

Nesje, Frikk; Schmidt, Robert C.; Drupp, Moritz A.

Working Paper

Designing Carbon Pricing Policies Across the Globe

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Designing Carbon Pricing Policies Across the Globe

Frikk Nesje, Robert C. Schmidt, Moritz A. Drupp

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Poschingerstr. 5, 81679 Munich, Germany

Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de

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Designing Carbon Pricing Policies Across the Globe

Abstract

This study presents a large-scale, global assessment of expert recommendations on key policy design options on how to implement carbon pricing schemes at a country level, for which there is no consensus in the literature. Based on a survey of more than 400 academic experts on carbon pricing, we find that almost twice as many favor a carbon tax over a cap-and-trade scheme for unilateral carbon pricing than vice versa, and three-quarters strongly recommend using border carbon adjustment to address competitiveness concerns. By contrast, guidance on revenue-use from carbon pricing is much more nuanced, with considerably lower support for lump-sum transfers to households than reflected in academic and policy discussions. Furthermore, recommendations on instrument choice and revenue use vary considerably with country- and expert characteristics, such as GDP per capita and academic discipline. Our findings can guide the search for suitable public policy approaches that combine environmental effectiveness with economic efficiency and fairness considerations.

JEL-Codes: Q540, H430.

Keywords: carbon pricing, expert survey, instrument choice, border carbon adjustment, revenue recycling.

*Frikk Nesje**
Department of Economics
University of Copenhagen / Denmark
frikk.nesje@econ.ku.dk

Robert C. Schmidt
Department of Economics
FernUniversität Hagen / Germany
robert.schmidt@fernuni-hagen.de

Moritz A. Drupp
Department of Economics
University of Hamburg / Germany
Moritz.Drupp@uni-hamburg.de

*corresponding author

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1. Introduction

There is a broad consensus among economists that carbon pricing is a key building block of an effective climate policy mix. Carbon pricing has proliferated in recent decades, partly due to diffusion from countries that adopt policy to neighboring countries (Linsenmeier et al. 2023). To date, 39 national jurisdictions have implemented carbon pricing schemes that collectively cover around 23 percent of global greenhouse gas emissions (World Bank 2023a). These existing schemes exhibit considerable heterogeneity in terms of instrument choice, stringency, as well as the use of revenues (World Bank 2023b). Recent debates regarding implementation have been informed by surveys of the population (e.g., Carratini et al. 2019; Douenne and Fabre 2022; Dechezleprêtre et al. 2022) and distilled in panels of and petitions by general economists in North America (e.g., IGM 2018; Wall Street Journal 2019) and in Europe (EAERE, 2019, 2022). With 77 percent greenhouse gas emissions across the globe currently unregulated by explicit carbon pricing and a number of countries working towards putting climate policy in place (World Bank 2023b), obtaining a better understanding of how to design carbon pricing policy from a representative account of expert views is crucial to inform public policy.

The question if a carbon price should be implemented as a carbon tax, via cap-and-trade, or some mix of instruments has occupied scholars for decades (Weitzman 1974; Karp and Traeger 2019; Stavins 2022). Furthermore, border carbon adjustment (BCA), as a means to protect the competitiveness of domestic industries under unilateral carbon pricing, has been discussed as a potential barrier to trade (e.g., Böhringer et al. 2022; Cosbey et al. 2019). Yet, BCA may be amenable to establishing effective carbon prices unilaterally in a non-cooperative world (e.g., Böhringer et al. 2022), or for fostering cooperation (Helm and Schmidt 2015, Al Khourdajie and Finus 2020), and has gained substantial prominence, as exemplified by the EU's planned Carbon Border Adjustment Mechanism – CBAM (European Commission 2021). Similarly, the use of revenues from carbon pricing is subject to intensive debate, not least due to its potential effects on public acceptance of carbon pricing and its political feasibility (Carratini et al. 2019; Klenert et al. 2018; Douenne and Fabre 2022), and its relation to instrument choice (Fischer 2001).² There are also a number of disciplinary differences in views on the role of carbon pricing more generally, as illustrated by a recent debate between economists and other climate policy experts that pointed to important areas of disagreement (Rosenbloom 2020a, 2020b; Van den Bergh and Botzen 2020). So far, no consensus view has emerged on any of these key policy design issues.

We address this gap by eliciting expert recommendations on key policy design issues related to carbon pricing. Expert elicitation has gained prominence in the past few years as a way to inform different stakeholders about complex issues in climate science and economics (e.g., Andre et al. 2022; Boumans et al. 2024; Christensen et al. 2018; Dannenberg et al. 2017; Dannenberg and Zitzelsberger 2019; DellaVigna et al. 2019; Drupp et al. 2018, 2024; Gollier et al. 2023; Howard and Sylvain 2020; Kornek et al. 2020; Meng et al. 2021; Otto et al. 2020; Pindyck 2019; Victor et al. 2022; Zickfeld et al. 2007). Our study targets a broad population of academics sourced as (potential) experts on carbon pricing by virtue of their pertinent and cited publications. Our systematic search process revealed 2106 authors on this topic around the globe, of which 467 participated in our survey. The survey combines two thematic parts: one part on policy design issues (summarized in Table 1) that focuses on three key carbon pricing design questions for which there is no consensus in the theoretical or applied literature, and a part on carbon price levels that is analyzed in a companion paper (Drupp et al. 2024). The

² While a survey among citizens highlights that returning the revenues to citizens is crucial for winning public support for a carbon pricing scheme (Carratini et al. 2019), other evidence suggests that existing rebate programs in Canada and Switzerland had only limited effects on public support of carbon pricing policies in these countries (Mildenberger et al. 2022).

survey closed with a question on potential determinants of experts' recommendations and an option to provide remarks. In addition to the survey data, we draw on country-level data (e.g., GDP per capita), and on observable expert characteristics, such as publication record or gender, to shed light on possible determinants.

Table 1. Summary of survey questions on policy design issues

Country	<i>Please specify the country you would feel most comfortable advising on carbon pricing (below, we will refer to this as “your country”).</i>
Instrument choice	<i>Assuming that no carbon pricing scheme has been implemented in your country yet, which instrument would you recommend? Carbon tax, cap-and-trade with price collar (price floor and price cap), cap-and-trade without price collar, other (please specify).</i>
Border carbon adjustment	<i>If your country implements a carbon pricing scheme unilaterally, would you strongly recommend introducing a border carbon adjustment scheme (if that is possible)?</i>
Revenue usage	<p><i>How should your government use the revenues raised by carbon pricing? (Multiple answers are possible)</i></p> <ul style="list-style-type: none"> <i>a) General government spending</i> <i>b) Equal lump-sum transfers to households</i> <i>c) Transfers to particularly affected households</i> <i>d) Reduction of distortionary taxes</i> <i>e) Grandfathering or tax cuts for firms</i> <i>f) Transfers to particularly affected firms</i> <i>g) Spending on environmental public goods</i> <i>h) Green R&D</i> <i>i) Subsidies for renewable energy</i> <i>j) International transfers to countries particularly affected</i> <i>k) International transfers to support climate policy in other countries</i> <i>l) Other.</i> <p><i>If you suggest more than one use, please indicate your most recommended option.</i></p>

Notes: The table provides a summary of the survey questions (shortened) related with key policy design issues. The full survey text is in the Online Appendix.

We document carbon pricing policy design recommendations before analyzing possible determinants. Our data shows that experts' views are substantially more nuanced than previously acknowledged by the limited evidence available. The IGM Economic Experts Panels, for example, were conducted among a small set of general economists, most without special climate policy expertise. In the US IGM (2018), 66 percent of the panel members agreed to the statement that “Carbon taxes are a better way to implement climate policy than cap-and-trade”, 29 percent were uncertain. No single IGM (2018) member expressed disagreement. In the European IGM (2020), which asked the same question, 53 percent of the panel members agreed and 35 percent were uncertain. However, 11 percent expressed disagreement, preferring, for instance, emissions trading. Our data allows us to investigate whether these differences carry over to experts on carbon pricing both within and beyond economics, and whether policy recommendations by US and European experts are representative of expert views in other parts of the world. A representative account of expert views on the implementation of BCA and on the usage of revenues from carbon pricing is also lacking.

2. Survey design and expert selection

To identify experts, we ran an automated keywords search in SCOPUS, and defined a potential expert as a (co-)author of at least two publications matching our keywords criteria since the year 2000, that have been cited at least once. The search string contained “carbon tax”, “cap-and-trade”, and various variations of these and equivalent terms. We narrowed our sample to those experts for whom we could find a workable e-mail address. This way, we identified 2106 potential experts on carbon pricing around the globe. Although other definitions of potential expertise exist, several of the studies cited above also rely on objective criteria like publication-based expertise rather than hand-selected experts.

Among these experts, we conducted an online survey on carbon pricing. Invitations to the survey were sent out by e-mail. The survey took place from June to November 2019, with three rounds of reminders. By the end of November 2019, we received 574 responses (including 97 explained non-responses), amounting to a response rate of around 25 percent. A description of our research methodology, including the search string, and other details of our approach, including data cleaning, are provided in the Online Appendix. Here, we briefly summarize our methodology.

In the survey, we included questions on key policy design issues that are analyzed in the present paper: Instrument choice, border carbon adjustment, and revenue usage. Furthermore, we asked each expert questions on their recommended level of carbon prices in different scenarios that we analyze in a companion paper (Drupp et al., 2024), which solely uses recommendations for policy design at a more aggregated level alongside other covariates to explain the variation in recommended carbon price levels. Additionally, we included one question on potential determinants of experts’ recommendations (such as global emission reduction targets, or expected climate damages). The full survey text (including the preamble) is in the Online Appendix.

Outside of the survey, we used further data sources in order to analyze possible drivers of experts’ recommendations. Based on their country as revealed in the survey, we collected country-level data including GDP per capita, existing carbon prices in the country (if any), as well as governance indicators. We have also collected publicly observable information on the experts who provided their name to us at the end of our survey. These measures were collected from SCOPUS, for example the expert’s number of publications, number of citations, and whether the expert has published on topics related to the social cost of carbon or integrated assessment models, among other things.

In Section 4 (Robustness and discussion), we also address standard concerns with surveys, related to non-response bias, strategic response bias, and non-representation bias. We do not find evidence for non-response bias and strategic response bias in our survey. There is some evidence of non-representation bias, but this is to be expected as the population of experts is not globally representative. Table A1 in the Online Appendix gives a descriptive overview.

3. Results

3.1 Instrument choice

We find that almost twice as many experts recommend using a carbon tax (49 percent) as compared to cap-and-trade with (23 percent) or without (6 percent) a price collar. A carbon tax is thus clearly preferred over cap-and-trade schemes on aggregate (two-sided t-test: $p < 0.000$). While 4 percent of experts selected “no clear recommendation” regarding instrument choice, 18 percent recommend some “other instrument or mix of instruments”. These were then asked to specify what other instrument or mix of instruments they had in mind. The majority of these

responses also contain some variant of “carbon tax” or “cap-and-trade” in combination with other instruments or additional measures. The ratio of “tax” vs. “cap-and-trade” in these qualitative responses is very similar to the one in the overall sample. Around 10 percent of these experts recommend cap-and-trade specifically for larger emitters or energy intensive industries, and a carbon tax for smaller emitters or other sectors, such as for agriculture or small and medium-sized firms (see Table A2 in the Online Appendix for further details).

Figure 1 shows recommendations on instrument choice on aggregate and split by continents and countries. A carbon tax is most strongly preferred over other instruments in North America (two-sided t-test: $p < 0.000$), followed by Africa & South America. The share of European experts who prefer a carbon tax (49 percent) coincides with the share of experts who prefer a tax in the overall sample. There are some notable exceptions within Europe, though. For instance, experts from Germany and Spain recommend cap-and-trade more often (see Figure 1 Panel A). Furthermore, 50 percent of the experts from Oceania recommend cap-and-trade, whereas Asian experts are almost equally split in their preference for tax vs. cap-and-trade (48 vs. 52 percent). Among Asian experts, those from China exhibit a clear preference for cap-and-trade with a price collar.

When using data on potential determinants, we find that experts recommending more stringent global emission reduction targets tend to recommend carbon taxes as opposed to cap-and-trade; this also holds when controlling for a country’s GDP per capita, whether experts published in economics, and their gender (univariate and multivariate logistic regression: $p = 0.012$ and $p = 0.015$). We further find that support for carbon taxes tends to increase in GDP per capita (linear regression: $p = 0.002$), and that a clear recommendation for carbon taxes as opposed to cap-and-trade exists only in richer countries—both when splitting our sample at the sample mean GDP per capita as well as at global GDP per capita (two-sided t-tests: $p < 0.000$). In contrast, experts in the bottom half of the global income distribution tend to recommend cap-and-trade more frequently, albeit insignificantly so (two-sided t-test: $p = 0.163$). A possible explanation for this is that these countries are more likely to benefit from selling part of their allocated permits on the global market, compared to countries with a higher GDP per capita with relatively fewer low-cost abatement options (see Keen and Kotsogiannis 2014, Bauer et al. 2020). In the Robustness and discussion (Section 4), we document how limited global representation of expertise (“non-representation bias”) affects instrument choice recommendations.

We further find that the existence of a carbon tax in an expert’s country is associated with higher support for carbon taxes (58 vs. 45 percent; t-test: $p = 0.011$), suggesting that regional and county-specific differences in the support for carbon taxes may reflect differences in experience with trying to apply such measures. We find no differences in recommending carbon taxes relative to other instruments for economists and non-economists (chi-squared test: $p = 0.573$), whereas female researchers tend to recommend carbon taxes less often (chi-squared test: 38 vs. 52 percent; $p = 0.058$), and recommend a mix of instruments more often (30 vs. 16 percent; $p = 0.008$). The higher aggregate recommendation for instruments other than a carbon tax in our expert sample compared with the IGM Economic Experts Panels (IGM 2018; European IGM 2020) is likely also due to the limited geographical coverage and the stronger gender imbalance of the IGM Panels. In sum, our findings suggest a clear recommendation for a carbon tax in the overall sample of experts, and especially in the US, with more nuanced views within Europe and elsewhere. This clear finding in support of carbon taxes, however, does not generalize to a hypothetical population of experts that would be globally representative (see Figure 4 in Section 4.3 and the Online Appendix).

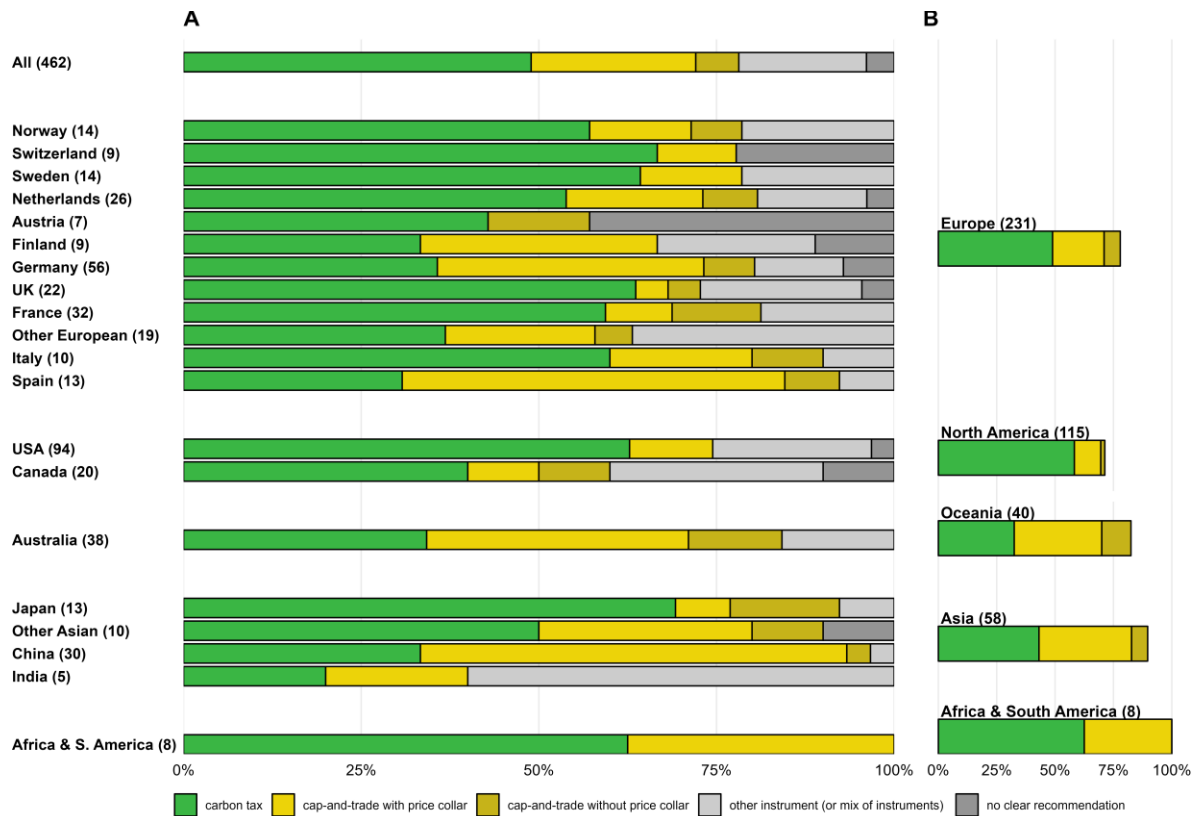


Fig. 1. Carbon pricing instruments. The shares of experts recommending the use of certain carbon pricing instruments, by experts' countries (Panel A), and continental groups of countries (Panel B), with carbon tax (green), cap-and-trade with price collar (yellow), cap-and-trade without price collar (dark yellow), other instrument or mix of instrument (light gray), and no clear recommendation (dark gray). Countries are ordered by continental group and along GDP per capita within a continent. (Number of observations in parentheses.)

3.2 Border Carbon Adjustment (BCA)

Regarding experts' views on BCA, we find that 74 percent of all respondents strongly recommend its usage (if that is possible), assuming that their country plans to implement a (new) carbon pricing scheme unilaterally (see Fig. 2). We find that this recommendation for BCA is consistent across all continents and virtually all countries. Among the countries with at least five observations (our threshold to protect the anonymity of our respondents, as in Drupp et al. (2024)), only experts from Norway are split equally between a strong recommendation on BCA or not (see Fig. 2 Panel A). On the other end, all experts from Switzerland strongly recommend the usage of BCA.

In terms of the survey data on potential determinants, we solely find that experts who expect a higher probability of severe climate damages tend to recommend BCA more often (logistic regression: $p=0.035$). Overall, our analysis reveals that support for BCA is widespread without much heterogeneity. Interestingly, experts who publish in economics journals tend to recommend the use of BCA less often compared to those who do not (70 vs. 80 percent; chi-squared t-test: $p=0.032$). Still, there is an overwhelming majority favoring BCA. The broad support for BCA we document aligns well with wording in the "Economists' Statement on Carbon Pricing" (EAERE 2019) which suggests BCA as a potential solution in the multilateral context. Although its implementation may involve considerable bureaucratic costs as well as legal challenges (Kruse-Andersen and Sørensen 2021; Böhringer et al. 2022; Dominiononi and Esty 2022), our findings suggest that the benefits outweigh those costs in the assessment of most experts. Particularly for higher carbon prices, the risks of carbon leakage, competitiveness losses, and firm relocation may be substantial (e.g., Nachtigall 2019).

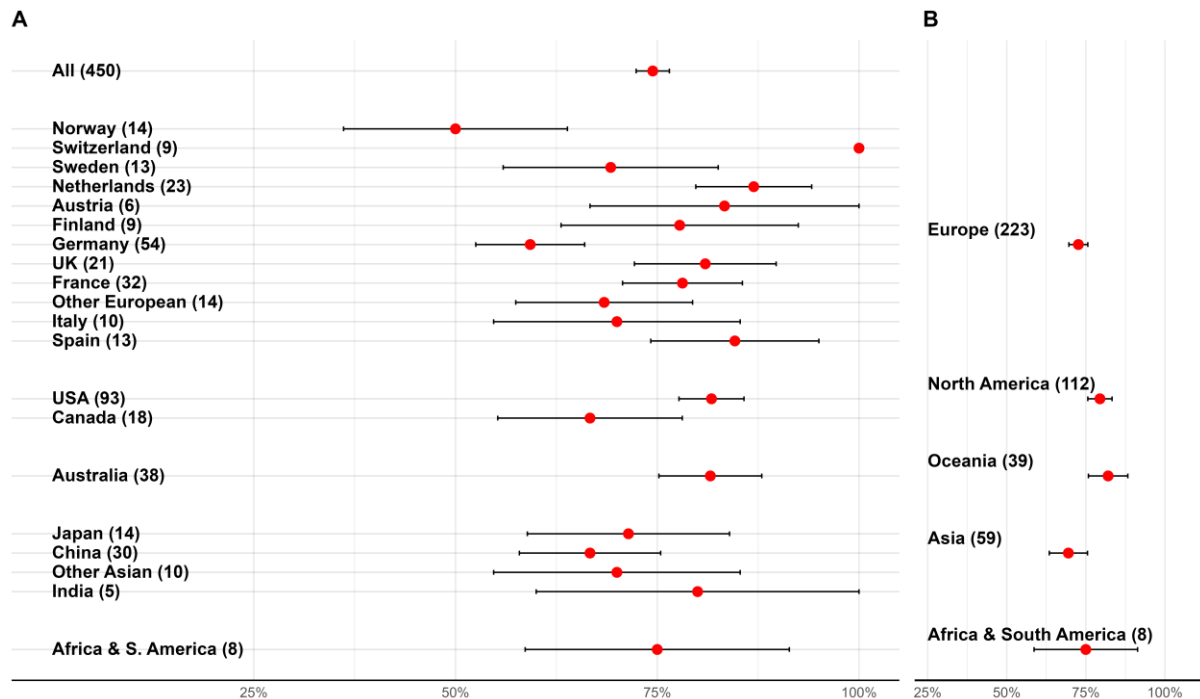


Fig. 2. Border carbon adjustment. Bars show mean *strong recommendation for BCA* (in percent) for countries (Panel A) and continental groups of countries (Panel B) (respectively for all respondents), with standard errors. (Number of observations in parentheses.)

3.3. Revenue use

Experts' recommendations on the use of revenues from carbon pricing display substantial heterogeneities. We first asked respondents to choose one or several among *multiple options* for the recommended usage of the revenues (see Table A3 in the Online Appendix). Here, we find the strongest support for green R&D: 59 percent of the respondents who answered the question chose this option (among others). The second most frequently suggested usage is "transfers to particularly affected households" (56 percent), followed by a reduction in distortionary taxes (43 percent). The option "equal lump-sum transfers to households" was chosen only by 25 percent of respondents. This contrasts strongly with the "Economists' Statement on Carbon Dividends" (Wall Street Journal 2019) that explicitly recommended (only) lump-sum transfers. Some of the detailed responses also contain other ways to use the revenues than our specified options. Examples include "climate adaptation", "dealing with the regressive impacts on poorer households ... in order to mitigate political resistance", "green infrastructure investments", "international transfers to support carbon sinks in other countries", and "transfers to low-income households" (see Table A4 in the Online Appendix).

We additionally allowed respondents to indicate one "most recommended option" in case they selected several options for the usage of revenues from carbon pricing (see Fig. 3). We observe that the option "transfers to particularly affected households" is most favored by experts, i.e., indicated by respondents as their most preferred option most frequently (24 percent). The option "equal lump-sum transfers to households" now ranks second (but at solely 15 percent), followed by "reduction of distortionary taxes" (15 percent). The option "green R&D" that ranked first among all options selected when multiple options are possible, only ranks fourth among experts' most recommended options (11 percent).

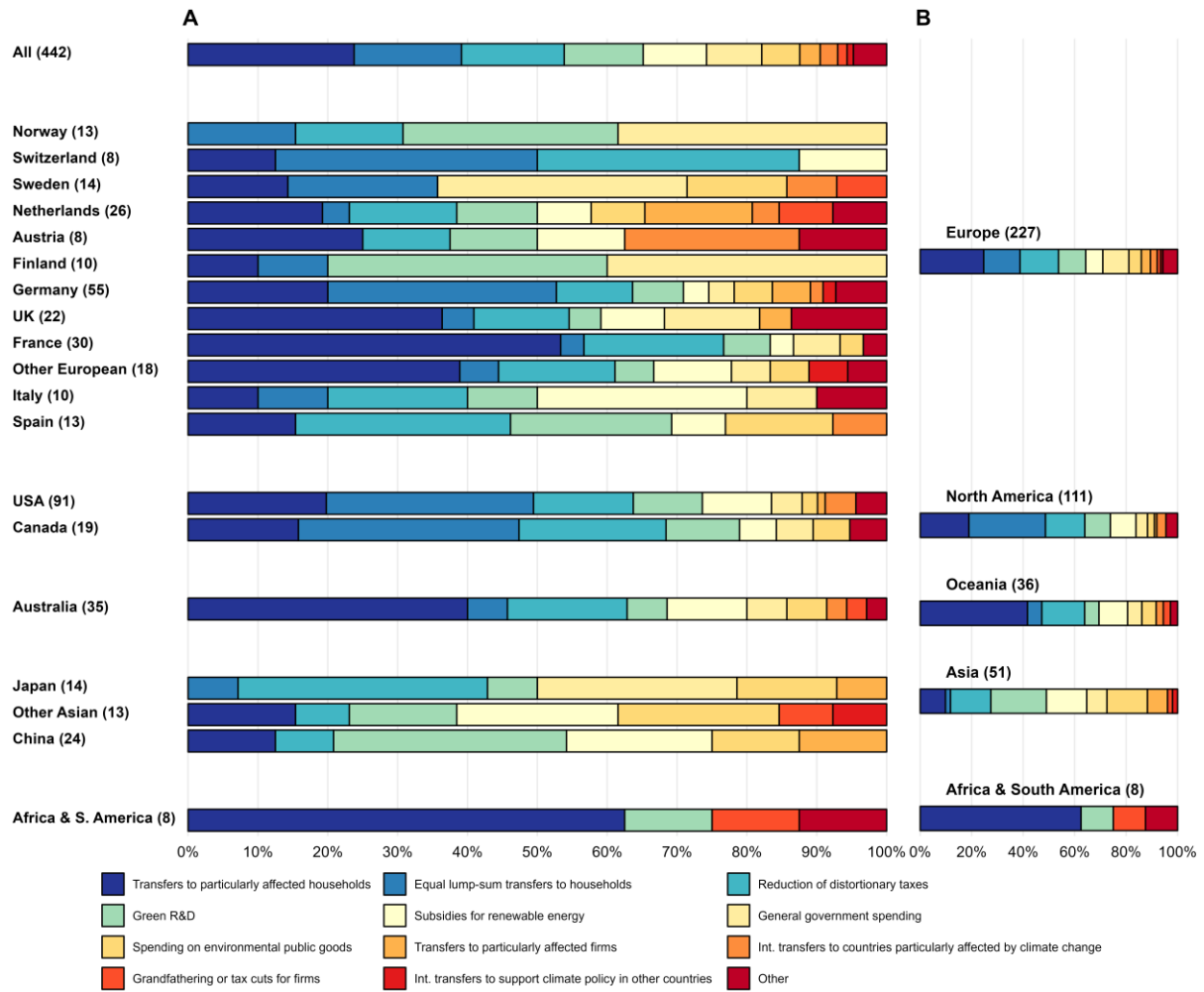


Fig. 3. Carbon pricing revenue use – most recommended option (in percent). Fraction of experts that indicate each of the options for revenue usage as “most recommended” for countries (Panel A) and continental groups of countries (Panel B). The option chosen by any expert who selected only a single option when several options are possible is also counted as this expert’s most recommended option. (Number of observations in parentheses.)

There are also some clear differences across continents and countries. Regarding experts’ most recommended options for revenue usage, we observe that “equal lump sum transfers to households” ranks first among North American experts (30 percent), whereas this option was indicated as the most preferred one by only 2 percent of Asian experts. Among the Asian experts, the strongest support is for the option “green R&D” (indicated as most recommended by 22 percent), followed by “reduction of distortionary taxes”, “spending on environmental public goods”, and “subsidies for renewable energy” (16 percent for each of these three options). Among European experts, by contrast, the option “transfers to particularly affected households” is indicated as “most recommended” most frequently (25 percent). Across Europe, however, there are notable heterogeneities. This is perhaps most striking for France, where political feasibility constraints due to distributional issues and inequality were very salient in public discourse (e.g., Douenne and Fabre 2022). In contrast, none of the experts from Norway, which exhibits a lower degree of inequality, recommends this option (see Panel A in Figure 3).

When using data on potential determinants for the case when respondents could choose multiple options, we find that those who expect a higher probability of severe climate damages tend to recommend a “reduction of distortionary taxes” less frequently (logistic regression:

$p=0.018$), but more often suggest using the revenue for environmental purposes, including “green R&D” and “subsidies for renewable energy” (logistic regressions: all $p<0.01$). Furthermore, experts recommending more stringent global emission reductions recommend “equal lump-sum transfers to households” more often.³ These experts, along with experts who suggest placing more weight on the well-being of future generations, also recommend supporting particularly affected households—both domestically and abroad—and climate policy in other countries more often (logistic regressions: all $p<0.05$).

Support for “equal lump-sum transfers to households” tends to increase along GDP per capita in the expert’s country, while the support for “spending on environmental public goods” and a number of other targeted options decrease with it (these options are “grandfathering or tax cuts for firms”, “green R&D”, and “subsidies for renewable energy”). We also observe that experts who have published in economics journals recommend “reduction of distortionary taxes” and “equal lump-sum transfers to households” more often than non-economists (chi-squared tests: $p=0.000$ and $p=0.035$), while they recommend targeted options such as “subsidies for renewable energy” or “spending on environmental public goods” less frequently (chi-squared tests: $p=0.000$ and $p=0.043$). Economists thus generally recommend options more in line with efficiency considerations, while non-economic experts tend to recommend options that have been shown to raise public support for climate policies more often (e.g., Douenne and Fabre 2022). Non-economic experts also recommend using parts of the revenue for “international transfers to countries particularly affected by climate change” more frequently (chi-squared tests: $p=0.007$).

4. Robustness and discussion

We conduct standard tests for non-response and other biases (cf. Armstrong and Overton 1977; Necker 2014; Johnson and Wislar 2012). As indicated above, we do not find evidence for non-response bias and strategic response bias in our survey. There is some evidence of non-representation bias, but this is to be expected as the population of experts is not globally representative.

4.1. Non-response bias

We reweight the recommendations on carbon taxes versus other instruments, BCA, and revenue use options by the characteristics of both respondents and non-respondents. Table A5 in the Online Appendix shows the full dataset for each of these variables, as well as the unweighted and weighted data. The unweighted data is the raw data for respondents that reveal their identity and is used for comparison to the weighted data. For the weighted data, we rebalance recommendations by propensity score matching using the following characteristics: Whether the expert is based in Europe, Oceania, Asia or the category of Africa & South America, is a male, as well as number of publications and citations, whether the publications are in economics journals and if so how many, and consider issues like integrated assessment models (IAMs), the social cost of carbon (SCC), carbon taxes or cap-and-trade. It is clear from Table A5 that there is no systematic change in recommendations by weighting. Moreover, quantitative implications are also minor.

³ Our finding that experts who recommend tougher emission cuts are relatively more in favor of compensating households who lose the most, compared to other uses of the revenue, may be rationalized by political economy considerations. Under smaller emission cuts, efficiency considerations may play a central role. By contrast, tighter regulations are more likely to face tough political opposition. Therefore, compensating affected households may play a more important role in garnering support for the carbon pricing policies under large emission cuts.

We can address other concerns related to non-response bias, including differences between respondents and non-respondents that do not depend on observable characteristics, by design as we are able to identify 97 explained non-respondents (Dutz et al. 2021).

4.2. Strategic response bias

We conduct two tests. First, we compare experts revealing their identity to us to experts who do not, to see if anonymous experts give systematically different recommendations as this has been a concern in the literature. Here, we find that experts who do not reveal their identity give similar recommendations in favor of carbon taxes versus other instruments, BCA, as well as for most revenue use categories compared to those revealing their identity (all t-tests: $p > 0.250$). These respondents are, however, less likely to recommend “transfers to particularly affected firms” (14 vs. 25 percent; t-test: $p = 0.050$), “spending on environmental public goods” (24 vs. 36 percent; t-test: $p = 0.057$) and “green R&D” (46 vs. 61 percent; t-test: $p = 0.025$).

Second, we compare experts replying early to those replying late, e.g. to a reminder instead of the initial invitation to participate, to check if those replying early differ in their recommendations. We do not find that experts replying to the initial invitation give different recommendations, on average, for carbon taxes versus other instruments, BCA, or any of the revenue uses than those who replied to a reminder (t-tests: $p > 0.140$). This holds also, on average, for those who replied to the second, third as well as fourth (and final) invitation to participate (t-test: $p = 0.271$, $p = 0.260$, $p = 0.283$), when not considering strong support for BCA or recommending international transfers to support climate policy in other countries. For BCA, we find that experts replying to the second invitation were less likely to support its introduction (66 vs. 78 percent; t-test: $p = 0.020$), while those replying to the final invitation did so more frequently (85 vs. 72 percent; t-test: $p = 0.023$). Yet, this is not worrying as strategic response bias concerns only those replying early on, and – if it were a concern – would bias our results in the more conservative direction. For international transfers to support climate policy in other countries, we pick up an effect only for the second round (31 vs. 21 percent; t-test: $p = 0.042$). Finally, we split the sample in two equal parts based on the order of responses by calendar time. Also here the results are reassuring since early respondents give similar recommendations for carbon taxes versus other instruments, BCA and most revenue uses compared to late respondents (t-test: $p = 0.110$). The only exception is “subsidies for renewable energy”, which were recommended less frequently by experts filling out the survey early on (30 vs. 39 percent; t-test: $p = 0.046$). If this was a concern, it would bias our results in a conservative direction.

4.3. Non-representation bias

Our survey seeks recommendations on designing carbon pricing policies based on a population of experts that is itself not globally representative, as a disproportionate fraction of academic experts are located in higher-income countries. Here, we investigate this potential non-representation bias by exploring how country and observable expert characteristics are associated with recommendations and then perform a reweighting of responses according to the global average of these country-level characteristics. We hereby focus on GDP per capita as well as the share of experts with an economics publication and the share of female experts, for illustrative reasons. For the share of female experts, we take 50 percent as the representative share. Such a representative share is not clear cut for the share of academic disciplines. For illustrative purposes, we set the share of economists to a low share.

Figure 4 shows that recommendations for a carbon tax versus cap-and-trade are far less frequent for global average GDP per capita compared to the average in our sample (Panel A). This support is not differing along the other dimensions (see Fig. A1 Panels B and C in the

Online Appendix). The strong support for BCA is consistently high along GDP per capita (see Fig. 4 Panel B). However, this support is lower for respondents with an economics publication, and comparably higher for experts without (Panel B of Fig. A2).

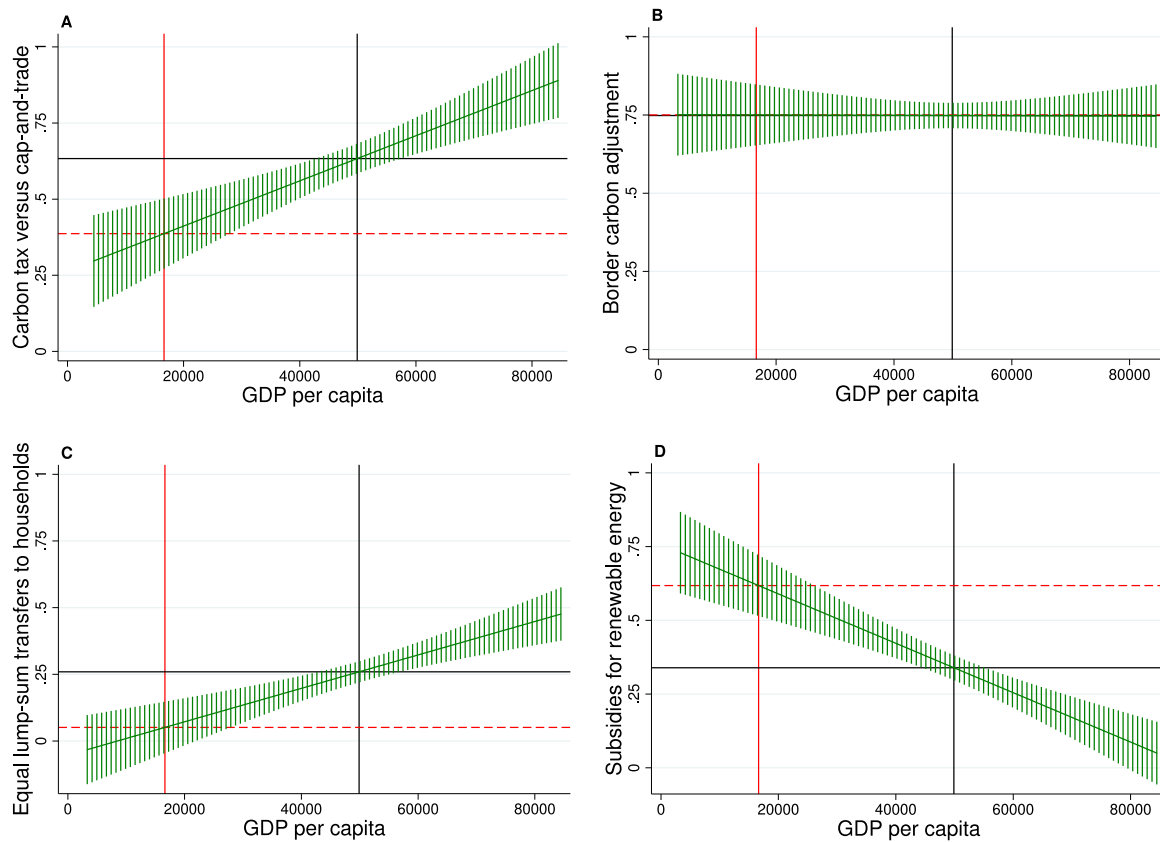


Fig. 4. Selected reweighting of recommendations by GDP per capita. The shares of experts recommending the use of a carbon tax versus cap-and-trade with and without price collar (Panel A), the use of border carbon adjustment (Panel B), as well as the use of revenue for lump-sum transfers to households (Panel C) and for subsidies for renewable energy (Panel D) along GDP per capita, from the sample mean GDP per capita to the global mean GDP per capita. A more detailed analysis of the relationship between recommendations and country- and expert characteristics is contained in the Online Appendix.

According to Fig. 4 Panel C, recommendations for the use of revenue for “equal lump-sum transfers to households” are far less frequent at global average GDP per capita. In comparison, they are only slightly less likely for non-economic experts (Fig. A3 Panels A and B). Our non-representation bias analysis also reveals that recommendations for the use of revenue for transfers to particularly affected households are not affected by the three country characteristics (Fig. A3 Panels D-F). Recommendations for the use of revenue for “subsidies for renewable energy” are, on the other hand, much more frequent at a global average GDP per capita (Fig. 4 Panel D), and somewhat more likely among non-economists (Fig. A3 Panels G and H). Finally, the use of revenue for a “reduction of distortionary taxes” is recommended less often at global average GDP per capita and at a much lower share of economic experts (Fig. A3 Panels J and K). We do not find any gender effects in the exemplary revenue use categories (Fig. A3 Panels C, F, I and L); Below a 5 percent significance level, female experts only recommend “green R&D” much more often than males (chi-squared test: $p=0.006$), leading to an adjustment from a share of 61 percent of experts recommending green R&D (among other options) in the sample to a share of 67 percent in the hypothetical population.

5. Conclusion

Tackling climate change requires an effective design of climate policy, including the pricing of carbon. Building on a rich dataset from a global survey of academic experts, we investigate recommendations on key policy design issues related to carbon pricing. While we document strong support for the use of carbon taxes and border carbon adjustment, our results also highlight important heterogeneities in recommendations. Notably, while prior surveys on carbon pricing, such as by the IGM Panel (2018), have often focused on general economists from North America (yielding similar results as our survey shows for the US), we find much more nuanced recommendations when considering climate policy experts in the rest of the world as well as non-economists. For instance, the option “equal lump sum transfers to households”, which corresponds to the only revenue usage emphasized prominently in the US “Economists’ Statement on Carbon Dividends” (Wall Street Journal 2019), is recommended only by a quarter of all experts (when multiple usage options can be selected), thus ranking fourth among all options in our survey. While the option is recommended by 42 percent of experts in North America, it is only recommended by 21 percent in the rest of the world. Relatedly, while compensating particularly affected households is frequently recommended to governments in lower and higher income countries alike, recommendations for equal lump-sum transfers increase with a country’s GDP per capita. In contrast, experts from lower income countries recommend governmental spending on subsidies for renewable energy or environmental public goods much more frequently. We also find that the clear and significant support for carbon taxes over cap-and-trade only exists in countries with a high GDP per capita. Furthermore, we document that while economists recommend lump-sum transfers and reductions in distortionary taxation more often, in line with efficiency considerations, non-economists rather recommend revenue-use options via governmental spending that have been shown to be more effective in raising public support for climate policies. Finally, we find that experts who support more stringent global climate policy and suggest placing greater weight on the well-being of future generations consistently suggest using the revenue from carbon pricing to support particularly affected households—both domestically and abroad—and to support climate policy in other countries. Our results can serve as important inputs for climate policy modeling, and can help inform policy-makers and researchers in the search for suitable carbon pricing policies that balance efficiency, distributional and political acceptability considerations in addressing the climate challenge.

Declarations

Conflict of interest: We, the authors, hereby declare that there persist no conflict of interest regarding the publication of this paper. This includes any financial, personal, or professional relationships that could potentially be perceived as influencing the research presented in this manuscript.

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Online Appendix

Full survey text, including preamble

We seek your advice on hypothetical new carbon pricing policies for CO₂ emissions covering all sectors of the economy. We first ask for your recommendations on global uniform carbon pricing. We then move to a national level and seek recommendations on unilateral carbon pricing. This includes questions regarding policy design issues. These include the use of revenues from carbon pricing as well as instrument choice, that is whether carbon pricing should be implemented in the form of a tax, a cap-and-trade scheme or some other instrument.

(Q1) Suppose that a “world government” exists, which seeks to maximize the well-being of all present and future people and plans to implement a uniform global carbon price (measured in real US dollars per ton of CO₂). Which carbon price would you recommend to the “world government” for the years 2020 [X], 2030 [X], and 2050 [X]? Which range of carbon prices would you still be comfortable with recommending for the years 2020 [X] – [X], 2030 [X] – [X], and 2050 [X] – [X]?

(Q2) Please specify the country you are most familiar with or that you would feel most comfortable advising on carbon pricing (below, we will refer to this as “your country”): [____].

(Q3) Suppose that your country unilaterally introduces a carbon price. Suppose further that any competitive disadvantages are neutralized by border carbon adjustment, exempting exports from the carbon price and pricing the carbon content of imports at the domestic rate. In this case, which carbon price would you recommend to your government for 2020 [X] and 2030 [X], and which range of carbon prices would you still be comfortable with recommending for 2020 [X] – [X] and 2030 [X] – [X]?

(Q4) Suppose that your country unilaterally introduces a carbon price without border carbon adjustment. In this case, which carbon price would you recommend to your government for the years 2020 [X] and 2030 [X]? Which range of carbon prices would you still be comfortable with recommending for the years 2020 [X] – [X] and 2030 [X] – [X]?

(Q5) If your country implements a carbon pricing scheme unilaterally, would you strongly recommend introducing a border carbon adjustment scheme (if that is possible)? Yes [x], No [x].

(Q6) Assuming that no carbon pricing scheme has been implemented in your country yet, which instrument would you recommend using for it to be implemented? Carbon tax [x], cap-and-trade with price collar (price floor and price cap) [x], cap-and-trade without price collar [x], other instrument (or mix of instruments), please specify [____], no clear recommendation [x].

(Q7) Considering the case of unilateral carbon pricing without border carbon adjustments, how should your government use the revenues raised by carbon pricing? (Multiple answers are possible.)

- a) General government spending [x]*
- b) Equal lump-sum transfers to households [x]*
- c) Transfers to particularly affected households [x]*
- d) Reduction of distortionary taxes [x]*

- e) Grandfathering or tax cuts for firms [x]
- f) Transfers to particularly affected firms [x]
- g) Spending on environmental public goods [x]
- h) Green R&D [x]
- i) Subsidies for renewable energy [x]
- j) International transfers to countries particularly affected by climate change [x]
- k) International transfers to support climate policy in other countries [x]
- l) Other, please specify [____].

If you suggest more than one use, please indicate your most recommended option by its letter [____]. Please also specify which percentage of total revenues should (roughly) be allocated to it [X].

(Q8) Please also provide your (very rough) views on the following issues:

(a) By what percentage should global CO₂ emissions be reduced by 2050 as compared to today?

<20% [x], 20% to <50% [x], 50% to <80% [x], 80% to <100% [x], ≥100% [x];

(b) How costly would it be to reduce global CO₂ emissions by 80% by 2050 (average abatement cost per year as percentage of global GDP until 2050)?

<0.25% [x], 0.25% to <0.5% [x], 0.5% to <1% [x], 1% to <3% [x], ≥3% [x];

(c) In the absence of effective climate policy (beyond current policies), what is the probability that in 2070, climate change will cause global damages, comprising both market and non-market impacts, of at least 20 percent of global GDP?

<5% [x], 5% to <10% [x], 10% to <20% [x], 20% to <50% [x], ≥50% [x];

(d) How large are the expected annual global damages from climate change, measured as a percentage of future global GDP and comprising both market and non-market damages, for 3°C global warming (in the absence of effective climate policy beyond current policies we may reach 3°C by around 2070)?

<2% [x], 2% to <5% [x], 5% to <8% [x], 8% to <12% [x], ≥12% [x];

(e) As compared to the utility of a person today, what is the weight (measured in percent) that should be put on the utility of a person in 2070 in global public decision-making?

<40% [x], 40% to <60% [x], 60% to <80% [x], 80% to <100% [x], 100% [x].

Feel free to provide us with any additional comments or feedback: [____].

Search string (used in SCOPUS)

TITLE-ABS-KEY ("carbon pric*" OR "carbon-pric*" OR "CO₂ pric*" OR "carbon tax*" OR "tax on carbon" OR "CO₂ tax*" OR "carbon trad*" OR "carbon-trad*" OR "price on carbon" OR "price on CO₂" OR "price per ton of carbon" OR "price per ton of CO₂" OR "social cost of carbon" OR "social cost of CO₂"

OR ("cap and trade" AND ("carbon" OR "CO₂" OR "climate change" OR "climate policy"))

OR ("cap-and-trade" AND ("carbon" OR "CO₂" OR "climate change" OR "climate policy"))

OR ("permit pric*" AND ("carbon" OR "CO₂" OR "climate change" OR "climate policy"))

OR ("permit trad*" AND ("carbon" OR "CO₂" OR "climate change" OR "climate policy"))

```

OR ( "permit-trad*" AND ("carbon" OR "CO2" OR "climate change" OR "climate policy") )
OR ( "emission* tax" AND ("carbon" OR "CO2" OR "climate change" OR "climate policy") )
OR ( "emission* pric*" AND ("carbon" OR "CO2" OR "climate change" OR "climate policy") )
) OR ( "emission-pricing" AND ( "carbon" OR "CO2" ) ) OR ( "emission* trad*" AND
("carbon" OR "CO2" OR "climate change" OR "climate policy")) OR ( "emission* permit*"
AND ("carbon" OR "CO2" OR "climate change" OR "climate policy") ) OR ( "tax on
emission*" AND ("carbon" OR "CO2" OR "climate change" OR "climate policy") ) )
AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-
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Details on data and data cleaning

We conducted a number of survey response data cleaning steps. A brief overview of these changes is provided below:

- Double responses: We kept the first and more complete response in two cases where we had two responses from the same respondents.
- Discretion: We deleted six unfinished responses and two responses that contained clear mistakes.
- Unreliable names: We deleted eight responses with unreliable names. In five cases we also imputed or removed the names of respondents based on information provided to us in the survey.
- Other adjustments: We also corrected the country for one respondent and did some imputation of recommended revenue use from the remaining survey data.

Additional figures

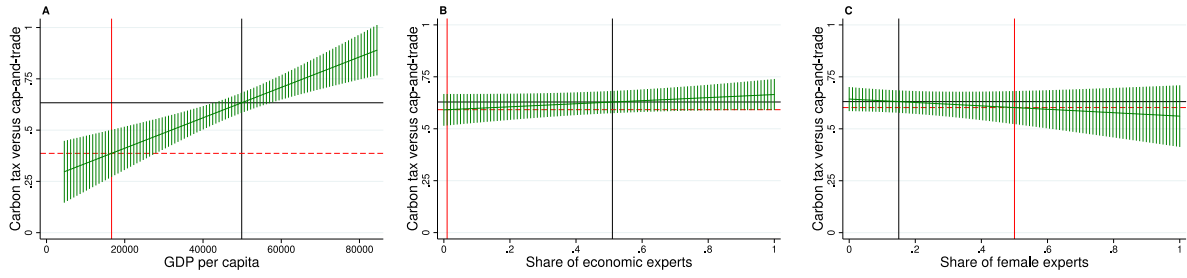


Fig. A1. Reweighting recommendations on carbon pricing instruments. The shares of experts recommending the use of a carbon tax versus cap-and-trade with and without price collar along GDP per capita (Panel A), from the sample mean GDP per capita to the global mean GDP per capita, as well as the share of experts with an economics publication (Panel B) in the sample relative to a marginal 1 percent, and the share of female experts (Panel C) in the sample relative to a 50-50 share.

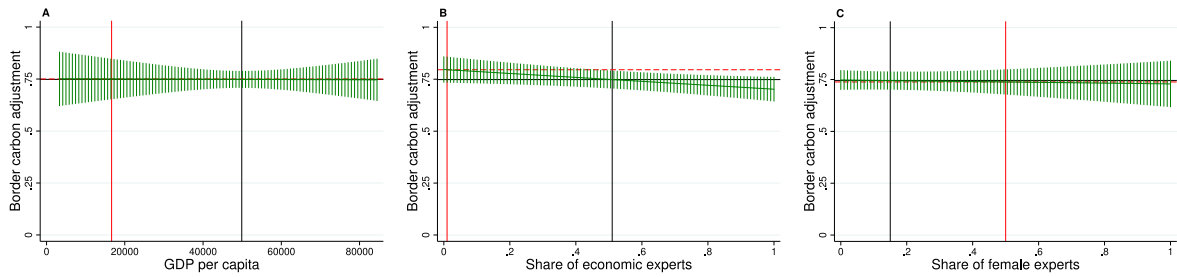


Fig. A2. Reweighting recommendations on border carbon adjustment (BCA). The shares of experts recommending the use of border carbon adjustment along GDP per capita (Panel A), from the sample mean GDP per capita to the global mean GDP per capita, as well as the share of experts with an economics publication (Panel B) in the sample relative to a marginal 1 percent, and the share of female experts (Panel C) in the sample relative to a 50-50 share.

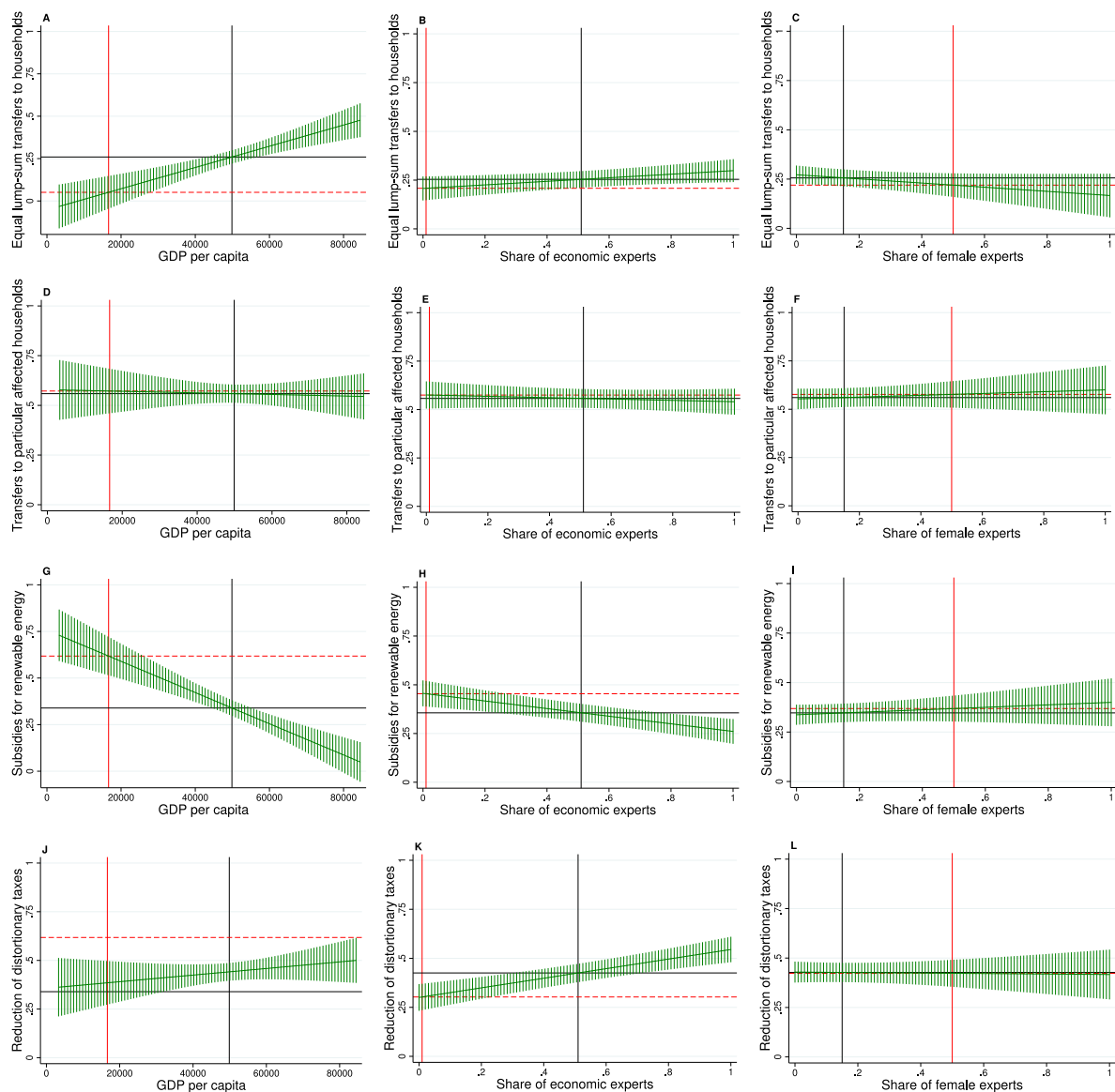


Fig. A3. Reweighting selected revenue use recommendations. The shares of experts recommending the use of revenue for lump-sum transfers to households along GDP per capita (Panel A), from the sample mean GDP per capita to the global mean GDP per capita, as well as the share of experts with an economics publication (Panel B) in the sample relative to a marginal 1 percent, and the share of female experts (Panel C) in the sample relative to a 50-50 share. We illustrate the corresponding analyses for transfers to particularly affected households in Panels D-F, for subsidies for renewable energy in Panels G-I, and for reductions in distortionary taxes in Panels J-L.

Additional tables

Table A1. Descriptive overview

Border Carbon Adjustment (BCA)	<i>Yes, strongly support BCA</i>		<i>No</i>	<i>N</i>
	74%		26%	450
Instrument choice	<i>Carbon tax</i>	<i>Cap & trade</i>	<i>Other instruments</i>	
	49%	29%	18%	462
Revenue usage (the three most preferred options)	<i>Transfers to particularly affected households</i>	<i>Equal lump-sum transfers to households</i>	<i>Reduction in distortionary taxes</i>	
	24%	16%	15%	442
Response categories				
Quantitative responses				468
Quantitative responses (non-anonymous/verified identity)				406
Qualitative responses				176
Explained non-responses				97
Total responses				574
Expert population				2106

Table A2. Other instrument (or mix of instruments)

a combination of policies, ETS for energy intensive industries, <i>tax</i> for others, revenue recycling used to investment in renewables and energy efficiency
a mix of instruments depending on who the regulatory object is
ambivalent between cap-and-trade with price collar and prescriptive sectoral policies - efficiency gains of c&t may be outweighed by political/distributional benefits of other policies
base-line and credit trading to connect with Kyoto CDM
border carbon tax and green procurement
budget/tax reforms which quantitative impact is measured yearly with four numbers; the sum of the four numbers allows to judge progress
cap and trade with a price floor and price cap and also renewable energy targets
cap and trade with collars and multiple steps to achieve a price-responsive allowance supply
cap and trade with continuously lowering the cap.
cap and trade with price collar + renewable energy subsidies
cap and trade with series of price steps in allowance supply
cap-and-trade (EU ETS) + <i>carbon tax</i> for non ETS sectors (agriculture, households, ...)
cap-and-trade at the EU level (not single member country)
cap-and-trade with a 'carbon central bank' (more flexible approach to price collar)
cap-and-trade with price collar, but with clearly-defined rebate or reduction in other taxes
cap-and-trade with price floor
cap-and-trade with price floor and border tax adjustments
capital grants to increase low carbon technology deployment along with <i>carbon tax</i> to give proper signal to market and society
carbon dividends
carbon dividends
carbon fee and dividend (i.e. <i>carbon tax</i> paid back to tax payers)
carbon pricing in combination with RES policy instruments and instruments that create markets for low-carbon products (e.g. via public procurement)
<i>carbon tax</i> (for sectors that are not directly subject to international competition), some sort of cap and trade with price collar for e.g. manufacturing industry combined with subsidies to renewables and technology development in the harder to abate sectors (e.g. aviation, shipping or industry).

<i>carbon tax</i> (with socially balanced dividend); subsidies for low carbon (and other GHGs) development
<i>carbon tax</i> + cap and trade depending on point and non-point sources
<i>carbon tax</i> + energy efficiency standards + reverse auctions for large-scale renewable energy
<i>carbon tax</i> + prices adjustment for other externalities
<i>carbon tax</i> + regulation
<i>carbon tax</i> and cap-and-trade
<i>carbon tax</i> and regulations
<i>carbon tax</i> combined with command-and-control / regulatory instruments
<i>carbon tax</i> for intermediate, feebate for final goods
<i>carbon tax</i> for private consumption, with redistribution. Cap and trade for industry.
<i>carbon tax</i> for small fossil fuel users, and emission trading scheme for larger emitters
<i>carbon tax</i> in combination with strong R&D policies, investment support (e.g. for households), information policies (e.g. for craftsmen) and standards (to prevent investment into carbon-intensive technologies)
<i>carbon tax</i> plus investment incentives plus energy efficiency measures
<i>carbon tax</i> with 75% to 100% per-person refund
<i>carbon tax</i> with a tax adjustment mechanism
<i>carbon tax</i> with complementary sectoral policies, increase in RD&D funding (with innovation policies)
<i>carbon tax</i> with differentiation across sectors; depends on international context
<i>carbon tax</i> , and R&D subsidies directed at new zero carbon tech
<i>carbon tax</i> , cap-and-trade for electricity, strong regulations for vehicles and buildings
<i>carbon tax</i> , feebate
<i>carbon tax</i> , green tax reform, subsidies for new technologies
<i>carbon tax</i> , subsidies to green transition, infrastructure investments, host of measures to address resulting inequalities/fairness/poverty.
<i>carbon taxes</i> + a wide range of other measures
contracts for difference
distinction btw carbon tax and cap-and-trade less important than price, signal and plans to tie price to emission reductions. A C&T can be designed to look very similar to a carbon tax and vice-versa. The distinctions are more political than functional, one may have more political feasibility and durability than the other or public acceptance. These are more important than the functional distinctions.
emission trading with carbon-content certification of imports
energy efficiency standard, carbon disclosure etc.
escalating <i>carbon tax</i> (for certainty) with dividend to offset some financial hardship
ETS with price collar plus (higher) <i>carbon tax</i> in difficult sectors such as transport
I am fine with both cap-and-trade with price collar and carbon tax
information, restrictions, subsidies for renewables, green R&D
many instruments including a carbon price
mix of <i>carbon tax</i> and cap-and-trade with price collar
mix of <i>carbon tax</i> , and cap and trade with high price floor, and many policy and measures (standards, infrastructures program, financing arrangements)
mix of consumer (households) and EITE industry output based pricing
mix of different <i>tax</i> and incentive programs
mix of instruments cap and trade with collar for industry plus <i>carbon tax</i> for other users
mix of <i>tax</i> , norms, subsidies
one (<i>tax</i>) for fossil carbon, one for biogenic methane, a tax for N2O.
output-based performance system, fuel charge and mix of incentives and regulations
output-based pricing system for large emitters; <i>carbon tax</i> for small emitters
output-based rebate with <i>carbon tax</i>

prioritization of GHG mitigation measures which maximize the benefits across SDGs
really carbon tax is cap and trade just with 0 cap before a penalty - not really a difference.
regulation: cap with NO trading or offsetting
rental price for carbon sequestration in biomass, land or atmosphere
repeal of existing regulations followed by <i>carbon tax</i>
revenue neutral <i>carbon tax</i> with cut on labour taxation
sector specific polices including cap-and-trade with a collar
sector-specific flex-regulations (RPS, LCFS, ZEV, OBPS, etc.)
smart cap, i.e., a cap and trade system where the equilibrium certificate price (co-)determines the cap
stringent cap and trade for heavy polluters (where quantitative limits are key and abatement costs are heterogeneous), <i>carbon tax</i> elsewhere.
<i>tax</i> and dividend
<i>tax</i> and technology and emission standards as well as subsidies for lead abaters in each industry and government-funded carbon entrepreneurs for each industries
<i>tax</i> and vat
<i>tax</i> combined with support for critical measures and technologies
<i>tax</i> with accompanying measures (spatial planning, infrastructure roadmap, social protection, regulation on existing polluting sources)
<i>tax</i> with subsidy scheme
<i>taxation</i> for households and SME, trading with collar for large companies

Qualitative responses (corrected for typos, etc.) to the survey question on instrument choice for unilateral carbon pricing: “other instrument (or mix of instruments), please specify”. There are 82 such qualitative responses; out of these, 27 responses were interpreted as clear recommendations for variants of “cap-and-trade” (here: highlighted in **bold** letters), and 48 responses as recommendations for variants of “carbon tax” (*italics*). Hence, the ratio of recommendations of carbon tax vs. cap-and-trade is very similar to the one in the overall sample. Furthermore, 8 respondents (around 10 percent of these experts) recommend cap-and-trade for larger emitters / energy intensive / trade exposed industries, and a carbon tax for smaller emitters or other sectors, such as for agriculture or small and medium-sized firms.

Table A3. Carbon pricing revenue use (multiple options possible)

Revenue use (multiple options possible)	All	EU	North America	Asia
a) General government spending	17%	19%	13%	21%
b) Equal lump-sum transfers to households	25%	25%	42%	9%
c) Transfers to particularly affected households	56%	57%	54%	45%
d) Reduction of distortionary taxes	43%	44%	44%	38%
e) Grandfathering or tax cuts for firms	7%	6%	4%	16%
f) Transfers to particularly affected firms	24%	28%	15%	26%
g) Spending on environmental public goods	35%	32%	24%	48%
h) Green R&D	59%	55%	56%	79%
i) Subsidies for renewable energy	35%	29%	25%	66%
j) International transfers to countries particularly affected by climate change	23%	22%	23%	22%
k) International transfers to support climate policy in other countries	23%	24%	22%	16%
l) Other	11%	13%	12%	0%

The fraction of experts who recommend different options for revenue usage, for continental groups of countries.

Table A4. Other revenue use for carbon pricing

"green spending", that is finance low-carbon local infrastructure -- I am not sure you mean that by (g)
Although unilateral carbon pricing has no effect on total climate change, the allocation of any revenues is an issue related to current policies of any government. Consequently there is not reliable forecasts.
anything that is not too distortionary and will garner sufficient support by the public that allow such carbon pricing to be implemented
Basic Income Grant
budget deficit reduction -- some might interpret (a) this way, but there's a difference
building resilience to climate change via adaptation
buying off political resistance from industry (possibly f but this is not quite the same point)
climate adaptation
Dealing with the regressive impacts on poorer households is important in order to mitigate political resistance (but exactly how that should be done is a tricky question). In addition one would have to deal with the situation for carbon intensive companies exposed to international competition by exempting them from the tax or by pricing imports (for steel etc. it is not point having a high carbon tax if their competitors do not face a similar tax). However, I am not sure that transfers is the best way to deal with it. Also, I think that support to green tech development as well as support for adaption and mitigation in very developing countries is needed too, but the carbon tax cannot provide funds for every warranted measure...
debt reduction
Earmarking is often really inefficient, but subsidising affected firms would be perverse. Fairness towards poor households is key for political acceptability. Then, coherent international development policy funded by general budget.
for a cap and trade government doesn't get any revenue, unless the permits are auctioned off, or some tax on earning from permit sales
Funds should go to supporting actions that reduce emissions. Public transit, renewable energy etc. cannot happen at individual scale, funds need to be pooled and dedicated to {Category:} to reduce emissions.
green industrial policy for low-carbon cleantech sectors
green infrastructure investments
I'd prefer a lump-sum per capita instead of per household
in short term - access to investment finance for particularly affected firms and individuals
infrastructure (preferably clean or low-carbon)
Infrastructure for large-scale renewable energy -- e.g. new and upgraded transmission lines; the creation of Renewable Energy Zones -- and new institutions (e.g. structure and rules of the electricity market).
international transfers conditional on carbon pricing introduction & increase of prices in other countries
international transfers to support carbon sinks in other countries
invest in renewable energy
invest in the Hydrogen Economy and invest in carbon sinks
investing in energy efficiency
local government spending by locality where tax is raised
NB UK issues its own currency so does not need to balance budgets
no revenue use
part to government budget, part to poorer country mitigation and adaptation
Payments for Ecosystem Services
Policies to foster regional economic development in areas negatively affected.
public development of renewable energy and transportation infrastructure (not just subsidies for private firms, but investment)
R&D and investment support for low-carbon technologies, particularly in industry
raising tax free threshold
reduce tax on labour to encourage employment and maintain competitiveness
reduction of labour tax

reduction of payroll taxes and social security contributions
spending on climate adaptation, particularly for infrastructure
stopping natural native forest usage, reforestation, renewables investment, education
subsidies to energy efficiency, to lower the energy bill being mindful of income classes
subsidies/tax cuts for GHG efficient behaviour/consumption/products
support Indigenous engagement in carbon and ES industry
supporting workers in particularly affected firms
taxes reductions combined with income based lump sum payments
temporary tax cuts for EITE firms for first 10 years; schedule announced ahead of time
the budget/tax reform instrument includes the marked categories
there would be no revenue except from fines. Revenue from higher income and wealth taxes must be spent on g, h, j, k
transfer to low income households without linking it to affected households
transfers to export sectors during some transition
transfers to low-income households
whatever turns out to be least cost for this country plus funding to make transition to renewables possible

Qualitative responses (corrected for typos, etc.) to the survey question on revenue usage (“Other, please specify.”). Some “typical” examples include “climate adaptation”, “dealing with the regressive impacts on poorer households ... in order to mitigate political resistance”, “green infrastructure investments”, “international transfers to support carbon sinks in other countries”, or “transfers to low-income households”.

Table A5. Reweighting policy design recommendations

	Carbon tax vs. other instruments	Border Carbon Adjustment	General government spending	Equal lump-sum transfers to households	Transfers to particularly affected households	Reduction of distortionary taxes	Grand-fathering or tax cuts for firms
Full dataset	49%	74%	17%	25%	56%	43%	7%
Unweighted	50%	74%	16%	26%	56%	43%	7%
Weighted	50%	75%	15%	25%	55%	40%	7%

Continued.

	Transfers to particularly affected firms	Spending on environmental public goods	Green R&D	Subsidies for renewable energy	International transfers to countries particularly affected	International transfers to support climate policy in other countries	Other
Full dataset	24%	35%	59%	35%	23%	23%	11%
Unweighted	26%	36%	60%	35%	24%	23%	12%
Weighted	26%	39%	62%	38%	26%	24%	12%

The model consists of the following characteristics (as described earlier): Whether the expert is based in Europe, Oceania, Asia or the category of Africa & South America, is a male, as well as number of publications and citations, whether the publications are in economics journals and if so how many, and consider issues like IAMs, the SCC, carbon taxes or cap-and-trade. Weights are estimated by propensity score matching.