# Understanding Public Support for Domestic Contributions to Global Collective Goods

## Results from a survey experiment on carbon taxation in Japan


**Abstract**

We contribute to the growing literature on how political support for domestic policies that contribute to global collective goods is impacted by other countries' policy actions. To do so, we focus on carbon taxation, one of the most important yet contested policy instruments for mitigating global warming, in the world's third largest economy, Japan. Using a combination of two experiments embedded in a representative public opinion survey, we examine arguments relating to how the adoption and level of ambition of other countries' carbon taxes affects the public's preferences for current and future carbon tax designs. We find evidence that the choices of other countries affect both support for carbon taxation and preferences over its design. More ambitious carbon pricing in other countries increases support for carbon taxation, while less ambitious pricing reduces support. Moreover, information about lower carbon prices in other countries decreases support more than other countries having no carbon taxation at all. Public support for more stringent domestic carbon pricing thus hinges on the policy choices of other countries, contrary to other environmental issues. Our research also shows, however, that particular domestic policy design choices can help in mitigating otherwise negative effects of non-cooperative behavior by other countries.



Keywords: carbon tax; climate policy; reciprocity; survey experiment; conjoint analysis; Japan

# 1. Introduction

Countries around the world are currently experimenting with a wide range of policy measures aimed at reducing greenhouse gas (GHG) emissions, and carbon dioxide in particular. Pricing carbon by means of taxing fossil fuels is widely regarded as a potentially effective (in terms of reducing fossil fuel consumption) and economically efficient (in terms of minimizing marginal abatement costs) policy choice. While various high-income countries have adopted carbon pricing schemes, in the form of emissions cap-and-trade systems and/or carbon taxes, the widespread adoption of effective carbon taxes remains challenging politically. Carbon taxes create clearly visible costs for mitigating emissions in the short-run, which the public must bear before realizing the long-term benefits.

For these reasons, carbon taxation has become politically salient in many countries. From failed ballot initiatives to street protests by the Gilets Jaunes in France (Bristow 2019; Guilluy 2018), the pricing of carbon has often stumbled due to domestic distributional politics. Previous research on public support for or opposition to carbon taxation has identified the key features of distributional conflict by examining the impact of socio-demographic backgrounds and the design of carbon taxation upon political support (Carattini et al. 2018; Klenert et al. 2018; Jagers et al. 2018; Beiser-McGrath and Bernauer 2019b; Davidovic 2019; Douenne and Fabre 2020; Bergquist et al. 2020). Such research has also made it clear that mass public support is key for the political feasibility of environmental policies in general, and carbon taxes in particular, and thus requires in-depth study (Anderson et. al 2017; Dolšak et al. 2020).

Yet, what determines continued support for such carbon taxes over time, in countries that have overcome initial domestic political hurdles and have introduced some form of carbon taxation? Such support is crucial, notably in view of the fact that carbon prices will have to increase quite dramatically in order to achieve a carbon-neutral economy by around 2050 to keep global warming within 2 degrees Celsius (IPCC 2018).

In this paper, we argue that international (in)action is key to understanding citizens' support for expanding or retrenching an existing carbon tax. In particular, for our empirical strategy we explicitly distinguish between other countries' adoption and level of carbon taxes, the latter of which is unexplored in previous studies. Continued public support for carbon taxation thus likely depends upon not only whether other countries have a carbon tax but also how ambitious those policies are. That is, ambitious carbon pricing by other countries is likely to enhance public support for carbon taxation in a given country, while no or weak carbon taxation by others is likely to have a support-reducing effect.

In this light, the Paris Agreement regards carbon pricing, including carbon taxes, as a major means to achieve its Intended Nationally Determined Contribution (INDC). In fact, two-thirds of all submitted INDCs under the Paris Agreement consider the use of carbon pricing to achieve their emission reduction targets.[1] The Paris Agreement implicitly rests upon generating a positive cycle of reciprocity, through the ratcheting up of pledges over time. Within this logic, the behavior of other countries is essential for the continued adoption and expansion of carbon pricing.

To empirically assess this general argument and its implications for general support of carbon taxation, as well as its specific design, we conducted a survey experiment in Japan. Japan is an important case for our analysis as it is a major contributor to global emissions that already introduced a carbon tax in 2012, albeit with a very low tax rate. To become effective in reducing emissions this tax rate will have to increase strongly. Given the middling nature of its carbon tax, Japan provides us with an opportunity to credibly analyze how individuals respond to other countries having more or less stringent carbon taxes, by raising or lowering its own carbon tax.

[1] https://unfccc.int/about-us/regional-collaboration-centres/the-ci-aca-initiative/about-carbon-pricing#eq-6 (Last accessed on December 17, 2020)

Our results show that carbon taxation levels in other countries are more relevant to citizens' policy preferences than the simple adoption of carbon taxation. Other countries having carbon taxes at a lower level than Japan's current tax, leads to a *larger* decrease in individuals' willing to pay than simply learning other countries do not have carbon taxes. This finding also feeds through to citizens' preferences concerning specific design features of a carbon tax, such as embedding conditionality within Japan's carbon tax design.

Our paper contributes to the existing literature in at least two ways. First, while previous studies on international reciprocity in climate policy have generally found small to no such effects (e.g., Tingley and Tomz 2014; Bernauer and Gampfer 2015; Bernauer et al. 2016; Beiser-McGrath and Bernauer 2019a; Mildenberger 2019), we find that reciprocity plays a greater role in carbon taxation. This is presumably because of its direct and easy to grasp costs to individuals and the less immediate and obvious benefits. Furthermore, while most studies on international cooperation assume reciprocity in binary terms, i.e., whether another country cooperates or not (Keohane 1986; Rhodes 1989; Goldstein and Pevehouse 1997; Tingley and Tomz 2014), we also explore how the level of cooperation by other countries, in terms of their price on carbon, affects public support.

Second, our results indicate that public support for carbon taxation is influenced by both leader and laggard countries. In this way, we also contribute to literature that is concerned with the importance of reference points in international cooperation. Prominent examples in the area of climate change are the "law of the least ambitious program" (Underdal 1980, 1998; Hovi and Sprinz 2006), and the potential impact of over- and under-pledging when forming new agreements (Tingley and Tomz 2020). We find that public support for raising the stringency of domestic climate policy is increased when individuals observe ambitious climate policies by other countries. Our results suggest, however, that the ratcheting-up mechanism embedded in the Paris agreement (positive reciprocity in small steps) is potentially fragile, with

100 the mass public wishing to decrease the stringency of an existing carbon tax when faced with
101 weak contributions by other countries to the global public good.
102 Overall, our evidence of reciprocity at the public level underlines that international
103 agreements that expect reciprocity as a mechanism to achieve climate cooperation are still
104 effective. While the Paris Agreement and the associated NDCs are multilateral in their
105 procedural features, countries unilaterally choose the specific policies they wish to adopt within
106 this process. Therefore, the ratcheting-up mechanism expected under the Paris Agreement still
107 depends on maximizing the positive reciprocity (policy-improving effect) of specific ambitious
108 policies while minimizing the negative (policy-deteriorating) impact of unambitious forms of
109 these same policies.
110 The remainder of the paper proceeds as follows. In the next section, we discuss the nature
111 of carbon taxation in Japan. This is followed by our theoretical arguments. Then, we outline
112 our empirical strategy for testing these arguments, report the results and discuss their research
113 and policy implications.
114

115 ## 2. Carbon Taxation in Japan

116

117 Japan's carbon dioxide ($CO_2$) emissions from fossil fuels in fiscal year 2019 were 1,029
118 $MtCO_2$, which makes it the 5$^{th}$ largest $CO_2$ emitter globally.[2] Its emissions per capita are
119 similar to Germany's, with 8.4 $tCO_2$ – those of the United States are 16 and those of China 7.1
120 $tCO_2$.[3]
121 Under the Paris Agreement's INDC, Japan pledged to reduce its GHG emissions by
122 26 % from the 2013 level until 2030, including land use, land-use change and forestry

[2] https://www.env.go.jp/press/files/en/868.pdf (Last accessed on April 27, 2021)
[3] http://www.globalcarbonatlas.org/en/CO2-emissions (Last accessed on April 27, 2021)

(LULUCF).[4] The pledged reductions are equivalent to 1Gt$CO_2$e, a decrease from the 1990 level by 18 % by 2030.[5] In fiscal year 2019, Japan's GHG emissions have declined by 24 % from the 2013 level. A phase out of old and inefficient coal-fired power plants by 2030 and a restriction on coal power financing overseas are expected to help Japan meet the target.[6] Nonetheless, Japan's target is very modest, notably in comparison to the EU, which has committed to at least a 40% reduction from the 1990 level by 2030.[7] The Climate Action Tracker scoreboard rates Japan's INDC target as "highly insufficient" given that it is not stringent enough to achieve the Paris Agreement's goal of limiting global warming to 2°C.[8]

Against the backdrop of the Fukushima accident and increased $CO_2$ emissions, a new coalition government (Democratic Party of Japan and People's New Party) introduced a carbon tax in 2012. This carbon tax is levied on oil (including gasoline, diesel, and heavy oil), Liquefied Petroleum Gas (LPG), Piped Natural Gas (PNG), and coal, and comes on top of the preexisting Petroleum and Coal Tax. The tax rate was increased in three steps over three and a half years and has levelled off since April 2016 at JPY 289 (around US$3) per ton of $CO_2$. Carbon tax rates vary between types of fossil fuel in accordance with their global warming effect. Exemptions and refunds are provided for specific types of fuels and fuels for specific purposes. The revenues from the carbon tax are used for reducing energy-related $CO_2$ emissions, energy saving measures, renewable energy, and the clean and efficient utilization of fossil fuels (Rudolph 2018, 96). The government introduced subsidies for local governments and the private sector to install energy efficient equipment, promote research and development for next-generation rechargeable batteries, and build renewable energy infrastructure suitable

[4] https://www.env.go.jp/en/earth/cc/2030indc.html (Last accessed on December 26, 2019)
[5] https://www.kikonet.org/info/press-release/2015-04-30/2030-climate-target (Last accessed on December 26, 2019)
[6] https://climateactiontracker.org/countries/japan/ (Last accessed on December 26, 2019)
[7] https://ec.europa.eu/clima/policies/strategies/2030_en (Last accessed on December 26, 2019)
[8] https://climateactiontracker.org/countries/japan/ (Last accessed on December 26, 2019)

144 for regions with different industrial and residential structures. An unpublished government-led
145 Cabinet Office (2007) survey seems to have suggested that spending carbon tax income for
146 climate related purposes was what Japanese citizens wanted.

147 The Japanese carbon tax is the first such tax in Asia (Singapore introduced a carbon tax
148 in 2019, China has a cap-and-trade system but no carbon tax, and a carbon tax in Taiwan is
149 still under consideration). However, compared to other industrialized countries, the Japanese
150 carbon tax is very weak.[9] $CO_2$ emissions coverage of the Japanese carbon tax is around 70%,
151 which is relatively high compared to other countries (e.g., around 40% in Switzerland and
152 Sweden). Nonetheless, even after controlling for differences in emissions coverage, the carbon
153 tax level in Japan is the 5$^{th}$ lowest among 28 countries with carbon taxes (World Bank 2019,
154 27).[10]

155 This low carbon tax rate in Japan is commonly ascribed to strong opposition from
156 industry and the dominance over many decades, and up to 2009, of the country's main political
157 party, the Liberal Democratic Party (LDP), which has a strong pro-business agenda. The
158 climate policy-making process in Japan reflects this situation, with the Ministry of Economy
159 and International Trade (METI, formerly the Ministry of International Trade and Industry) and
160 the (much less influential) Ministry of the Environment (MOE) in charge (Rudolph 2018, 99).

161 Initially, the MOE had proposed a higher carbon tax than the one actually introduced.
162 The proposal was rejected by the METI and LDP politicians. The METI warned that the
163 marginal abatement costs associated with the MOE proposal would be much higher than those
164 in the United States and EU and recommended that the tax rate should be low, with the tax

[9] Other industrialized countries' carbon tax rates are in fact much higher, including those in Sweden (1991, US$127), Switzerland (2008, US$96), Finland (1990, US$60-70), Norway (1991, US$3-59), France (2014, US$50), Iceland (2010, US$31), Denmark (1992, US$26), Ireland (2010, US$22), Slovenia (1996, US$19), Spain (2014, US$17), Portugal (2015, US$14), Latvia (2004, US$5), Chile (2017, US$5) , Singapore (2019, US$4) and Estonia (2000, US$4) (World Bank 2019, 25-26) Information in parentheses shows the year of introduction and tax rates as of 2019 (World Bank 2019).

[10] Countries with very low carbon taxes include Poland, Ukraine, Estonia, and Mexico.

revenue to be spent for supporting technology development and dissemination. A compromise then emerged between the METI and MOE. On the one hand, the METI noted that carbon tax revenue would help enhance the competitiveness of the Japanese nuclear power industry over the fossil fuel industry and secure financial resources for purchasing Kyoto Protocol emission credits. The MOE, on the other hand, considered a carbon tax useful for mobilizing revenues to be used for reducing $CO_2$ from energy-related industries. Ultimately, Keidanren, a powerful Japanese business association, acquiesced to a carbon tax in order to prevent a cap-and-trade system (Rudolph 2018). [11] However, to obtain industrial acquiescence the MOE had to settle for a low carbon tax rate.

In sum, Japan did introduce a carbon tax while several other high-income countries still do not have such a tax. However, compared to those countries with a carbon tax, the carbon tax rate in Japan is very low, and certainly far below what is commonly regarded as the social cost of carbon (Ricke et al. 2018).[12] In general, public opinion greatly influences policy design as well as its adoption, especially in democratic countries (e.g., Burstein 2003). In fact, within and outside Japan's context, a large strand of literature examines public opinion/support for nuclear energy, which is deemed to shape national energy policy (e.g., Poortinga et al. 2013; Uji et al. 2021). Additionally, studies examining public opinion response to the Fukushima disaster find that it had significant effects upon individuals' policy preferences, which has been linked to subsequent policy choices by governments (e.g., Poortinga et al. 2013; Latré et al. 2017, Böhmelt 2020). Strong public support may enable the government to implement higher carbon taxes by assuaging business's opposition. Thus, it is important to know the policy design of a carbon tax that Japanese public is willing to accept.

[11] Shortly before the introduction of the carbon tax, Keidanren called on the government to rethink the new tax because it raises energy costs further and might push companies to move operations to countries that regulate carbon emissions less. (https://www.reuters.com/article/us-energy-japan-tax/japans-new-carbon-tax-to-cost-utilities-1billion-annually-idUSBRE8990G520121010, last accessed on December 26, 2019)

[12] https://country-level-scc.github.io/explorer/(Last accessed on December 26, 2019)

## 3. Public Support for Carbon Taxation

In this section we develop the theoretical arguments that guide our experimental research design. In particular, we focus on how the behavior of other countries may influence citizens' support for carbon taxation levels and design in Japan. We first discuss key elements of carbon taxation design: its price (cost), inclusion of other countries, revenue usage, and potential exemptions. We then outline how the adoption, or lack thereof, of carbon taxation by other countries affects support for levels and design of carbon taxation. Subsequently, we discuss how the degree of adoption by other countries, having carbon taxes that are lower or higher than Japan's carbon tax, may alter incentives to support carbon taxation.

### *3.1 Design of Carbon Taxation*

Arguably the key feature of a carbon tax, and often the exclusive focus of research, is the price for $CO_2$ emissions. The effectiveness of a carbon tax in internalizing the externality of emissions and incentivizing firms and consumers to switch to cleaner production and consumption is dependent on implementing a high enough price on carbon.

Yet there are other design features of carbon taxation too that are relevant for understanding public support. In many cases, support for a policy measure involves multidimensional choices, and an individual policy decision is the result of balancing the pros and cons of a proposal (Hainmueller et al. 2014; Stadelmann-Steffen & Dermont 2018). Thus, the support for a policy instrument depends on the specific design of the policy, or the combinations of different policy components. Carbon taxation is not an exception. Given our focus on the implications of behavior by other countries, we focus on three additional carbon tax design features: ``get-out" clauses, revenue recycling, and exemptions.

First, carbon taxes may be designed to include clauses for further deepening, or withdrawal, dependent upon other countries' behavior. Such conditionalities form the basis of many countries' Nationally Determined Contributions (NDCs) under the Paris Agreement (Chan et al. 2018). Specifically, a carbon tax may be designed to allow for further "deepening" if other countries also adopt carbon taxes. Or alternatively, a carbon tax can be designed to include a "get-out" clause that limits the future scope of the tax if other countries end up with no or weak carbon taxes.

A second design feature that has gained prominence in recent years concerns how revenue from the carbon tax is used. Researchers and policy makers have thus focused on the importance for public support of pledging to use carbon tax revenue for particular purposes that are beneficial to society (Carattini et al. 2018, Klenert et al. 2018, Jagers et al. 2018; Beiser-McGrath and Bernauer 2019b). Several studies find that committing carbon tax revenues to purposes that directly benefit citizens, such as for instance tax reductions or funding renewables, can increase public support for carbon taxation (Carattini et al. 2018; Klenert et al. 2018; Jagers et al. 2018; Beiser-McGrath and Bernauer 2019b; Douenne and Fabre 2020, Fairbrother 2019). This design feature also affects the distributional consequences of a carbon tax. If the revenue is used in a way that provides direct benefits to the population, thus mitigating the distributional costs of a carbon tax, then the public may be more amenable to a higher carbon price.

A third design feature pertains to whether exemptions are put in place for economically important actors. Recent discussion of carbon border taxes has highlighted that a domestic carbon tax does per se not price the carbon footprint of imported goods (Lockwood and Whalley 2010; Fischer and Fox 2012). This means that domestic firms, particularly exporters, may suffer an economic disadvantage compared to firms in countries without a carbon tax. Domestic exporting firms both have their domestic production costs raised by a carbon tax and

compete against firms without such additional costs. Thus, whether other countries do in fact have a carbon tax or not becomes particularly salient.

In light of this discussion, we consider the behavior of other countries both upon support for carbon taxation, as well as the specific design features outlined above.

### *3.2 Adoption of Carbon Taxation by Other Countries*

Having outlined the most important design features of a carbon tax, we now turn to discussing how the adoption by other countries, or lack thereof, of a carbon tax might affect domestic public support for carbon taxation. Climate policy is usually considered in terms of an international reciprocity challenge (e.g., Bernauer 2003, Barrett 2003; Sandler 1997). The reason is that limiting global warming is a global public goods problem that implies strong interdependence among countries in terms of preferences and behavior (policy action). It also involves a free-rider problem, in the sense of countries that do not mitigate their GHG emissions still being able to benefit from mitigation by other countries, which in turn acts as a disincentive for countries that would otherwise want to reduce their emissions.

Such challenges in international politics are often resolved through reciprocal commitments. This means that countries formally make costly policy action contingent on other countries engaging in such action too. This logic of reciprocity, built off of canonical game theoretic models such as the (iterated) prisoners dilemma (e.g., Axelrod and Keohane 1986; Oye 1986; Axelrod and Hamilton 1984; Abreu 1988), means that the adoption of climate policy is conditional upon the adoption, or lack thereof, of other countries.[13]

[13] Likewise, policy diffusion studies analyze policy interaction among countries. However, they address the effect of a country's policy "adoption" on other countries rather than the effect of its policy "level," the latter of which is our main analytical focus. While diffusion studies suggest that geographically or socially similar or proximate countries have greater policy influences, we do not distinguish proximities of countries to avoid the complexity of our survey design.

Unlike other environmental policies, where unilateralism appears to be more prevalent (Bernauer and Gampfer 2015; Bernauer et al. 2016; McGrath and Bernauer 2017), carbon taxation, absent revenue recycling, imposes clearly visible and immediate costs on individuals while generating long-term benefits that are difficult to monetize (avoiding dangerous global warming levels). Explicitly setting a price on carbon means that all individuals in society are pushed towards internalizing the costs of their behavior, even though, as discussed above, policy design of carbon taxation can make cost implications less pronounced for some groups of individuals. Internationally, the visible costs of carbon taxes also make public concern about the fairness of burden sharing more prominent. Citizens are less likely to be accepting of costly policies when other countries are not seen to be doing their part. This is compounded by the fact that a global issue, such as climate change, cannot be resolved by the actions of one country in isolation. Specifically, a more stringent carbon tax, absent other countries' adoption, is likely to be judged as ineffective. In such circumstances, citizens concerned about other countries' behavior are unlikely to support increasing the stringency, and thus personal cost, of a carbon tax, as it does not result in significant benefits in the form of global emission reductions. Therefore, we expect that information on whether other countries have adopted carbon taxation affects support for a domestic carbon tax. The following hypothesis reflect these arguments.

**H1:** *Adoption of carbon taxation in other countries increases support for domestic carbon taxation.*

What impact could carbon taxation policy in other countries have upon support for the three carbon tax design features outlined above? First, considering "get-out" clauses, we expect that non-adoption of carbon taxation by other countries increases demand for get-out clauses.

In contrast, carbon tax adoption by other countries is likely to reduce such demand, as countries demonstrate the credibility of their climate policies through stringent policy adoption.

Second, revenue usage from carbon taxation is likely to increase in importance in scenarios where other countries do not adopt carbon taxes. In this case, negative economic effects of carbon taxation, which are compounded by a lack of international action, can potentially be mitigated through revenue usage mechanisms that benefit the domestic economy and its population. The manner in which carbon tax revenue is spent will still be important for citizens when other countries also adopt carbon taxation, as individuals will have general preferences on how government revenue is used. However, this design feature is likely to be less salient under such conditions.

Third, support for exempting Japanese exporting firms from carbon taxation may be conditional upon the behavior of other countries. Although the economic competitiveness of export-intensive sectors is harmed by a unilateral carbon tax in an open economy, this effect is mitigated if exporting firms based in other countries are also subject to a carbon tax within their own jurisdictions. The decline of international economic competitiveness has a negative impact on production and employment of exporting firms, which significantly affects people's lives (Böhringer and Rutherford 1997). This suggests that not only the government but also the public should be concerned about the effect of a carbon tax on international competitiveness of export-intensive sectors. With a “level-playing field” in place, individuals will be less interested in exempting exporting firms, and may in fact oppose exemptions because they involve unequal treatment. The absence of carbon taxation in other countries, in contrast, may induce citizens to support exempting firms in order to maintain the global economic competitiveness of Japanese companies. These arguments are reflected in the following hypothesis.

**H2:** *Adoption of carbon taxation in other countries reduces demand for "get-out" clauses, revenue recycling, and exemptions for domestic exporting firms in Japan's carbon taxation design.*

### *3.3 Beyond Adoption – Ambition Levels of Climate Policy*

In this section, we consider the behavior of other countries in terms of a continuum, rather than in binary form (carbon taxes adopted or not). Specifically, how do citizens react to other countries having adopted a more or less stringent version of the policy? Do citizens support carbon taxation if other countries also have carbon taxes, even if these are lower (or higher) than their home country's carbon tax? Or do they demand modifications to the home country's carbon tax in line with other countries' taxation level?

Higher levels of carbon taxation in other countries may motivate citizens to support higher carbon taxes in their own country. This motivation can emerge for a variety of reasons. First, higher carbon taxes in other countries may reduce concerns about losing international economic competitiveness when implementing a higher carbon tax, as other countries have already taken this step. Such behavior by other countries may thus serve to solve an international coordination problem (Barrett 2016), opening up the possibility for deeper cooperation in this area. Higher carbon taxation by other countries may also contribute to setting a norm as to what is an appropriate level of carbon taxation, in combination with recommendations of international organizations, such as the International Monetary Fund (IMF) and World Bank (Davenport 2016).

Alternatively, citizens may be confronted with lower carbon taxes in other countries. In that case, they may respond in accordance with the "law of the least ambitious program" (Underdal 1998). The latter holds that international environmental policy is often limited to

coordinating on the policy preferences of the least ambitious party. Influenced by this logic, public support for climate policy may take this into account. Absent information about other countries' behavior, citizens may consider the current level of a carbon tax to be what is "necessary" to deal with the problem. Yet learning that other countries have lower carbon taxes may signal that the (higher) domestic carbon tax currently implemented is not needed for contributing internationally to limiting global warming.

This may induce individuals to consider that a lower carbon tax would be sufficient to tackle the problem. Contrary to a binary conception of reciprocity, as discussed above, other countries adopting lower carbon taxes than in Japan may decrease support for increasing carbon taxes in Japan. Citizens may then continue to support a carbon tax in Japan, but at a reduced level. The following hypothesis reflects these arguments:

**H3:** *Higher carbon taxes in other countries increase support for higher carbon taxes in Japan, and vice versa.*

We also expect carbon tax levels in other countries to affect preferences over the design of domestic carbon taxation in Japan. Ambitious carbon taxes in other countries are likely to assuage demand for get-out clauses, and strengthen preferences for more stringent carbon taxation. First, we expect that higher carbon taxes in other countries will make get-out clauses appear less relevant because other countries have clearly demonstrated that they are committed to carbon taxation.

Second, as discussed before, the effect of carbon taxation in other countries on preferences over revenue usage domestically is likely to be ambiguous. However, if there is an effect it is likely that high carbon taxes in other countries reduce demand for revenue recycling that is personally beneficial to citizens.

Third, higher carbon taxes in other countries are likely to reduce demand for exempting domestic exporting firms. The reason is that in such a scenario concerns over an international level playing field will be weaker and citizens are likely to care about "equal" treatment of firms within the country.

Returning to the logic of the least ambitious program, we expect individuals to respond to low carbon taxes in other countries by preferring a less ambitious domestic carbon tax policy. First, citizens are likely to then be more supportive of get-out clauses. Second, holding the level of carbon taxation constant, individuals will likely maintain similar preferences for how carbon tax revenue is used, though we might see somewhat increased support for revenue usage that directly benefits individuals. Third, we expect to find more demand for exemptions for exporting firms, as they compete with firms from countries with lower carbon taxes. These arguments are reflected in the following hypothesis.

**H4:** *Higher carbon taxes in other countries reduce demand for get-out clauses, revenue recycling, and exemptions for domestic exporting firms, and vice versa.*

## 4. Data and Method

We assess the empirical implications of our theoretical arguments based on data from an original survey experiment carried out with a representative sample of adult Japanese citizens drawn from online panels of Rakuten Insight in Japan ($N$=2,280). Our sample is representative of the adult Japanese population in terms of age, gender, and region. The experimental design combines a framing and a conjoint experiment, somewhat similar to that of Beiser-McGrath and Bernauer (2019a) for the case of fossil fuel consumption. The survey

design with full texts of introduction, information frames, and questions in Experiments 1 and 2 are provided in A.9. in the Appendix.

All respondents were provided with information on energy-related causes of climate change and its negative consequences, highlighting the importance of global cooperation among countries. The text stated that "Using fossil fuels (coal, oil, gas, petrol/gasoline, diesel) for cars, trucks, electricity production, industry, household heating, and other purposes causes $CO_2$ emissions. These $CO_2$ emissions from countries worldwide are accumulating in the atmosphere of the Earth and are causing global climate change. Climate change, in turn, has a wide range of negative consequences, such as more droughts, floods, heatwaves, and storms. Solving this problem requires countries to cooperate globally". This was followed by a brief explanation of carbon taxation as a potential means of climate policy, and the current carbon tax in Japan. The latter text stated that "In 2012, Japan introduced a carbon tax on fossil fuels. This carbon tax is currently 340 yen per ton of $CO_2$ emissions. For the average person in Japan, this carbon tax creates additional costs of 270 yen per month. The government of Japan is currently considering a revision to this carbon tax and your opinion on this is very important to know.[14]"

**Experiment 1: Information Provision Experiment**

We conducted an information provision experiment to test our hypotheses regarding other countries' adoption and level of carbon taxation and support for the existing carbon tax (H1 and H3). Respondents were randomly provided with information on carbon tax policies in other countries (four treatment groups and one control group). We employed frames that

[14] The carbon price of 3 USD/$tCO_2$ (from World Bank carbon price 2018) was converted into yen (340 yen/$tCO_2$). Then, this was multiplied by Japan's $CO_2$ emissions per capita (9.5 $tCO_2$) to calculate monthly carbon tax costs per person.

include different pieces of information on the presence or absence of carbon taxes and the rates of carbon taxes in other countries, as shown in Table 1.[15]

We then asked whether the current carbon tax rate in Japan should be increased, maintained, or decreased, and how much respondents were willing to pay for the carbon tax. The first question reads "In your opinion, should the carbon tax in Japan, which is currently 340 yen per ton of $CO_2$ emissions, be…1. Increased a lot 2. Increased somewhat, 3. Maintained at the current level, 4. Decreased somewhat, 5. Decreased a lot, and 6. Abolished entirely". The second question reads "Specifically, if you could tell the government of Japan what to do with respect to a carbon tax, what amount should the carbon tax (per ton of $CO_2$) in Japan be? … 0 yen, 17 yen, 34 yen, 170 yen, 340 yen (current level), 680 yen, 1700 yen, 3400 yen, and more than 3400 yen".

This type of framing experimental approach enables us to measure the effect of each treatment information on the public support for a given policy, by comparing the level of support between the control group and the respective treatment groups.

***Table 1. Framing treatments***

| Group | Treatment text |
|---|---|
| Treatment 1 | Many other countries have **also introduced a carbon tax.** |
| Treatment 2 | Many other countries have **not introduced a carbon tax.** |
| Treatment 3 | Many other countries have **higher carbon taxes than Japan**. Carbon taxes in those other countries range from 4,000 to 15,000 yen per ton of $CO_2$. This is **10-45 times more than in Japan**. |
| Treatment 4 | Many other countries have **lower carbon taxes than Japan**. Carbon taxes in those other countries range from 100 to 170 yen per ton of $CO_2$. This is **only half or less than in Japan**. |

**Experiment 2: Conjoint experiment**

[15] We conducted manipulation checks to make sure respondents understood each frame correctly. Details on manipulation checks are presented in A.2. in the Appendix.

Our second experiment allows us to examine how information provision on other countries' behavior affects preferences over the design features of a carbon tax in Japan (H2 and H4). A conjoint experiment design allows us to identify the effect of specific design features upon support for carbon taxation. Conjoint analysis, compared to classical survey experiments, has three main advantages. First, it enables us to evaluate how the specific components of a policy influence public support for the whole policy. Second, by showing a policy that consists multidimensional components, we can understand individuals' realistic policy decisions, in which the public evaluates not a single but multiple policy components. Lastly, since conjoint experiments provide respondents with multiple reasons to justify a particular choice and rating, it can reduce social desirability bias (Bechtel and Scheve 2013; Hainmueller et al. 2014; Stadelmann-Steffen & Dermont 2018). Given that the public often faces multidimensional factors when considering support for carbon tax, conjoint analysis is an appropriate survey experimental approach to our case.

Respondents were first re-provided the information on carbon tax policies in other countries from the Experiment 1 again. Then, they were asked to complete choice tasks. In each of those choice tasks, two policy designs, each of which was composed of four policy attributes, were displayed side-by-side, and study participants had to express their preferences by responding to forced-choice and rating-choice questions. They completed five such tasks.

The four policy design attributes shown in A.3. in the Appendix reflect fundamental design features a carbon tax may have, including the tax rate/level, what the response to carbon taxation choices of other countries should be, how tax revenue will be used, and whether there are exemptions for exporting firms. While more nuanced representations of carbon tax design features might provide additional insights, we believe that the four attributes chosen have been subject to most political debate in Japan and elsewhere. Additionally, support for each of these aspects of carbon taxation can be plausibly influenced by the behavior of other countries, unlike

other prominent features of carbon taxes such as oversight measures. Furthermore, we wish to minimize the risk of respondent satisficing from including additional attributes (Bansak et. al 2019). Before completing the choice tasks, respondents were given a brief description of each of the four attributes.

The attributes were assigned in randomized order per survey participant, and were then held constant across the five choice tasks in order to limit the cognitive burden on participants. The attribute values shown in A.3. in the Appendix were fully randomized. This approach allows us to identify the causal effects of each attribute on the policy preferences of citizens. With two policy proposals per choice task and five choice tasks, this results in 2 (policy proposals) x 5 (choice tasks) x 2'280 (respondents). This results in a maximum of 22,800 observations.

The effect of information on other countries' carbon tax adoption and levels upon preferences over carbon tax design features is estimated by including interaction terms between Experiment 1 treatment status and the attribute values of the conjoint experiment.

Socio-demographic questions were asked toward the end of the survey. Questions on respondents' views toward climate change, economic conditions, Japanese companies, and the Japanese government, were asked before the framing experiment or after the conjoint experiment, with a view to avoiding priming effect.

## 5. Results

We present findings from the framing and conjoint experiments designed to test our four hypotheses. In A.4. in the Appendix, we also report a general picture of respondents' preferences (baseline preferences) toward carbon taxation, absent our experimental stimuli.

### 5-1 Experiment 1: Support for the Level of Carbon Taxation

We examine how information about other countries' behavior impacts policy support and design preferences. First, we estimate the effect of information about other countries' carbon taxation choices upon individuals' preferences for increasing or decreasing the current carbon tax and their preferred price level (H1 and H3). To do so, we reversed the scale of the former variable (i.e., "increased a lot" is coded as 6 and "abolished entirely" is coded as 1). We estimate linear regressions by Ordinary Least Squares (OLS). Therefore, our treatment effects correspond to differences in the average of these outcomes. Our main result holds when we estimate ordered logit model as reported in A.5. in the Appendix. Table 2 displays the treatment effects for each of these dependent variable items, both with and without covariate adjustment. Positive and negative coefficients indicate increase and decrease of support for raising carbon taxes, respectively. A balance check for covariates is available in A.1. in the Appendix. First, support for lowering the tax rate increases when respondents receive information that many other countries do not have a carbon tax (Treatment 2) or have lower carbon tax rates than Japan (Treatment 4). This finding of negative reciprocity runs counter to recent empirical findings on the unilateral nature of environmental preferences (e.g., Tingley and Tomz 2014, Beiser-McGrath and Bernauer 2019a), suggesting that carbon taxation follows a somewhat different logic to that of other environmental issues and policies. Second, support for increasing the carbon tax rate increases when citizens obtain information that many other countries have higher carbon tax rates (Treatment 3). Third, simply learning that other countries have adopted carbon taxes does not significantly increase support or willingness to pay.

***Table 2. Effect of information provision on support for carbon tax level in Experiment 1***

| | Outcome Variable | | | |
|---|---|---|---|---|
| | Increase / Decrease | | Preferred Price | |
| Intercept | 4.079 (0.062) | 3.191 (0.198) | 4.699 (0.083) | 3.321 (0.273) |

| | | | | |
|---|---|---|---|---|
| T1: Others Have | 0.022 (0.089) | 0.032 (0.088) | 0.003 (0.119) | 0.012 (0.118) |
| T2: Others Don't Have | -0.277 (0.089) | -0.282 (0.088) | -0.347 (0.119) | -0.358 (0.118) |
| T3: Others Higher | 0.273 (0.088) | 0.284 (0.087) | 0.364 (0.117) | 0.378 (0.116) |
| T4: Others Lower | -0.470 (0.090) | -0.471 (0.089) | -0.374 (0,121) | -0.378 (0.119) |
| Covariates | No | Yes | No | Yes |
| N | 1,750 | 1,750 | 1,750 | 1,750 |
| Adjusted $R^2$ | 0.043 | 0.065 | 0.026 | 0.057 |

*Notes:* Coefficients and standard errors are estimated using linear regression. Standard errors are shown in parentheses and statistically significant results at the standard significance level of $\alpha = 0.05$ are highlighted in gray. Results in columns 2 and 4 are adjusted for covariates---female, age, urban size, education level, income, and ideology.

We can also test whether information about the size of the carbon tax (larger or smaller) has a significantly different effect from the adoption of a carbon tax by other countries. To do so, we conducted Wald tests for the equality of coefficients (i.e., treatment effects) using four models in Table 2. The null hypotheses are that coefficients of Treatment 1 and 3 are equal, and coefficients of Treatment 2 and 4 are equal. *F* statistics of the models are 6.212 ($p = 0.002$), 6.296 ($p = 0.002$), 4.623 ($p = 0.001$), and 4.885 ($p = 0.008$), respectively. These results show that (1) information on other countries having a lower carbon tax (Treatment 4) has a stronger negative effect than information that other countries do not have carbon taxes (Treatment 2), and (2) information on other countries' higher carbon taxes (Treatment 3) has a stronger positive effect than information that other countries have carbon taxes (Treatment 1). Information about lower carbon tax levels having a stronger negative effect than lack of adoption in other countries suggests that the risk of shallow participation in environmental policies reduces ambition significantly more than other countries simply not participating. Conversely, the stronger effect of higher carbon tax levels when compared to adoption by other countries suggests that ambitious efforts by other countries are required for increasing support for carbon taxation beyond the status quo.

## 5-2 Experiment 2: Preferences Over the Design of Carbon Taxation

Next, we examine how the behavior of other countries affects respondents' preferences toward specific design features of a carbon tax (H2 and H4). In the following, we present the conjoint results based upon the forced choices.[16] This means we assess the importance of policy design, when choosing between two hypothetical carbon taxes. In A.6. in the Appendix, we report Average Marginal Component Effects (AMCEs) and Marginal Means (MMs) for four different features of a carbon tax from the conjoint experiment, which vary according to which information each respondent received in the framing experiment (Experiment 1). AMCEs measure the causal effect of including an attribute on choosing a carbon tax, in reference to a baseline category. These are akin to average treatment effects in factorial experiments, where the reference category is the baseline of the attribute. Marginal Means, in contrast, show the expected support for a policy that contains this attribute value, averaging over all other attributes. Thus, this approximately tells us what the average support for a policy containing this specific attribute value. For further discussion see Leeper, Hobolt, and Tilley (2019). In the following, we present how the information treatments affect design preferences for each attribute. To do so we calculate the difference of marginal means between treatment groups and the control group.[17]

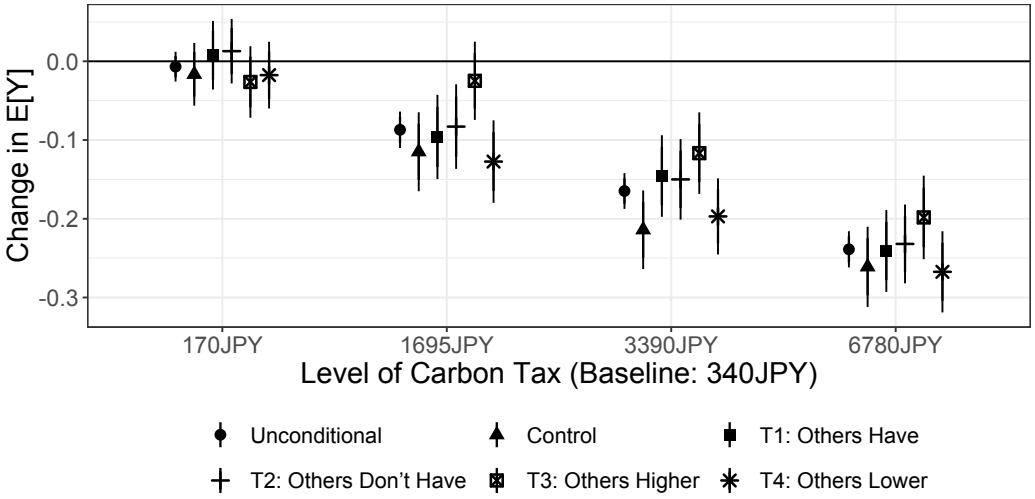
### 5-2-1 Costs of carbon taxation

[16] Results are robust to using respondents' ratings instead, full details of which are presented in A.8. in the Appendix. We also re-examined the results with a sample that excludes respondents who failed our comprehension checks. The results are presented in A.7. in the Appendix.

[17] As before, we present the conjoint results from the forced choices, but the main results hold with rating choices, which are presented in A.8. in the Appendix.

First, we estimate how information on other countries' behavior affects respondents' willingness to pay. Figure 1 shows the AMCEs for carbon tax level in the conjoint experiment, which vary according to which information a respondent receives in the framing experiment. In general, we see that more costly carbon taxes receive less support. However, this effect is significantly weaker for those respondents who received information that other countries have *higher* levels of carbon taxation (Treatment 3). Individuals respond with a higher willingness to pay when facing more ambitious carbon taxation in other countries. In contrast, the other information treatments do not significantly change the level of support for carbon pricing.

***Figure 1. Effect of information provision on support for carbon tax level***

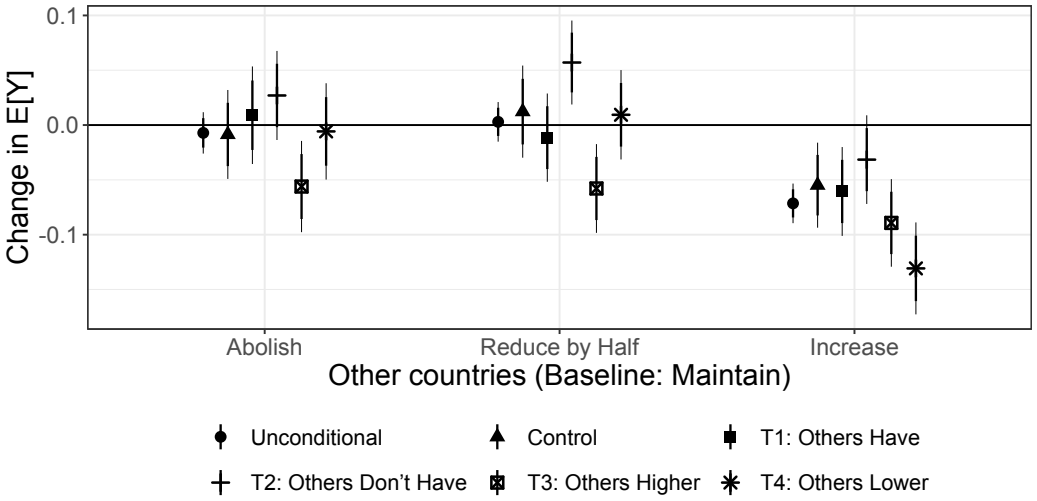



** Points indicate the change in probability of support for a carbon tax policy when respondents receive an attribute value, compared to the baseline, within a treatment condition. Thin lines represent 95% confidence intervals. Thick lines indicate 83.7% confidence intervals, to visually assess whether the estimates are significantly different from one another.*

**5-2-2 "Get-out" clauses**

As shown in Figure 2, if a majority of other countries do not introduce a carbon tax within next five years, respondents are generally indifferent between maintaining and reducing the level of the carbon tax in Japan. Yet, this significantly changes depending on information about other countries' behavior. Information that other countries have higher carbon taxes than Japan reduces individuals' support for decreasing or abolishing Japan's existing carbon tax, were carbon taxation not adopted by a majority of other countries. In contrast, information that other countries do not have carbon taxes increases support for halving Japan's carbon tax, were a majority of countries unable to adopt carbon taxes in the future.

***Figure 2. Effect of information provision on support for get-out clause***

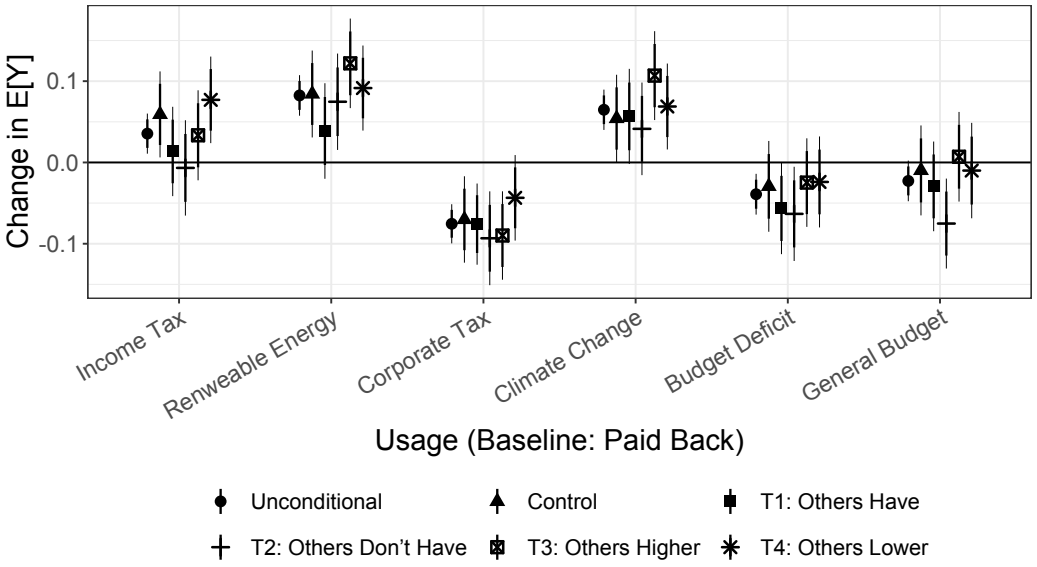



** Points indicate the change in probability of support for a carbon tax policy when respondents receive an attribute value, compared to the baseline, within a treatment condition. Thin lines represent 95% confidence intervals. Thick lines indicate 83.7% confidence intervals, to visually assess whether the estimates are significantly different from one another.*

**5-2-3 Revenue usage**

With regard to revenue recycling, respondents prefer to reduce income taxes, support renewable energy projects, and fund measures to protect against climate change, as illustrated in Figure 3. Preferences toward revenue usage seem largely unaffected by information about carbon taxes in other countries compared to the control group, which runs contrary to our expectations.

***Figure 3. Effect of information provision on support for revenue usage***



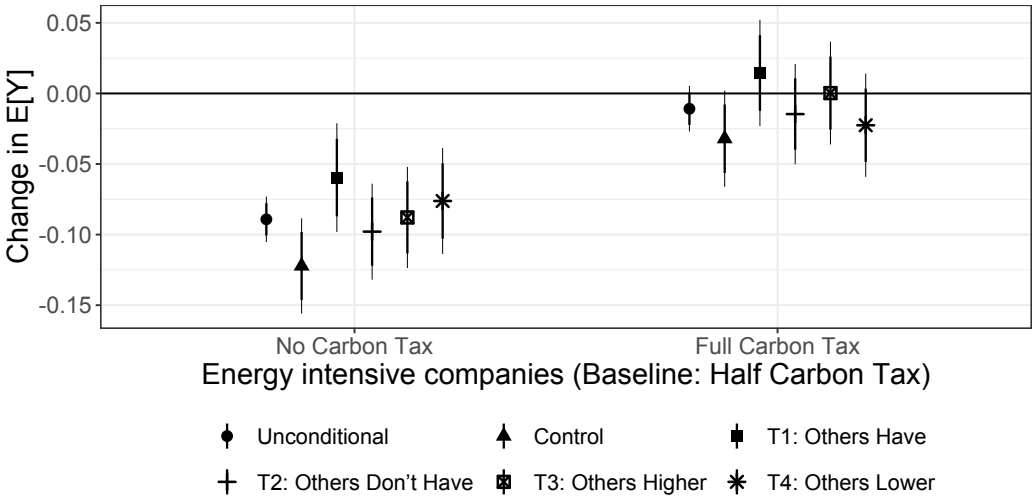

** Points indicate the change in probability of support for a carbon tax policy when respondents receive an attribute value, compared to the baseline, within a treatment condition. Thin lines represent 95% confidence intervals. Thick lines indicate 83.7% confidence intervals, to visually assess whether the estimates are significantly different from one another.*

### 5-2-4 Exemptions for energy-intensive export companies

In terms of tax exemptions for energy-intensive export companies, Figure 4 shows that respondents are indifferent between having no exemption and a "half" exemption. Support for the carbon tax decreases, however, if companies are fully exempted. Turning to the effect of our information treatments, we find that support for fully exempting companies from the carbon tax increases when respondents receive information on other countries having carbon taxes (Treatment 1). This runs contrary to our expectations where we would expect citizens to

be less supportive of exemptions when Japanese firms are not disadvantaged, i.e., when other countries have adopted carbon taxes.

***Figure 4. Effect of information provision on support for tax exemptions for energy-intensive export companies***




** Points indicate the change in probability of support for a carbon tax policy when respondents receive an attribute value, compared to the baseline, within a treatment condition. Thin lines represent 95% confidence intervals. Thick lines indicate 83.7% confidence intervals, to visually assess whether the estimates are significantly different from one another.*

## 6. Conclusion

A growing literature examines how to design environmental policies with a view to making them not only effective in problem solving terms, but also politically feasible by garnering sufficient public support (Beiser-McGrath and Bernauer 2019b; Wicki et al. 2019; Fesenfeld et al. 2020). This is particularly relevant for policy interventions that impose easily quantifiable and immediate, and thus highly visible and politically salient, costs on large parts of society. Carbon taxes, one of the key policy instruments for reducing greenhouse gas emissions, are a paradigmatic example for this.

As advanced industrialized countries in particular are seeking to increase carbon prices in order to achieve their Paris Agreement commitments and eventually make their economies carbon neutral by the middle of this century, academic research on mass public preferences concerning carbon taxes and their design is rapidly gaining ground.

Focusing on the world's third largest economy, Japan, which has started out with very low carbon taxation levels and thus has a long way to go in this regard, we have used a combination of two experiments embedded in a representative public opinion survey to examine two types of arguments. These pertain to preferences of the Japanese public over four key elements of carbon tax design (taxation level, revenue recycling, get-out clauses, and exemptions for exporting firms), and how those preferences are affected by the behavior of other countries in this area.

Overall, we find that the adoption and level of carbon taxation in other countries has a significant effect upon both individuals' general support for a domestic carbon tax, as well as over relevant design features. That being said, we also found similar patterns of public support on some policy design features across experimental groups. Such consistent patterns across groups were also confirmed in previous studies (Stadelmann-Steffen and Dermont 2020). With respect to the four hypotheses we developed, our findings are the following.

**(H1) Adoption of Carbon Tax and Domestic Support:** We find that information about other countries failing to adopt carbon taxes significantly decreases support for the domestic carbon tax. Information that other countries have adopted carbon taxation does not significantly change support.

**(H2) Adoption and Policy Design:** The results suggest that other countries' adoption, or lack thereof, of carbon taxes significantly changes demand for "get-out" clauses to be included in a carbon tax. Such information, however, does not affect demands over domestic firm exemptions and how the revenue from the carbon tax is used.

**(H3) Level of Carbon Tax and Domestic Support:** We find that information about other countries having a higher priced carbon tax than Japan significantly increases support. Likewise, information about other countries having a lower priced carbon tax significantly decreases supports. These price effects are significantly stronger than the adoption effects considered for H1.

**(H4) Level of Carbon Tax and Policy Design:** Similar to H2, we find that information about other countries' behavior primarily affects demands for "get-out" clauses within a proposed carbon tax. When faced with countries having higher carbon taxes, individuals are less supportive of including such clauses. Information about other countries' level of carbon taxation does not have consistent significant effects upon the other design features, revenue usage and domestic firm exemptions.

These results suggest that the depth of policy action by other countries is as important as policy adoption per se when considering the public's appetite for tackling global issues, such as climate change. This is particularly relevant for the ratchetting-up mechanism of the Paris agreement, which tolerates initially low levels of commitment in the expectation that future pledges will be more ambitious. On the one hand, ambitious actions of some countries are expected to motivate countries with low levels of commitment. On the other hand, initially unambitious actions may be considered the norm, dampening ambition in other countries, and defaulting to the law of the least ambitious program. These suggest that international agreement that expects reciprocity as a mechanism to achieve climate cooperation can be effective. Nonetheless, to realize the ratcheting-up mechanism assumed under the Paris Agreement, the Agreement needs to be designed to maximize the positive reciprocity while minimizing the potential for negative reciprocity.

Future research could examine the extent to which these dynamics apply to other environmental issues, as well as to other global issues where countries are able to choose their

level of policy effort. Additionally, and in line with theories of policy diffusion (Gilardi and Wasserfallen 2019) and relative gains (Grieco 1988), researchers could examine whether specific countries' behavior have a greater influence on the public's support for carbon taxation, as has been done in other environmental areas (Beiser-McGrath and Bernauer 2019b).

## Ethics Statement

The Institutional Review Board (IRB) of the Kobe University approved the survey experiment described in this article. Informed consent was obtained from all subjects.