Marine Plastic Pollution: What are the Benefits of International Cooperation?

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Objective

Marine plastic pollution is a global phenomenon with large impacts on marine wildlife, coastal tourism, and fishing activities; and with potentially significant consequences for human health [1]. The transboundary nature of the problem has led to a lack of effective abatement actions to address the accumulation of over quarter of a million tonnes of plastic in the world's oceans [3]. The problem has recently attracted the attention of NGOs, governments, and citizens worldwide, culminating in a resolution in March 2022 by the UN Environment Assembly to forge an international legally binding agreement to tackle marine plastic pollution.

The objective of our research is to inform such an agreement by quantifying, for countries in the North Atlantic, (i) the economic damages caused by marine plastic, (ii) the costs of abating plastic, (iii) transnational plastic flows, (iv) the optimal level of plastic abatement, (v) the gains from international cooperation, (vi) the conditions under which mutually beneficial cooperation can occur.

Methodology

We estimate each country's economic damages from plastic pollution by aggregating the **willingness to pay** (WTP) of citizens in that country to abate pollution. We use discrete choice experiments to estimate the WTP of survey respondents in the UK and the US [2]. The WTP of other countries is obtained by **benefit transfers** method: the WTP pay of countries east (west) of the Atlantic is proportional to that of the UK (US) and their relative gross national incomes.

We compare marginal cost estimates of abating plastic pollution from two different approaches. The first uses panel data from Eurostat to obtain an estimate of the increase in governmental expenditure associated with an additional tonne of waste managed. The second approach uses the fact that, in the absence of an international agreement, it is optimal for each single country to abate pollution up to the point where its own **marginal costs** and **marginal damages** are equal [4].

Since marine plastic pollution flows across national borders, individual countries do not suffer all the damages caused by their own plastic emissions. Countries are therefore not fully incentivised to carry out the optimal level of plastic abatement, implying there are potential gains to coordinate abatement efforts internationally.

International cooperation is modelled with a modified version of the **acid rain game** [4]. We use ocean current and tide data to map transnational plastic flows for 17 North Atlantic countries. These flow estimates, together with the cost and damage functions, allow us to estimate the **full cooperative solution**. This is the level of abatement where the **sum of net benefits (avoided damages adjusted for abatement costs) across *all* the countries involved is maximised**.

We calculate how the net benefits under full cooperation compare to the net benefits under non-cooperation. This is the level of abatement where each individual country maximises its own net benefits by only considering their domestic plastic emissions and ignoring the effects of their emissions on other countries.

Given an individual country's net benefits, we estimate which countries are worse off under the full cooperative scenario. From this we can devise compensation schemes to ensure international cooperation is mutually beneficial.

Results

Preliminary simulation results indicate that the gains from international cooperation for the selected North Atlantic countries can be substantial. Using the full cooperative outcome, we also simulate how gains can be transferred to countries who are net losers in this scenario.

The simulations not only give insight into the overall gain from international cooperation, but also insight into the distribution of the economic gains and losses across the identified countries.

Initial simulation results suggest that in designing an effective international agreement for reducing marine plastic pollution, negotiation should potentially allow for a redistribution of economic transfers.

References

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