶⁸ And similar to the actionable subsidies of the SCM Agreement in

⁶⁴ “(f) aid for investment to comply with the mandatory standards of the EU directives listed in Annex XXIX to Chapter 6 (Environment) of Title V of this Agreement, within the implementation period provided for therein, and involving adaptation of plant and equipment to meet the new requirements, can be authorised up to the level of 40 % gross of the eligible costs.” (It seems that Annex XXX was misrepresented to Annex XXIX. Annex XXIX is the annex to Chapter 5.)

⁶⁵ EU-Singapore FTA was concluded in December 2012 and expected to take in force in this year. EU-Singapore FTA is modeled after Korea-EU FTA. Although the structures of agreement and concession levels are similar between two agreements, there are some differences reflecting distinct characteristics of each country. One of the differences is provisions of subsidies. Compared to Korea-EU FTA which does not have much difference from SCM Agreement, the EU-Singapore FTA has more concrete provisions but less stricter than WTO subsidy rules.

⁶⁶ ‘where such aid does not affect conditions of trade of either Party and competition between the Parties’ See Annex 12-A and Footnote 1 of Annex 12-A of EU-Singapore FTA.

⁶⁷ In the EU-Singapore agreement, a subsidy shall be subject to the chapter twelve (competition and related matters), only if it is specific within the meaning of Article 2 of the SCM Agreement.

⁶⁸ Article 12.8 Other Subsidies

1. The Parties agree to use their best endeavours to remedy or remove through the application of their competition laws or otherwise, distortions of competition caused by other specific subsidies related to trade in goods and services which are not covered by Article 12.7 (Prohibited Subsidies), insofar as they affect or are likely to affect trade of either Party, and to prevent the occurrence of such situations. Annex

which the parties may use remedies when adverse effects arise, the EU-Singapore FTA enables the parties to use their best endeavours to remedy or remove distortions caused by ‘other subsidies,’ insofar as they affect or are likely to affect trade of either party. If subsidies do not affect trade, the parties cannot use remedy thereby allowed under the EU-Singapore FTA. The annexes provide a list of types of ‘other subsidies’ which do not produce these ‘distorting effects’ on trade. The annex states subsidies to facilitate the development of certain economic activities or of certain economic areas may be granted by a Party when they are necessary to achieve an objective of public interest, and when the amounts of the subsidies involved are limited to the minimum and their effect on trade of the other Party is limited.⁶⁹ And the footnote to the annexes provides that such category may include subsidies for ‘environmental purposes.’⁷⁰ In a nutshell, according to the provisions, annexes, and footnote to the EU-Singapore FTA, subsidies for environmental purposes are one of the subsidy types resulting in no trade distorting effects, therefore these subsidies can be granted when they are necessary for public interest and the subsidy amount needed is minimum to achieve. It is noteworthy since this kind of subsidy provisions can be regarded as a resurrection of non-actionable subsidies category.

12-A contains guidance in particular on the types of subsidies which do not produce these effects.

⁶⁹ This is like the expired ‘non-actionable’ category under the SCM Agreement. See Annex 12-A ‘Principles Applicable to Other Subsidies’ of the EU-Singapore FTA.

⁷⁰ Footnote of Annex 12-A provides ‘This category may include but is not limited to, subsidies for clearly defined research, development and innovation purposes, subsidies for training or for the creation of employment, subsidies for environmental purposes, and subsidies in favour of small and medium-sized companies, defined as companies employing fewer than 250 persons.’

5.2.3.2. Environmental provisions of RTAs

With the global interest in environmental issues, recent RTAs increasingly incorporate environmental provisions after early 1990s. Before then, RTAs often incorporated environmental issues only in the preamble or general exceptions. It was NAFTA (1994) which firstly included the substantive environmental provisions. This also included a side agreement, the North American Agreement on Environmental Cooperation (NAAEC).

RTAs can be classified into two types in general based on the degree of environmental commitment. First type is the RTAs that incorporate substantive environmental provisions going beyond the WTO standards. WTO's environmental commitments regarding subsidies are the Preamble of the Marrakesh Agreement and GATT Article XX.⁷¹ An RTA is considered to be included in this first type if it includes not only these two commitments of the WTO but also other substantive environmental provisions going beyond the WTO. The second type of agreements, on the other hand, has environmental commitments not going beyond the WTO. If an RTA includes less than the two WTO commitments, it is regarded as the second type.

⁷¹ The preamble states that sustainable development and environmental protection are goals of the WTO and the GATT Article XX sets out that measures are compatible with GATT/WTO rules if they are 'b)...necessary to protect human, animal or plant life or health', and 'g)...relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.'

One of the substantive environmental provisions of RTAs is a provision on ‘legal precedence of MEAs.’⁷² This provision roots from NAFTA in 1994.⁷³ And presumably under the influence of NAFTA, most RTAs signed by Canada provide this provision.⁷⁴ It provides that obligations of MEAs shall prevail, in case of any ‘inconsistency’ between the provisions and specific trade obligations set out in certain multilateral and bilateral environmental agreements. Most RTAs which include this provision provide a list of MEAs.⁷⁵ Considering that a conflict between the WTO and MEAs is an unresolved problem, it is noteworthy that it gives a ‘legal’ precedence of MEAs over obligations of RTAs.

Another one is reaffirmation of the commitment to the Kyoto Protocol.⁷⁶ This provision is found in the recent RTAs signed by EU.⁷⁷ When the commitment to the Kyoto protocol is stated in the RTAs, they reaffirm their commitment to effectively implement in their law the multilateral environmental agreements (MEAs) to which they are party.⁷⁸ And this commitment is backed up by a

⁷² This provision is not found in type A RTAs.

⁷³ Article 104 (Relation to Environmental and Conservation Agreements) of NAFTA

⁷⁴ Examples are Canada-Peru FTA in 2009, Canada-Colombia FTA in 2011, Canada-Jordan FTA in 2012, Canada-Panama FTA in 2013, Canada-Honduras FTA in 2014, and Canada-Korea FTA in 2015.

⁷⁵ For example, lists of NAFTA and Canada-Chile FTA include CITES, Montreal, Basel.

⁷⁶ The EU-Colombia-Peru FTA also reaffirms the commitment to CBD and Cartagena protocol. This is also noteworthy because CBD recognizes the sovereign rights of states over their natural resources, and states each party shall take legislative or policy measures through the financial mechanism. Cartagena protocol also urges parties to allocate adequate financial resources for the implementation of the environmental plan.

⁷⁷ EU-Korea FTA, EU-Georgia FTA, EU-Rep.of Moldova reaffirm the commitment to UNFCCC and Kyoto Protocol, and EU-Colombia and Peru FTA does to CBD, UNFCCC, Kyoto Protocol, and Cartagena Protocol.

⁷⁸ Although they do not guarantee ‘legal precedence of MEAs’, when the Kyoto

provision which states ‘nothing in this Agreement shall prevent the Parties from adopting or maintaining measures to implement the MEAs to which they are party’.⁷⁹

In addition, there are other substantive environmental provisions such as ‘enforcement of environmental laws’, ‘environmental co-operation’, ‘consultations and exchange of information on environmental matters’, ‘formal dispute settlement mechanism for environmental matters’, and ‘public participation in environmental matters.’ Some RTAs also contain separate environmental agreements.⁸⁰

protocol is included in the list of MEAs, but the effect of provisions seems not different.
⁷⁹ For example, EU-Georgia FTA states that ‘the Parties reaffirm their commitment to reaching the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) and the Protocol thereto (Kyoto Protocol). They commit to cooperate on the development of the future international climate change framework under the UNFCCC and its related agreements and decisions.’ See Article 230 of EU-Georgia FTA

⁸⁰ See “Measuring the Degree of Commitment of Environmental Provisions in Regional Trade Agreements”, COM/TAD/ENV/JWPTE/RD(2014)30, OECD, 26-May-2014.

5.2.3.3. Framework to understand the governance on green subsidies under RTAs

Based on aforementioned subsidy provisions and environmental provisions, this paper suggests a theoretical framework for the purpose of better understanding the governance on the green subsidies under RTAs.

Considering the primary purpose of subsidy rules is to regulate trade-distorting subsidies, it is natural that the focus of subsidy provisions is on preventing the use of trade-distorting subsidies. Therefore, the subsidy provisions function to ‘reduce’ policy space for the environmental subsidies.⁸¹ On the other hand, as environmental rules aim to encourage the use of environmental measures, environmental provisions come to ‘expand’ environmental measures including subsidies.

As such, the stronger the subsidy provisions, the less policy space for environmental subsidies, whereas the stronger the environmental provisions, the broader policy space for environmental subsidies. Based on this logic, the dimensions of policy space for the environmental subsidies can be comparably explained. There can be four types of RTAs: (A) strong environmental provisions

⁸¹ Certain environmental measures, such as feed-in tariff schemes for renewable energy, have been the subject of dispute at the WTO with regards to their consistency with the Subsidies and Countervailing Measures Agreement. As one may expect, the report from the Panel and Appellate Body addresses several salient interpretations over the SCM Agreement regarding environmental measures for renewable energy. Being outside the immediate scope of this paper, WTO disputes will not be reviewed here. What we want to emphasize at this point is that the way environmental subsidies are justified under the SCM Agreement is not straightforward.

and weak subsidy provisions; (B) strong environmental provisions and strong subsidy provisions; (C) weak subsidy provisions and weak environmental provisions; (D) weak environmental provisions and strong subsidy provisions.

5.2.3.4. RTAs in Type A: strong environmental provisions vs weak subsidy provisions

RTAs in Type A have the largest policy space for environmental subsidies, since they have the most lenient subsidy rules while environmental provisions are the strongest among the four types of agreements. Suppose that an RTA provides, for instance, an environmental provision that permit environmental measures or incentives to solve pollution issues, and also provides a subsidy provision which allow subsidies for environmental protections. In this case, with such two provisions, each party may have policy space to use environmental subsidies under RTAs. There are only a couple of cases of this Type A RTAs. Those are EU-Singapore FTA and EU-Ukraine FTA, and EU-Ukraine FTA which has not only subsidy provisions that permit environmental subsidies as aforementioned, but also substantive environmental provisions such as ‘a legal precedence of MEAs’, and ‘commitment to Kyoto protocol.’

This second case of the two RTAs is like a resurrection of non-actionable subsidies category. Despite their strong environmental provisions, it is not necessary to examine them because they already allow environmental subsidies in the subsidy provisions. However, the first case of RTAs does not allow direct

inclusion of environmental subsidies in subsidy provisions, unlike the environmental provision of the second case. Considering, as noted above, that the purpose of a subsidy provision is to regulate the use of subsidies, unless subsidy provisions explicitly allow environmental subsidies, any parties who do not stand for environmental subsidies can interpret subsidy provisions as a basis against the use of environmental subsidies. In other words, there is some controversy whether environmental subsidies are allowed under the first case of RTAs. Therefore, the first case of RTAs has smaller policy space than the second case.

5.2.3.5. RTAs in Type B: Strong environmental provisions vs strong subsidy provisions

RTAs in Type B provide not only strong environmental provisions but also strong subsidy provisions. We can find several RTAs corresponding to this type. Examples are Canada-Peru FTA, Canada-Panama FTA, Canada-Jordan FTA, Canada-Honduras FTA, and Switzerland-China FTA. Mostly are the FTAs signed by Canada.

Regarding the subsidy provisions, contrary to Type A Agreements, these RTAs provide strict provisions. These RTAs provide that the WTO Agreement exclusively governs the rights and obligations of the Parties in respect of subsidies. For example, Switzerland-China FTA provides that ‘the rights and obligations of the Parties in respect of subsidies and countervailing measures

shall be governed by Articles VI and XVI of the GATT 1994 and the WTO Agreement on Subsidies and Countervailing Measures'. Similarly, Canada-Peru FTA, Canada-Jordan FTA, and Canada-Panama FTA states that 'the WTO Agreement exclusively governs the rights and obligations of the Parties regarding subsidies'.

On the other hand, regarding environmental provisions, similar to those in Type A agreements, these FTAs affirm the parties' environmental obligations under multilateral environmental agreements and providing the legal precedence of MEAs. The problem is that the environmental provision on 'legal precedence of MEAs' supports the use of some SCM 'actionable' subsidies for environmental purposes.⁸² Of course MEAs do not allow the use of the two SCM prohibited subsidies.⁸³ Because MEAs articulate that they do not support the use of inherently trade distorting, protectionist, or discriminatory subsidies. However, a subsidy 'not' inherently trade distorting, protectionist, or discriminatory such as some actionable subsidies is supported by the MEAs.

These two strong provisions provide important emerging regulatory conflict between trade rules and environment rules. Interestingly, due to the involvement

⁸² Charnovitz (2014) analyzed that subsidies to domestic enterprises that cause adverse effects to foreign exporters seeking access to market of subsidizing country, some subsidies to domestic enterprises that export and thereby cause injury to industry in market of importing country, and some subsidies to domestic enterprises that export and thereby cause adverse effects to competing exporters seeking access to third country markets, are allowed under the MEAs, whereas they are illegal under the WTO Law. See Charnovitz (2014), p 63.

⁸³ Given MEAs specifically warn against measures that distort trade, the two WTO prohibited subsidies are not justified under the MEAs. See Charnovitz (2014).

of the SCM Agreement to the RTA subsidy provisions, the conflict between MEAs and the WTO regarding environmental subsidies is resumed under the RTAs.⁸⁴ As noted in the previous section, the EU and Switzerland are in positions that WTO laws should be renovated to ensure their compatibility with trade measures in MEAs. On the other hand, India, Canada, and New Zealand are in views that MEAs should ensure the compatibility of trade measures with WTO rules first. Considering that the gap of countries' positions have not narrowed much on the relations between MEAs and WTO, the conflict between MEAs and trade rules seem to be hardly settled under the RTAs.

Case 1. RTAs with 'environmental provisions' supporting environmental subsidies

These aforementioned FTAs' environmental provisions provide high level of environmental protection, going beyond the WTO. And environmental provisions stated above may play a role as a basis for the use of environmental subsidies by contracting parties.

The next step is to examine the subsidy provisions of these agreements. Their subsidy provisions, on the other hand, provide weaker rules than the WTO. In case of the EU-Georgia FTA and the EU-Colombia-Peru FTA, they only provide

⁸⁴ MEAs conflict with WTO rules since they incorporate 'trade' measures to achieve their environmental goals. For example, the Rotterdam Convention allows parties to ban some imports and the CITES requires import and export licences for trade in endangered species.

a definition of a subsidy. These two FTAs state that the definition of a subsidy follows the definition set out in Article 1.1 of ASCM and be specific within the meaning of ASCM Article 2. They also state that the CVDs rule is also governed by the ASCM. However it does not provide which subsidies are actionable or prohibited.⁸⁵ This is compared to EFTA-Albania or Canada-Peru FTA, which explicitly confirm each party's rights and obligations under the SCM Agreement. Under the EFTA-Albania or Canada-Peru FTA, not only the definition but also subsidy rules on prohibited subsidies or actionable subsidies are governed by the WTO. That is, by adopting only a part of subsidy rules from the SCM Agreement, the EU-Georgia FTA and the EU-Colombia-Peru FTA provide more lenient subsidy rules than the WTO.

Instead of following the definition given in ASCM, on the other hand, EU-Rep. of Moldova FTA provides its own definition of 'state aid' in the chapter of 'competition.' It states that the state aid which distorts or threatens to distort competition and which affects trade between the Parties shall be incompatible with the Agreement.⁸⁶ It generally states that trade-distorting subsidies are not compatible with the Agreement. And it adopts EU's subsidy rules to assess state aid, which are by comparison more generous than that of WTO.⁸⁷ Also, the EU has widely used subsidies on renewable energy for environmental reasons.

⁸⁵ Although it provides that each party has rights to apply trade remedies in accordance with the relevant WTO provisions, but which subsidies are actionable or prohibited are not provided.

⁸⁶ Chapter 10 Competition, Section 2 State Aid, Article 339 General principles and scope

⁸⁷ Chapter 10 Competition, Section 2 State Aid, Article 340 Assessment of state aid:
'1. State aid shall be assessed on the basis of the criteria arising from the application of

Considering these facts, the answer to whether subsidy provisions of these agreements play a hindering role in using environmental subsidies arising from the environmental provision is a careful ‘no.’

Case 2. RTAs with ‘subsidy provisions’ allowing environmental subsidies

The second case is RTAs that support environmental subsidies by subsidy provisions themselves, and the case in point is EU-Singapore FTA and EU-Ukraine FTA. EU-Ukraine FTA has subsidy provisions that permit environmental subsidies under certain conditions. In the first paragraph of general principles of ‘states aid’, the EU-Ukraine FTA simply states that any state aid which distorts competition is incompatible with the Agreement insofar as it may affect trade between the parties. However in the next paragraph, FTA assigns more in providing the lists of allowed state aids, and environmental subsidy is one of such allowed state aids. According to this paragraph, if the environmental subsidy is to comply with the listed mandatory standards, within the implementation period provided, and involving adaptation of plant and equipment to meet the new requirements, it can be authorised up to the level of 40 % gross of the eligible costs.⁸⁸

the competition rules applicable in the EU, in particular Article 107 of the Treaty on the Functioning of the European Union and interpretative instruments adopted by the EU institutions, including the relevant jurisprudence of the Court of Justice of the European Union.’

⁸⁸ “(f) aid for investment to comply with the mandatory standards of the EU directives listed in Annex XXIX to Chapter 6 (Environment) of Title V of this Agreement, within the implementation period provided for therein, and involving adaptation of plant and

Similarly, subsidy provisions of EU-Singapore FTA⁸⁹ allow subsidies for environmental purposes, but they are explained in the footnote section of the annexes in a more cautious manner.⁹⁰ Similar to the SCM Agreement which divides subsidies⁹¹ into prohibited subsidies and actionable subsidies, the EU-Singapore FTA categorizes subsidies into prohibited subsidies and ‘other subsidies.’⁹² And similar to the actionable subsidies of the SCM Agreement in which the parties may use remedies when adverse effects arise, the EU-Singapore FTA enables the parties to use their best endeavours to remedy or remove distortions caused by ‘other subsidies,’ insofar as they affect or are likely to

equipment to meet the new requirements, can be authorised up to the level of 40 % gross of the eligible costs.” (It seems that Annex XXX was misrepresented to Annex XXIX. Annex XXIX is the annex to Chapter 5.)

⁸⁹ EU-Singapore FTA was concluded in December 2012 and expected to take in force in this year. EU-Singapore FTA is modeled after Korea-EU FTA. Although the structures of agreement and concession levels are similar between two agreements, there are some differences reflecting distinct characteristics of each country. One of the differences is provisions of subsidies. Compared to Korea-EU FTA which does not have much difference from SCM Agreement, the EU-Singapore FTA has more concrete provisions but less stricter than WTO subsidy rules.

⁹⁰ ‘where such aid does not affect conditions of trade of either Party and competition between the Parties’ See Annex 12-A and Footnote 1 of Annex 12-A of EU-Singapore FTA.

⁹¹ In the EU-Singapore agreement, a subsidy shall be subject to the chapter twelve (competition and related matters), only if it is specific within the meaning of Article 2 of the SCM Agreement.

⁹² Article 12.8 Other Subsidies

1. The Parties agree to use their best endeavours to remedy or remove through the application of their competition laws or otherwise, distortions of competition caused by other specific subsidies related to trade in goods and services which are not covered by Article 12.7 (Prohibited Subsidies), insofar as they affect or are likely to affect trade of either Party, and to prevent the occurrence of such situations. Annex 12-A contains guidance in particular on the types of subsidies which do not produce these effects.

affect trade of either party. If subsidies do not affect trade, the parties cannot use remedy thereby allowed under the EU-Singapore FTA. The annexes provide a list of types of ‘other subsidies’ which do not produce these ‘distorting effects’ on trade, The annex states subsidies to facilitate the development of certain economic activities or of certain economic areas may be granted by a Party when they are necessary to achieve an objective of public interest, and when the amounts of the subsidies involved are limited to the minimum and their effect on trade of the other Party is limited.⁹³ And the footnote to the annexes provides that such category may include subsidies for ‘environmental purposes.’⁹⁴ In a nutshell, according to the provisions, annexes, and footnote to the EU-Singapore FTA, subsidies for environmental purposes are one of the subsidy types resulting in no trade distorting effects, therefore these subsidies can be granted when they are necessary for public interest and the subsidy amount needed is minimum to achieve.

Returning to the main discussion, the policy space for environmental subsidies under the second case of the two RTAs is obviously bigger than the first case agreements. This second case of the two RTAs is like a resurrection of non-actionable subsidies category. Despite their strong environmental provisions, it is not necessary to examine them because they already allow environmental

⁹³ This is like the expired ‘non-actionable’ category under the SCM Agreement. See Annex 12-A ‘Principles Applicable to Other Subsidies’ of the EU-Singapore FTA.

⁹⁴ Footnote of Annex 12-A provides ‘This category may include but is not limited to, subsidies for clearly defined research, development and innovation purposes, subsidies for training or for the creation of employment, subsidies for environmental purposes, and subsidies in favour of small and medium-sized companies, defined as companies employing fewer than 250 persons.’

subsidies in the subsidy provisions. However, the first case of RTAs does not allow direct inclusion of environmental subsidies in subsidy provisions, unlike the environmental provision of the second case. Considering, as noted above, that the purpose of a subsidy provision is to regulate the use of subsidies, unless subsidy provisions explicitly allow environmental subsidies, any parties who do not stand for environmental subsidies can interpret subsidy provisions as a basis against the use of environmental subsidies. In other words, there is some controversy whether environmental subsidies are allowed under the first case of RTAs. Therefore, the first case of RTAs has smaller policy space than the second case.

In either case, however, it is obvious that Type A RTAs have the biggest policy space among the four types. Because, as noted above, the agreements in Type A has the most lenient subsidy rules as well as the strongest environmental provisions among the four types of agreements.

RTAs in Type B: Strong environmental provisions vs strong subsidy provisions

RTAs in Type B provide not only strong environmental provisions but also strong subsidy provisions. More concretely, they provide environmental provisions going beyond the WTO's environmental provisions while the subsidy provisions are governed by the WTO. We can find several RTAs corresponding to this type. Examples are Canada-Peru FTA, Canada-Panama FTA, Canada-Jordan FTA, Canada-Honduras FTA, and Switzerland-China FTA. Mostly are the FTAs signed by Canada.

Regarding environmental provisions, similar to those in Type A agreements, these FTAs provide strong environmental provisions such as recognition of each party's sovereign rights to conserve and protect its environment. They also affirm the parties' environmental obligations under multilateral environmental agreements.

On the other hand, regarding the subsidy provisions, contrary to Type A Agreements, these RTAs provide strict provisions. These RTAs provide that the WTO Agreement exclusively governs the rights and obligations of the Parties in respect of subsidies. For example, Switzerland-China FTA provides that 'the rights and obligations of the Parties in respect of subsidies and countervailing measures shall be governed by Articles VI and XVI of the GATT 1994 and the WTO Agreement on Subsidies and Countervailing Measures'. Similarly, Canada-Peru FTA, Canada-Jordan FTA, and Canada-Panama FTA states that 'the WTO Agreement exclusively governs the rights and obligations of the Parties regarding subsidies'. Certain environmental measures, such as feed-in tariff schemes for renewable energy, have been the subject of dispute at the WTO with regards to their consistency with the Subsidies and Countervailing Measures Agreement. As one may expect, the report from the Panel and Appellate Body addresses several salient interpretations over the SCM Agreement regarding environmental measures for renewable energy. Being outside the immediate scope of this paper, WTO disputes will not be reviewed here. What we want to emphasize at this point is that the way environmental subsidies are justified under the SCM Agreement is not straightforward and their prospect seems rather pessimistic after the expiry of Article 8.

Discussions on emerging regulatory conflict

There are some problems of conflict between ‘subsidy’ provisions and ‘environmental’ provisions in case of type B Agreements which provide not only strong environmental provisions but also strong subsidy provisions. Specifically speaking, such conflict arises in the category of WTO actionable subsidies. The environmental provision on ‘legal precedence of MEAs’ supports the use of SCM actionable subsidies for environmental purposes.⁹⁵ Because MEAs support the use of some actionable subsidies which are not inherently trade distorting, protectionist, or discriminatory, while not supporting for the two SCM prohibited subsidies.⁹⁶ On the other hand, the subsidy provision does not allow the use of SCM actionable subsidies for environmental purposes when they cause ‘adverse effects’, according to the subsidy provision which is governed by the WTO.

Interestingly, due to the involvement of the SCM Agreement to the RTA subsidy provisions, the conflict between MEAs and the WTO regarding environmental subsidies is resumed under the RTAs.⁹⁷ Under the WTO, a conflict between the

⁹⁵ Charnovitz (2014) analyzed that subsidies to domestic enterprises that cause adverse effects to foreign exporters seeking access to market of subsidizing country, some subsidies to domestic enterprises that export and thereby cause injury to industry in market of importing country, and some subsidies to domestic enterprises that export and thereby cause adverse effects to competing exporters seeking access to third country markets, are allowed under the MEAs, whereas they are illegal under the WTO Law. See Charnovitz (2014), p 63.

⁹⁶ Given MEAs specifically warn against measures that distort trade, the two WTO prohibited subsidies are not justified under the MEAs. See Charnovitz (2014).

⁹⁷ MEAs conflict with WTO rules since they incorporate ‘trade’ measures to achieve their environmental goals. For example, the Rotterdam Convention allows parties to ban some imports and the CITES requires import and export licences for trade in endangered species.

WTO and MEAs is an unresolved problem as seen in recent conflict between SPS Agreement and Cartagena Protocol. Also, in the Doha Round, the harmonization of WTO laws with trade measures in multilateral environmental agreements (MEAs) is an important but unresolved issue. As noted in the previous section, the EU and Switzerland are in positions that WTO laws should be renovated to ensure their compatibility with trade measures in MEAs. On the other hand, India, Canada, and New Zealand are in views that MEAs should ensure the compatibility of trade measures with WTO rules first. Considering that the gap of countries' positions have not narrowed much on the relations between MEAs and WTO, the conflict between MEAs and trade rules seem to be hardly settled under the RTAs.

VI. Empirical Analysis on Environmental Effectiveness of Environmental Provisions

Some may doubt that it is not clear whether the modification of SCM Agreement will have positive environmental effect, given that the evidence on its impact has been scarce. There is however, some anecdotal evidence on how modifications of trade rules might improve environmental quality. For example, environmental provisions in RTAs can contribute to strengthening of domestic environmental regulations (such as on air quality), introducing new institutional arrangements (such as the creation of a Ministry of Environment), establishing co-operation mechanisms on improving environmental law and enforcement, and improving environmental awareness and public participation (OECD, 2018).

Under this context, this section empirically tests whether the modification of trade rules would help to promote environment. For this, environmental provisions in RTAs are used as an indicator for the modification of trade rules. As discussed earlier, the increasing importance of regional and bilateral trade negotiations has been reinforced by the lack of progress in the multilateral negotiation arena in environmental issues. On the one hand, the WTO has not succeeded in integrating environmental issues in the multilateral trade negotiations, usually claiming that these issues rather belonging to environmental multilateral agreements (OECD 2017). It has been within the framework of regional and bilateral trade agreements where some progress has been made concerning the inclusion of environmental chapters or the signature of

environmental side agreements, in which provisions are included to protect the environment and to cooperate in environmental issues. Since the mid-1990s a number of RTAs started to include environmental provisions, so-called WTO+ provisions, in the text of the agreements or in side agreements. In this regard, historical data for the impact of environmental provisions can be only found in RTAs.

6.1. Literature Review

6.1.1 The impacts of RTAs on the environment

The first published study on the environmental impact of trade rules was Ghosh and Yamarik (2006). The authors suggest and evaluate empirical models in which trade, growth and RTA are linked and RTAs can have direct and indirect effects on the environment. Their empirical approach combines three well-known modeling strategies in the economics literature. First, since the early 1990s, the trade gravity model (Feenstra, 2004), which is considered to be the mainstay of empirical trade modeling, is used to estimate the determinants of bilateral trade flows. Second, GDP growth per capita modeled growth-empirical literature (Frankel and Romer, 1990, Doyle and Martínez-Zarzoso, 2011), which considers trade openness as one of the most important factors explaining economic growth. Finally, the above-mentioned documents link trade, growth and environmental quality based on the seminal work of Grossman and Krueger (1991) and Antweiler et al. (2001) are used to estimate the determinants of environmental degradation. Air quality (suspended particulate matter, sulfur dioxide and

nitrogen dioxide) and four resource utilization indicators (carbon dioxide per capita, change in deforestation rate, energy depletion per capita and water pollution per capita) are taken into account for deforestation measures.

Key findings indicate that RTA members have indirectly positive environmental impacts by reducing trade and increasing per capita income to reduce pollution. In contrast, no evidence of the presence of direct effects was found. For example, we can not find any evidence that the RTA membership itself affects the environmental outcome. However, these studies had limitations: first, it is based on data for a year, so it cannot contain dynamic elements, and second, the authors do not explain the mechanism by which membership in the RTA can affect the environment.

OECD (2018) overcome this limitations by introducing approaches to estimate the effects of trade and trade policy on several environmental indicators using data for more years. OECD has developed an indexing system that identifies 9 broad categories of environmental provisions and then lists specific questions relating to each category, and analysed the environmental effects of environmental provisions in RTAs (OECD, 2018). A maximum score for each question is allocated, and relative weighting has been developed across the different categories to allow for balanced scoring of different RTAs. The weighting has been developed based on a review of RTA texts and analytical literature.

6.2. Empirical framework and analysis

This empirical framework builds on the OECD(2018). The environmental indicators considered are total green house gas emissions (GHG) and carbon

dioxide per capita as indicators of air quality. Environmental indicators used as dependent variables in the empirical models and the corresponding explanatory variables and data sources are described in the data section below.

6.2.1 Data sources and variables

Annual data for a cross-section of countries over the period 2000 to 2012 are used in the empirical estimations. Primary data source is OECD which provides data for total greenhouse gas emissions, carbon dioxide emissions, environmental policy stringency index, GDP per capita, and population. Information concerning RTAs and the environmental provisions included in each agreement builds on OECD (2018).

An environmental policy index, which measures the environmental policy stringency in OECD countries and has been constructed by the OECD, is used as a proxy for policy intervention in the environmental area. The indicator is a composite country-specific measure of environmental policy stringency (EPS). The current version of the indicator covers 27 OECD countries and 6 non-OECD countries.

6.2.2 Modelling framework

The core model is based on the theory developed by Antweiler et al. (2001) relating trade with environmental quality and includes proxies for the so-called scale, composition and technique effects as determinants of environmental impact. Basic model can be expressed as below:

$$\ln(E_{it}) = \gamma_0 + \gamma_1 EP_{it} + \gamma_2 \ln(GDP_{it}) + \gamma_3 \ln(POP_{it}) \\ + \gamma_4 \ln(Trade_{it}) + \gamma_5 Stringency_{it} + \gamma_6 \ln(Land_{it}) + \mu_{it}$$

Where:

- E_{it} , a given environmental indicator for country i at time t .
- $EP_{it} = \sum_j rta_{ijt} w_{jt}$, a weighted average of the rta_{ijt} that take the value of one when countries i and j have a RTA in force in year t , zero otherwise. w_{jt} denotes the weights given to the different RTAs.⁹⁸
- $GDP\ per\ capita_{it}$, GDP per capita at current US dollars at PPP in country i in year t . GDP per capita serves to capture the hypothesis that environmental quality eventually increases with income.
- Pop_{it} , population in number of inhabitants in country i in year t .
- $Trade_{it}$, refers to the openness ratio measured as the sum of exports and imports divided by gross domestic product in country i (j).

⁹⁸ For more details on the weighting scheme, refer to OECD (2018).

- *Stringency_{it}* , a country-specific and internationally-comparable measure of the stringency of environmental policy in country *i* in year *t*. Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behaviour. It is included to control for the impact of green policies other than R&D subsidies.
- μ_i is the country fixed effects.

Data for all variables except for the index and share are converted into logarithmic form to minimize their skewness.

A range of models have been estimated, starting with time and country fixed effect model. Controls and variables are subsequently added. The lagged values of the RTA variable (in past periods) will be used as regressors in the above equation to take into account the endogeneity issue.

6.2.3. Empirical results

This sections present the main results for the regressions on the air quality. First, table 11 present OLS regression results for CO2 emissions. Column (1)-(2) shows the results of fixed effects, and column (3)-(4) shows the results of random effects. The Sargan-Hansen test reveals that fixed effect model is more appropriate (Table 12), but the random-effect panel regressions are also used as

complements and consistency checks to take into account the cross-sectional information. To address endogeneity issues, IV instrumental variable regressions and Generalised Methods of Moments (GMM) estimations are also conducted. Regressions on the greenhouse gas emissions are also run for the robustness checks.

In most of all models, the variable environmental provisions shows a negative and significant coefficient, indicating that for each additional RTA with EPs, mean concentration of greenhouse gas emissions decrease by around 0.3 percent.

Table 11. Ordinary least squares (OLS)

Dependent variable: CO2 emissions				
Model type	(1) FE[1]	(2) FE[2] with time fixed effects	(3) RE[1]	(4) RE[2] with time fixed effects
Environmental provisions	-0.00352*** (0.000671)	-0.00368*** (0.000989)	-0.00343*** (0.000681)	-0.00262*** (0.000910)
Population	-0.585*** (0.178)	-0.641*** (0.174)	0.0265 (0.0477)	0.0328 (0.0480)
GDP	-0.0189 (0.0691)	-41.57*** (7.621)	-0.106* (0.0637)	-38.47*** (7.240)
Trade	0.00192** (0.000913)	0.0104 (0.00799)	0.00224** (0.000937)	0.00875 (0.00812)
Environmental policy stringency	0.0368** (0.0176)	0.00191 (0.0166)	0.0278 (0.0181)	-0.00287 (0.0171)
Constant	5.334* (2.747)	365.4*** (66.55)	-4.145*** (0.876)	327.3*** (62.61)
Observations	299	299	299	299
R-squared	0.362	0.530		
Number of countries	23	23	23	23
Overall	0.0646	0.0345	0.296	0.368
Within	0.362	0.530	0.334	0.502
Between	0.0718	0.0401	0.341	0.373

Note: ***, ** and * indicate significance at respectively the 1%, 5% and 10% level.

Table 12. Sargan-Hansen test results for regressions on environmental effects of environmental provisions

Random-effects GLS regression		Number of obs = 491				
Group variable: countries		Number of groups = 23				
R-sq:		Obs per group:				
within = 0.1072		min = 12				
between = 0.1627		avg = 21.3				
overall = 0.1612		max = 22				
Corr (u _i , X) = 0 (assumed)		Wald chi2 (7) = 59.48				
		Prob > chi2 = 0.0000				
Dependent variable: Greenhouse gas emissions						
	Coefficient	Std. Err.	z	P > z	[95% Conf. Interval]	
Environmental provisions	0.00	0.00	-3.76	0.00	-0.01	0.00
Population	0.08	0.06	1.19	0.23	-0.05	0.20
GDP	0.04	0.08	0.50	0.62	-0.12	0.20
Trade	0.00	0.00	1.48	0.14	0.00	0.00
Environmental policy stringency	0.00	0.02	-0.16	0.88	-0.05	0.04
constant	-13.00	1.13	-11.54	0.00	-15.21	-10.79
sigma_u	0.37					
sigma_e	0.12					
rho	0.90	(fraction of variance due to u _i)				
Cross-section time-series model: xtreg re						
Sargan-Hansen statistic	8.625	Chi-sq(5)	P-value = 0.1250			

To control for the endogeneity of trade, GDP, environmental provisions, and environmental policy stringency, I additionally used instrumental variable estimation techniques (IV) (Table 13). Endogeneity problems include the possible reverse causal relationship between dependent and independent (i.e. environmental quality and environmental provision) and self-selection problem (i.e. trade, environmental policy stringency index, and GDP). I applied three year lags to the possible endogenous variables to generate instrumental variables. The results show that coefficient of the environmental provisions are still robust in overall under the IV regressions. For Robustness check, Generalised Method of Moments technique is also used, and the results are also robust (Table 14).

Table 13. IV instrumental variable estimation results

VARIABLES	(1) IV[1] environmental provision	(2) IV[2] Trade	(3) IV[3] environmental policy stringency	(4) IV[4] GDP
Environmental provisions	-0.00780*	-0.00292*	-0.00358	-0.00331*
	(0.00432)	(0.00169)	(0.00221)	(0.00199)
Population	0.0293	0.0636	0.0726	0.0659
	(0.0594)	(0.0714)	(0.0579)	(0.0674)
GDP	-57.30***	-49.80***	-63.11**	-65.30
	(13.80)	(15.94)	(25.63)	(40.96)
Trade	0.00693	-0.00473	0.00945	0.00541
	(0.00685)	(0.111)	(0.00931)	(0.00677)
Environmental policy stringency	0.0358	0.0431	-0.186	0.0360
	(0.0369)	(0.0369)	(0.331)	(0.0327)
Constant	493.6***	427.7***	543.5**	562.5
	(119.6)	(138.2)	(222.8)	(355.9)
Observations	230	230	230	230
Number of countries	23	23	23	23
R-squared	0.447	0.379	0.440	0.363

Note: ***, ** and * indicate significance at respectively the 1%, 5% and 10% level.

Table 14. Robustness check for the impact of environmental provisions on environment – using alternative techniques: Generalised Method of Moments (GMM)

VARIABLES	(1) GMM[1]	(2) GMM[2]	(3) GMM[3]
Environmental provisions	-0.0130* (0.00773)	-0.0128* (0.0165)	-0.0114* (0.00693)
Population	0.0251 (0.0543)	0.235* (0.125)	0.0518 (0.0431)
GDP	-31.12* (18.30)	-184.6* (107.2)	-41.86* (24.34)
Trade	0.0133 (0.0248)	-0.0991 (0.121)	0.00905 (0.0238)
Environmental policy stringency	-0.0977 (0.136)	-0.533* (0.281)	-0.359* (0.210)
Constant	264.2* (158.0)	1,586* (924.2)	356.6* (210.4)
Observations	299	299	299
Number of countries	23	23	23

Note: ***, ** and * indicate significance at respectively the 1%, 5% and 10% level.

6.2.4. Sub-conclusion

The main results for emissions show that environmental provisions of trade agreements have a positive effect on reducing environmental degradation. The direct effect is explained by the fact that the environmental provisions in RTAs will encourage members to apply and enforce more stringent environmental regulations and these should in turn reduce environmental damage (OECD 2018). The effect is independent from the trade-induced effect given that the model captures the trade-induced effect. This effect is also independent from the effect induced by other national environmental policies that are summarized in the environmental performance index, which is also used as an explanatory variable in the regressions. The main finding is that the practice of including provisions that refer to the environment in trade agreements can address climate change and environmental degradation, which implies that the modernization of WTO Agreement for green subsidies may have positive environmental effects.

VII. Conclusion: How to Modernise WTO Law Governing Green Subsidies

The linkage between trade and the environment has been intensely debated in the multilateral trading system over the past few decades. Nevertheless, the debate remains unresolved and continues to evolve. The status of green subsidies within the multilateral trading system has become increasingly significant, particularly following the recent WTO disputes involving renewable energy subsidy programs.

Section 3 and 4 have shown that some green subsidies are economically and environmentally justified given their positive effects to environmental quality and non-distorting effects to imports.⁹⁹ The subsequent sections have shown that a clash exists between international climate change mitigation goals and WTO law, so that WTO subsidy rules ought to be reformed in order to safeguard 'policy space' for government green subsidies.

⁹⁹ Economic theory as well as empirical analysis point to valid reasons why green subsidies sometimes should be used. However, as WTO Subsidy law does not take into account the purpose of subsidies and their environmental effects, many green subsidies run into conflict with trade law.

The question is how to reform the subsidy rules to promote green subsidies for the environment as long as it does not harm international economic welfare.¹⁰⁰ In my view, it would be difficult to remove the prohibition against the two WTO-illegal subsidies (i.e. Export subsidies and LCR subsidies). Even though these subsidies are environmentally justified, economically not justified given that they may cause race-to-bottom wars as countries could make themselves better off by competing in export subsidies (Sykes 2005). Similarly, if all countries do LCR subsidies, then all would be worse off, so-called collective action dilemma. LCR subsidies are not environmentally justified either, as LCR subsidies do not have the environmental benefits of other subsidies because they merely induce the substitution of more costly domestic inputs for cheaper foreign alternatives, and therefore do not further--they may even hinder attaining--environmental objectives" (Mattoo and Subramanian 2013) This is also empirically confirmed by the regression results shown in section 2. According to the regression result, Feed-in-tariffs which has LCR requirements did not have positive environmental

¹⁰⁰ However, modernising trade rules to be more compatible with the environmental objectives would not call into question any fundamental principles of the trading system. The Preamble to the WTO Agreement already refers to "the objective of sustainable development," and WTO case law includes the holding that "sustainable development is one of the objectives of the WTO Agreement" (Panel report, US-Shrimp case, WTO 2001). In 2001, the WTO Doha Ministerial Declaration also declared that "We are convinced that the aims of upholding and safeguarding an open and non-discriminatory multilateral trading system, and acting for the protection of the environment and the promotion of sustainable development can and must be mutually supportive."

effect. Moreover, even MEAs do not support these WTO-illegal subsidies which are inherently trade distortive, as discussed in the previous section. If environmental regimes does not acknowledge the value of an export or LCR subsidy, the trade rules won't need to do so.

In this regards, the reform could be done in the WTO-actionable subsidies. As a corollary of fossil fuel subsidies, trade agreements could also specify the conditions under which renewable energy subsidies may be allowed. For instance, it may be possible to agree on making certain types of renewable energy subsidies non-actionable (Kennedy, 2012; Meltzer, 2013). This option would effectively mean reviving an expired provision of the Agreement on Subsidies and Countervailing Measures in the regional context (Howse, 2010; Horlick and Clarke, 2016). The expired Article 8 already identifies certain environmental and research subsidies as non-actionable.

If Article 8 is revived, some currently illegal and actionable subsidies will be non-actionable including such as subsidies for industrial research, pre-competitive development activity, and adaption of existing facilities to new environmental requirements. However, the problem is that it can exclude some other subsidies which are not identified in Article 8 but justified economically and environmentally. In this regards, I would argue that reviving Article 8 would not be enough. One option could be modifying Article 8 adding a positive list of subsidies helpful to the environment as some analysts argue (Charnovitz 2010). Empirically analysis using historical data will help in identifying environmentally positive subsidies as done in Section 2.

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Annex

Annex Table 1. Robustness check for dependent variable: CO2 emissions

VARIABLES	(1) FE[1]	(2) FE[2]	(3) FE[3]
R&D subsidies (lagged)	-0.00900** (0.00431)	-0.00614 (0.00411)	-0.00857** (0.00418)
Fossil	0.985*** (0.0711)	1.114*** (0.0785)	1.173*** (0.0809)
Population	1.198*** (0.120)	0.977*** (0.126)	1.130*** (0.137)
GDP per capita	0.118** (0.0500)	0.136*** (0.0468)	0.104** (0.0479)
Feed-in-tariffs		0.00430** (0.00213)	0.00414* (0.00212)
Openness			0.106*** (0.0396)
Constant	-13.37*** (2.027)	-10.45*** (2.169)	-13.02*** (2.358)
Observations	454	401	401
R-squared	0.616	0.646	0.653
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex Table 2. Robustness check for feed-in-tariffs

VARIABLES	(1) FE[1]	(2) FE[2]	(3) FE[3]
R&D subsidies (lagged)	-0.00900** (0.00431)	-0.00215 (0.00429)	-0.00474 (0.00438)
Fossil	0.985*** (0.0711)	1.180*** (0.0772)	1.231*** (0.0794)
Population	1.198*** (0.120)	1.054*** (0.124)	1.192*** (0.136)
GDP per capita	0.118** (0.0500)	0.153*** (0.0472)	0.122** (0.0485)
Environmental policy stringency		-0.0220*** (0.00826)	-0.0200** (0.00824)
Openness			0.0985** (0.0397)
Constant	-13.37*** (2.027)	-12.19*** (2.151)	-14.48*** (2.326)
Observations	454	401	401
R-squared	0.616	0.649	0.655
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex Table 3. Robustness check for renewable R&D subsidies with different lags

VARIABLES	(1) FE[1]	(2) FE[2]	(3) FE[3]	(4) FE[4]
Fossil	1.195*** (0.0815)	1.173*** (0.0809)	1.167*** (0.0791)	1.116*** (0.0796)
Population	1.146*** (0.127)	1.130*** (0.137)	1.291*** (0.131)	1.107*** (0.146)
GDP per capita	0.131*** (0.0478)	0.104** (0.0479)	0.112** (0.0488)	0.131*** (0.0503)
Feed-in-tariffs	0.00344* (0.00203)	0.00414* (0.00212)	0.00494** (0.00212)	0.00508** (0.00214)
Openness	0.0763** (0.0361)	0.106*** (0.0396)	0.165*** (0.0431)	0.109** (0.0440)
R&D subsidies (lag1)		-0.00857** (0.00418)		
R&D subsidies (lag2)			-0.00813* (0.00455)	
R&D subsidies (lag3)				-0.00369 (0.00459)
Constant	-13.63*** (2.188)	-13.02*** (2.358)	-15.83*** (2.233)	-12.66*** (2.470)
Observations	422	401	392	381
R-squared	0.656	0.653	0.680	0.659
Number of countries	26	26	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex Table 4. Robustness check for dependent variable: CO2 emissions

	(1)	(2)	(3)
VARIABLES	FE[1]	FE[2]	FE[3]
R&D subsidies (lagged)	-0.00900** (0.00431)	-0.00614 (0.00411)	-0.00857** (0.00418)
Fossil	0.985*** (0.0711)	1.114*** (0.0785)	1.173*** (0.0809)
Population	1.198*** (0.120)	0.977*** (0.126)	1.130*** (0.137)
GDP per capita	0.118** (0.0500)	0.136*** (0.0468)	0.104** (0.0479)
Feed-in-tariffs		0.00430** (0.00213)	0.00414* (0.00212)
Openness			0.106*** (0.0396)
Constant	-13.37*** (2.027)	-10.45*** (2.169)	-13.02*** (2.358)
Observations	454	401	401
R-squared	0.616	0.646	0.653
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex Table 5. Robustness check for feed-in-tariffs

	(1)	(2)	(3)
VARIABLES	FE[1]	FE[2]	FE[3]
R&D subsidies (lagged)	-0.00900** (0.00431)	-0.00215 (0.00429)	-0.00474 (0.00438)
Fossil	0.985*** (0.0711)	1.180*** (0.0772)	1.231*** (0.0794)
Population	1.198*** (0.120)	1.054*** (0.124)	1.192*** (0.136)
GDP per capita	0.118** (0.0500)	0.153*** (0.0472)	0.122** (0.0485)
Environmental policy stringency		-0.0220*** (0.00826)	-0.0200** (0.00824)
Openness			0.0985** (0.0397)
Constant	-13.37*** (2.027)	-12.19*** (2.151)	-14.48*** (2.326)
Observations	454	401	401
R-squared	0.616	0.649	0.655
Number of countries	29	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex Table 6. Robustness check for renewable R&D subsidies with different lags

VARIABLES	(1) FE[1]	(2) FE[2]	(3) FE[3]	(4) FE[4]
Fossil	1.195*** (0.0815)	1.173*** (0.0809)	1.167*** (0.0791)	1.116*** (0.0796)
Population	1.146*** (0.127)	1.130*** (0.137)	1.291*** (0.131)	1.107*** (0.146)
GDP per capita	0.131*** (0.0478)	0.104** (0.0479)	0.112** (0.0488)	0.131*** (0.0503)
Feed-in-tariffs	0.00344* (0.00203)	0.00414* (0.00212)	0.00494** (0.00212)	0.00508** (0.00214)
Openness	0.0763** (0.0361)	0.106*** (0.0396)	0.165*** (0.0431)	0.109** (0.0440)
R&D subsidies (lag1)		-0.00857** (0.00418)		
R&D subsidies (lag2)			-0.00813* (0.00455)	
R&D subsidies (lag3)				-0.00369 (0.00459)
Constant	-13.63*** (2.188)	-13.02*** (2.358)	-15.83*** (2.233)	-12.66*** (2.470)
Observations	422	401	392	381
R-squared	0.656	0.653	0.680	0.659
Number of countries	26	26	26	26

Note: Year fixed effects are included in all regressions. ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

Annex table 7. Robustness check for the impact of environmental provisions on environment – using alternative dependent variable: greenhouse gas emissions

VARIABLES	(1) FE[1]	(2) FE[2]-with fixed effects	(3) time RE[1]	(4) RE[2]-with fixed effects
Environmental provisions	- 0.00301*** (0.00106)	-0.00109 (0.00179)	- 0.00282*** (0.00107)	-0.000511 (0.00161)
Population	-0.980*** (0.282)	-0.814** (0.316)	0.0128 (0.0717)	0.0353 (0.0735)
GDP	0.0679 (0.109)	5.197 (13.81)	-0.0772 (0.0999)	1.701 (12.66)
Trade	0.00261* (0.00145)	0.0115 (0.0145)	0.00315** (0.00147)	0.0111 (0.0145)
Environmental policy stringency	-0.00127 (0.0280)	0.00307 (0.0302)	-0.0156 (0.0285)	-0.00865 (0.0307)
Constant	4.457 (4.352)	-42.72 (120.6)	-10.90*** (1.337)	-26.71 (109.5)
Observations	298	298	298	298
R-squared	0.213	0.242	0.177	0.217
Number of countries	23	23	23	23

Note: ***,** and * indicate significance at respectively the 1%, 5% and 10% level.

국문 초록

최근 녹색상품의 무역규모가 빠르게 성장하는 추세이며, 많은 국가들이 자국 녹색산업 육성 및 국제 경쟁력 제고를 위해 보조금, 세제혜택 등 다양한 지원 정책을 확대하고 있다. 이러한 녹색 보조금이 국제무역에 영향을 미칠 경우, 세계무역을 규율하고 있는 WTO 규범의 적용대상이 될 수 있다. 따라서 본 논문의 주요 목적은 녹색 보조금 사용을 위한 정책 공간을 확보하기 위해 WTO 규범을 현대화 해야하는지에 대해 논의하고, 녹색보조금과 다자무역규범을 상호 조화시킬 수 있는 방안을 모색하는 데 있다. 이를 위해 본 연구는 환경 및 무역 효과에 대한 계량 경제분석을 바탕으로 녹색 보조금에 대한 정당성을 분석한다.

주요 단어: 녹색보조금, WTO 규범, 계량경제분석, 환경조약

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