Supplementary Information to

The ocean carbon sink enhances countries' inclusive wealth and reduces the cost of national climate policies

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1 Supplementary Notes

1.1 Implications of the carbon sink in oversea territories for the domestic wealth contribution

Countries and regions benefit from the ocean carbon sink in their oversea territories, increasing the domestic wealth contribution. Based on the DJO estimates (Dell et al. 2012), the EU29 receives USD 15.84 (SD 1.17) billion domestic wealth contribution from the ocean carbon sink attributed to its oversea territories. Within the EU29 oversea territories, the largest wealth contributions arise from French Polynesia and Greenland, contributing USD 6.14 (SD 0.91) billion and USD 2.92 (SD 0.43) to domestic wealth in France and Denmark, respectively, and in turn to the EU29. Obviously, using the Tol (2019) estimates instead, the domestic wealth contribution of the overseas territories in the EU29 shrinks considerably to USD 0.13 (SD 0.02) billion, though the proportional contribution remains unchanged, of course. Note that the balance of the transboundary wealth contribution changes more than the domestic wealth contribution if countries could not claim the carbon sink of their overseas territories, because the reduction in the attributed ocean carbon would be multiplied by the SCC instead of the CSCC. For example, according to the DJO estimates, if the ocean carbon sink in its overseas territories is not attributed to the EU29, the EU29's balance of transboundary wealth contribution would decrease by USD 79.00 (SD 7.80) billion. The overall wealth contribution of the ocean carbon sink though remains unaffected by the attribution to countries.

2 Supplementary Figures

Supplementary Figures includes Figures SMF1, SMF2, SMF3, SMF4, and SMF5. SMF1 shows the national CO_2 prices for the ten countries/regions with the largest CO_2 emissions in the fossil and industrial sectors. SMF2 shows the efficiency gains by emissions trading by the example China and the United States. SMF3 shows the efficiency gains by emissions trading for the ten countries/regions with the largest CO_2 emissions in the fossil and industrial sector. SMF4 shows the cost and CO_2-price effects of a weakening of the ocean carbon sink for the ten countries/regions with the largest CO_2 emissions in the fossil and industrial sectors. SMF5 shows the increase in abatement cost for a weaking of the ocean carbon sink for NDCs with high ambition.

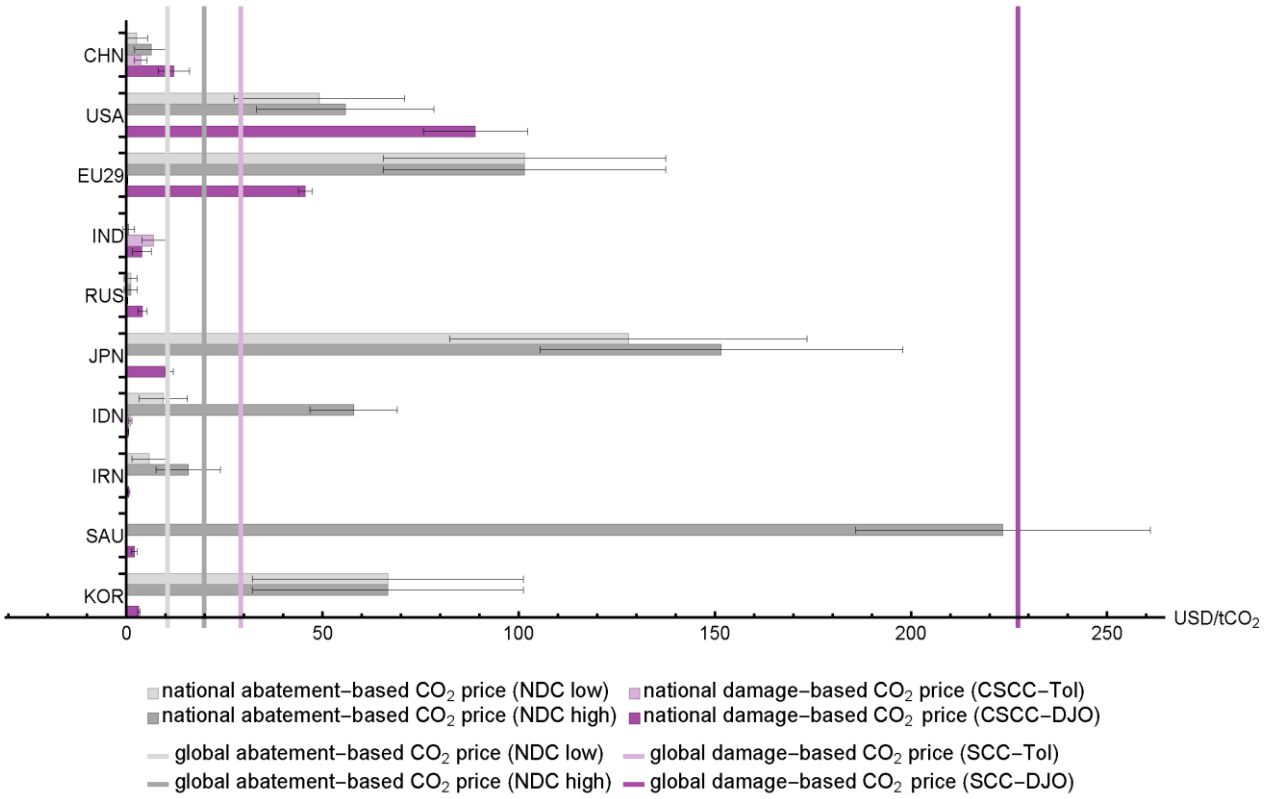

Figure SMF1: National and global CO_2 prices. The bars show the national abatement-based CO_2 prices estimates (i.e., without international emissions trading) for NDCs with low and high ambition levels, respectively, and national damage-based CO_2 prices estimates, (i.e., country social cost of carbon (CSCC)), obtained from Dell et al. (2012) in Ricke et al. (2018, 2019), abbreviated as DJO, and obtained from Tol (2019), abbreviated Tol, respectively. The vertical lines show the global abatement-based CO_2 price estimates (i.e. with international emissions trading), for NDCs with low and high ambition levels, respectively, and the global damage-based CO_2 estimates (i.e., social cost of carbon SCC), for the DJO and Tol estimate, respectively. Error bars represent ±1 SD for the national CO_2 prices. The figure includes the ten countries/regions with the largest CO_2 emissions in the fossil and industrial sectors. Countries are indicated by their ISO3 code: CHN, China; USA, United States, EU29, European Union 27 with Norway and Iceland; IND, India; RUS, Russia; JPN, Japan; IDN, Indonesia; IRN, Iran; SAU, Saudia-Arabia; KOR, South Korea.

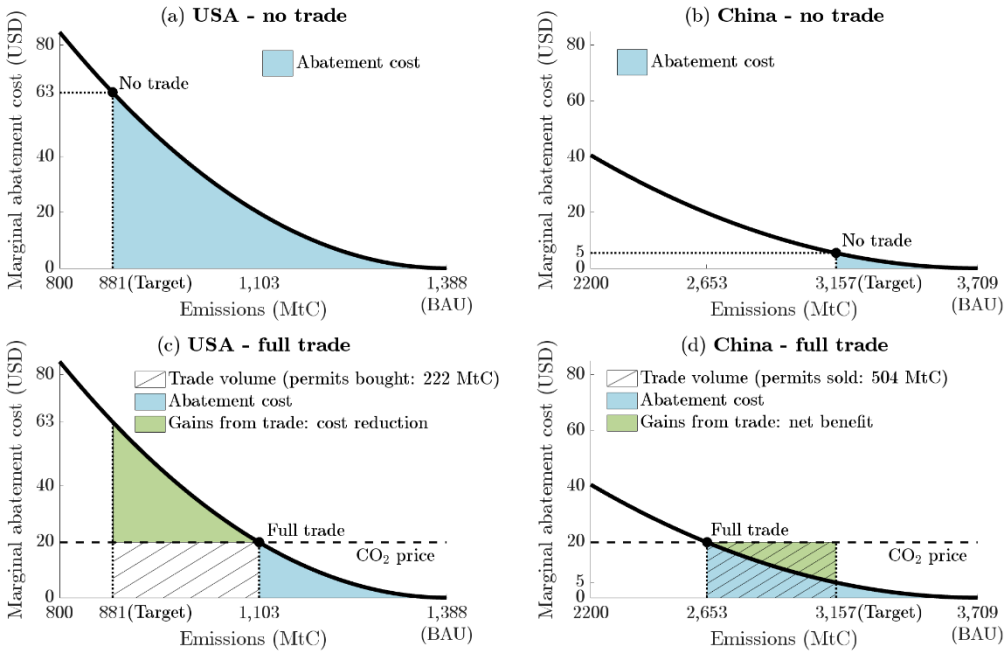

Figure SMF2: Efficiency gains by emissions reductions trading for the US and China. The upper panel shows the national CO_2 prices (= marginal abatement cost) for NDCs with high ambition level without emissions reduction trading for the U.S. and China (Panel a and b, respectively). The lower panel shows the global CO_2 prices under full emissions trading (i.e. unique CO_2 price across countries) for NDCs with high ambition level. The U.S. has lower emissions reductions under full emissions tradition, buying emissions reductions internationally (Panel c). China has higher emissions reductions under full emissions tradition, selling emissions reductions internationally (Panel d). Both countries gain from trade.

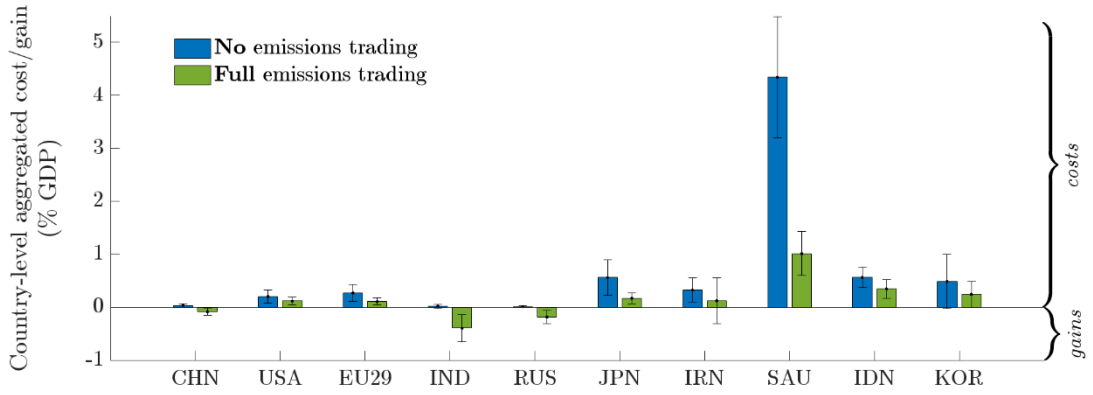

Figure SMF3: Costs and gains by emissions reductions trading for the ten countries/regions with the largest CO_2 emissions in the energy and industrial sector as percentage of their GDP. The figures shows that all countries gain from emissions reductions trading (i.e. either lower costs or higher gain), in in particular i) those countries which have very high national CO_2 prices, since these countries can substitute a large amount of costly domestic emissions reductions by international emissions reductions (e.g. Saudia Arabia), and ii) those countries which have very low national CO_2 prices, since these countries can expand their emissions reductions substantially and sell emissions reductions internationally. Error bars represent ±1 SD for the percentage of the costs. Countries are indicated by their ISO3 code: CHN, China; USA, United States, EU29, European Union 27 with Norway and Iceland; IND, India; RUS, Russia; JPN, Japan; IDN, Indonesia; IRN, Iran; SAU, Saudia-Arabia; KOR, South Korea.

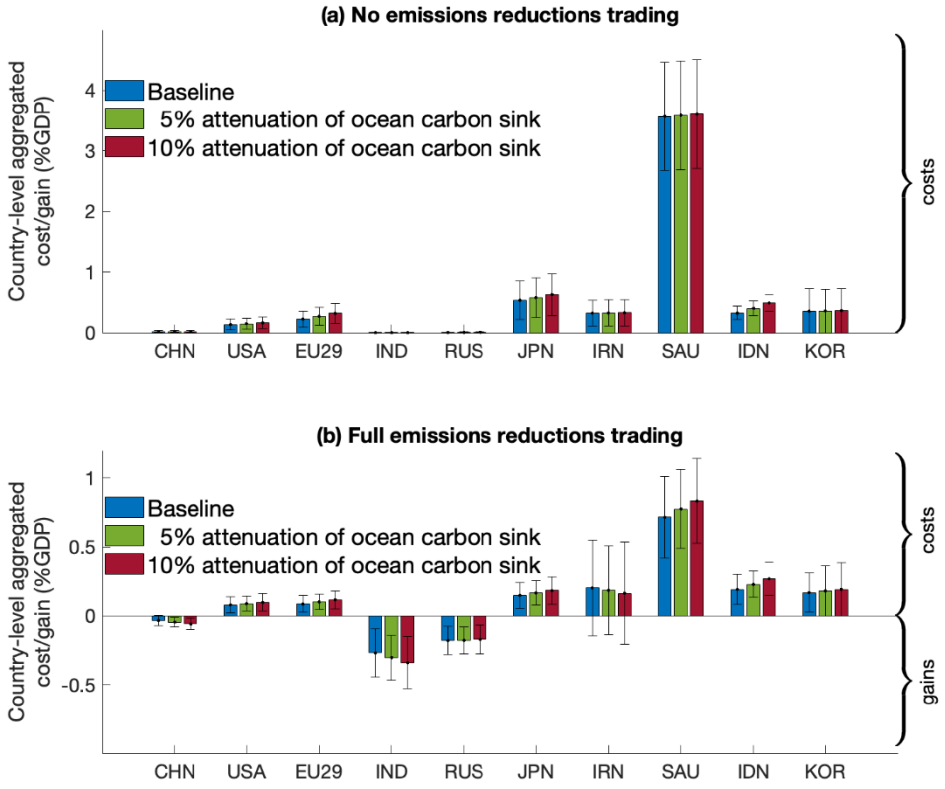

Figure SMF4: Cost implications of the weakening of the ocean carbon sink for national climate policies. The figure shows the change in costs (or gains in case of a negative cost) from a weakening of the global ocean carbon sink by 5 and 10 percent for the ten countries/regions with the largest CO_2 emissions in the energy and industrial sector. Error bars represent ±1 SD for the national CO_2 prices. Countries are indicated by their ISO3 code: CHN, China; USA, United States, EU29, European Union 27 with Norway and Iceland; IND, India; RUS, Russia; JPN, Japan; IDN, Indonesia; IRN, Iran; SAU, Saudia-Arabia; KOR, South Korea.

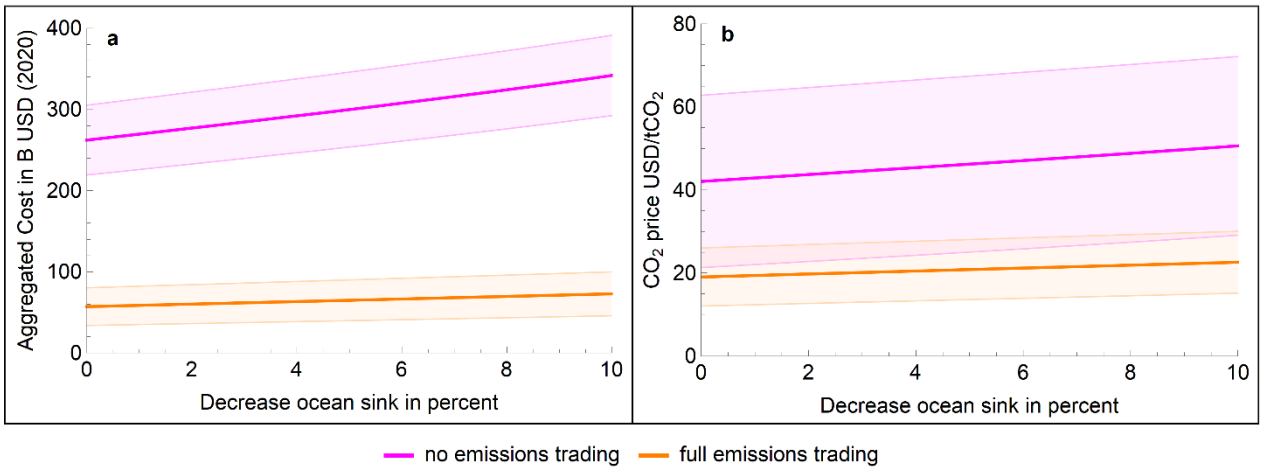

Figure SMF5: Increase in abatement cost (level and marginal) for weaking of ocean sink. The calculation assumes that NDCs with high ambition are in place. Error bars represent ±1 SD.

3 Supplementary Tables

The supplementary tables can be found at https://github.com/wilmwilmsen/OceanValue. Supplementary Table TS1 shows the CO_2 price data, including the Country Social Cost of Carbon (CSCC) estimates (i.e. the damage-cost based approach) and the abatement-cost based approach CO_2 prices, derived for NDCs with low and high ambition. The table shows the information for the baseline scenario and for a weakening of the ocean carbon sink, differentiating between national climate policies only and full emissions reductions trading. Table ST2 shows the abatement cost of achieving the NDCs as percentage of GDP (a negative entry indicates a gain). The table shows the information for the baseline scenario and for a weakening of the ocean carbon sink, differentiating between national climate policies only and full emissions reductions trading. Table ST3 shows the balance of transboundary wealth contribution for all countries, with and without consideration of the carbon sink attributed to high sea.

4 Supplementary Data

The supplementary data can be found at https://github.com/wilmwilmsen/OceanValue. Supplementary Data M1 shows the attribution of the carbon sink to countries, including information about the attribution resulting from oversea territories. Supplementary Data M2 shows the calculation of the contribution of the attributed ocean carbon sink to comprehensive investment and in turn inclusive wealth. Supplementary Data M3 shows the calibration of the country-specific abatement cost functions. Supplementary Data M4 shows the CO_2 market model, where countries achieve compliance with their emissions reduction targets defined via their NDCs, either restricted to national climate policies (no emissions trading) or as part of international climate policies (with full emissions trading). The file allows to adjust the emissions reduction level in dependence of a potential weakening of the ocean carbon sink.

References

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