Supplementary Information for

Will the use of a carbon tax for revenue generation produce an incentive to continue carbon emissions?

This file includes:

Supplementary Figure S1-S10
Supplementary Figure S1. Global population (a), cost of backstop technology capable of 100% abatement of industrial CO₂ equivalent emissions (b), global gross output (c), and gross output per capita (d). The population and the cost of backstop technologies are exogenous in the DICE model and thus the same in different paths. All prices are in 2005 US dollars.
Supplementary Figure S2. Global average atmospheric CO$_2$ equivalent concentrations in the welfare-maximizing, revenue-maximizing and zero-carbon-tax pathways.
**Supplementary Figure S3.** Abatement cost and climate change damage under the welfare-maximizing (a) and revenue-maximizing (b) cases.
Supplementary Figure S4. Global cumulative CO$_2$-equivalent emissions since 2010 in the welfare-maximizing, revenue-maximizing and zero-carbon-tax pathways.
Supplementary Figure S5. (a) Plot of total tax (including personal and corporate income taxes, value added taxes, excise taxes, and tariffs) as a percentage of gross domestic product (GDP) against per capita GDP (in log scale) by country. (b) Frequency distribution of total tax as a percentage of GDP. Data are derived for the latest available year during in 2010-2015. Data source: The World Factbook for total tax and the World Bank for the per capita GDP. The GDP are based on the purchasing power parity (2005 US dollars).
Supplementary Figure S6. Impact of the rate of technology improvements on the optimized carbon prices (a) and carbon tax revenues (b) under the welfare-maximizing (blue) and revenue-maximizing (red) cases. The DICE model accounts for a backstop technology that can replace all CO$_2$ from fossil fuels. In the model, the backstop cost for 100% removal of annual CO$_2$ emissions is $344$ $(\text{ton CO}_2)^{-1}$, that is assumed to decline at 0.5% per year. Here we run a simulation that the rate of decline of backstop cost is halved (declining at 0.25% per year) or doubled (declining at 1% per year) to quantify the impact of technology improvements.
Supplementary Figure S7. Impact of the function of climate damage on the optimized carbon prices (a) and carbon tax revenues (b) under the welfare-maximizing (blue) and revenue-maximizing (red) cases. The DICE model assumes a quadratic function to estimate the damage caused by CO₂ emissions-induced temperature change. Here we run simulations in which the coefficient (0.00267 in the standard DICE model) between the damage caused by climate change and the change of temperature is doubled or halved.
**Supplementary Figure S8.** Impact of the rate of decline of backstop technology cost (a) and climate damage (b) on cumulative emissions since 2010 under the welfare-maximizing (blue) and revenue-maximizing (red) cases. The DICE model assumes a quadratic function to estimate the damage caused by CO$_2$ emissions-induced warming. In (b), we increase the coefficient of climate damage by a factor of 2 and 4.4 times.
Supplementary Figure S9. Global mean atmospheric temperature increase relative to 1900 (a) and percent increase (decrease) in utility of consumption relative to the zero-carbon-tax case (b) in a case that shifts from the revenue maximizing path to utility maximizing in 2085.
Supplementary Figure S10. Carbon prices (a), carbon tax revenues (b), annual CO₂ emissions (c), cumulative emissions since 2010 (d) and global atmospheric temperature increase relative to 1900 (e) under the welfare-maximizing case (blue), the revenue-maximizing case (red), and the revenue-maximizing case (green) with a maximum rate of increase in carbon price (no more than one doubling per decade). In the revenue-maximizing case without a maximum rate of increase in carbon prices, cumulative CO₂ emissions intersect with the welfare-maximizing case in year 2125. By comparison, in the revenue-maximizing case with a maximum rate of increase in carbon prices, cumulative CO₂ emissions intersect with the welfare-maximizing case in year 2115.