Should there be government intervention in the market in the case of the environment? If so, what are some possible policy options, and how would they resolve the issue?

In this essay, I argue that there *should* be government intervention to address climate change by modelling environmental damage as a negative externality. I will discuss the advantages and disadvantages of a few remedies to internalise the externality of environmental damage, focussing specifically on carbon dioxide emissions (CO_2). First, I will explain why the absence of government intervention results in a Pareto-inefficient outcome. Next, I will highlight some of the difficulties when addressing climate change and evaluate different policies.

I argue that no governmental intervention leads to a Pareto-inefficient outcome. Consider an agent choosing to get its electricity from either a coal-fired power-plant or a solar farm. If the coal-based electricity is cheaper than the electricity from the solar farm, it will choose in its own best-interest, the coal power plant. However, this is because the effect that the CO_2 emissions have on the environment is not reflected in the price of the electricity. In other words, there is a "missing market" for the externality. This will lead to a Pareto-inefficient outcome as the factory will opt for the coal-based electricity and, if we assume that a higher general utility is achieved by not polluting (e.g. the negative effects that the pollution has on general utility is higher than the utility gained from cheaper electricity prices), general utility is lower than if the factory had picked the solar-based electricity. When small groups of people interact, informal agreements and social norms will be sufficient to deal with environmental problems, avoiding 'the tragedy of the commons'. However, in the case of CO_2 abatement, because it is a concern for the whole world with many different actors involved, it requires not only governmental intervention but also international cooperation.

To find the Pareto-efficient outcome, one can – as a simplification – see the issue as a trade-off between consumption and the quality of the environment (measured through CO_2 abatement). The cost of CO_2 abatement rises as emissions are reduced. One can plot it as a feasible frontier, with the marginal rate of transformation (MRT) being the increase in environmental

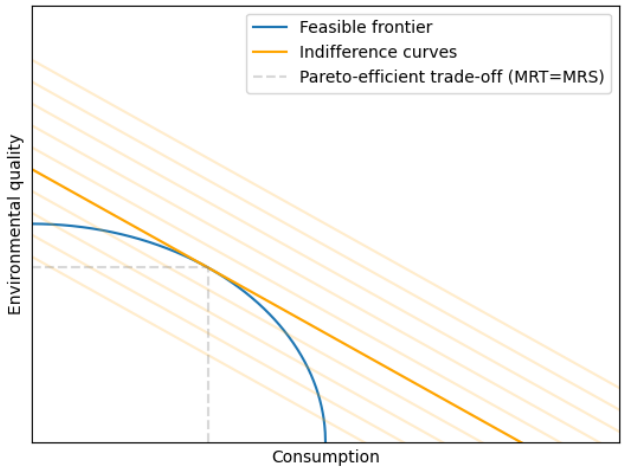

Figure 1: The Pareto-efficient level of abatement.

quality divided by the decrease in consumption. If we then assume that it is possible to aggregate everybody's utility into a single function, optimisation can be achieved by drawing the indifference curves and finding where the marginal rate of substitution (MRS) is equal to the marginal rate of transformation. This way, the cost of a decrease in environmental quality is internalised, leading to a Pareto-efficient outcome. Otherwise, as the polluters would not have the environmental quality in their utility function, if they act in their own best-interest, the equilibrium would be more to the right (more consumption/production and lower environmental quality).

There are different policies to get to this Pareto-efficient outcome. The Coasian method would be to give property rights for the environment to the polluters, rights to pollute. This could be done through a system of tradable permits. This system has already been adopted by many countries and is a so-called 'cap and trade system'. The government can set the total amount of pollution allowed: the 'cap', which should reflect the desired environmental quality given by the calculated Pareto-efficient outcome. And can then distribute permits to pollute up to this level. Individual actors can then trade these permits. This has the effect that the carbon abatement is done by the firms for which this is the least expensive. If there are, for example, two firms with different costs of carbon abatement, gains from trade could be achieved if the firm for which carbon abatement is cheaper sells some of their permits to the firm for which it is more expensive. Although this leads to a Pareto-efficient outcome, the surplus would be gained by the actor who sells the permits. However, this might increase the incentive to innovate, as the actors who have the cheapest CO_2 abatement get the most surplus.

Another intervention would be to place Pigouvian taxes on CO_2. This would result in exactly the same equilibrium as the Coasian method. And to get the same incentive for innovation, the government could subsidise it with the tax revenue. The government could, if it perfectly knew the Pareto-efficient amount of CO_2 abatement, implement a per-unit carbon tax to reduce emissions to the Pareto-efficient level. Consider the example of a factory which optimises its profits by choosing the quantity to produce. In the figure, I have plotted the factory as a price taker with its own marginal private cost (MPC). This is the cost for the factory to produce an additional unit. Unfortunately, the factory

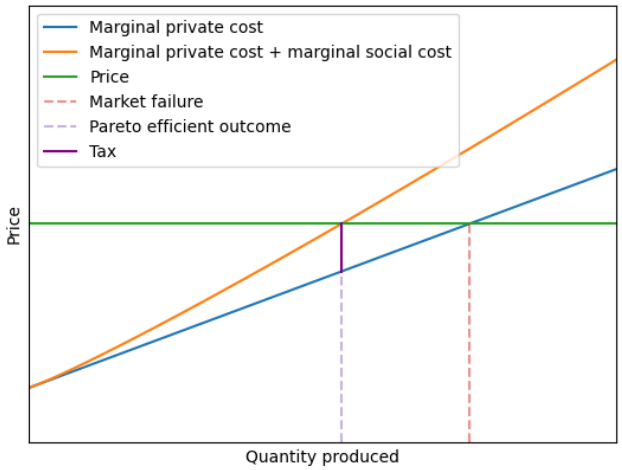

Figure 2: A carbon tax to internalise the externality.

emits CO_2 which creates a social cost, namely the cost of a bad environment. This leads to a market failure: when the factory optimises its profits the social cost of producing is not considered. However, if the social cost is reflected in the marginal cost by taxing the factory for every unit of CO_2 it emits, a Pareto-efficient outcome is achieved. Usually, however, implementing taxes is unpopular, which might have contributed to the fact that many countries have opted for a 'cap and trade' system. Another problem is that it is very difficult to determine the optimal tax rate as the government does not have perfect information.

However, there are a few unique features about climate change which make certain policies more prudent. One of these is climate tipping points. These are critical thresholds where small changes can trigger significant and irreversible effects. They occur when there are positive feedback loops such as the ice-albedo effect – as ice is a lighter colour than water, when it melts, more light is absorbed which leads to a higher water temperature which then leads to less ice. As there is a lot of uncertainty about how close we are to these thresholds, a 'cap and trade' policy might be more desirable. It allows the policymaker to set the maximum emissions, the cap, sufficiently far from these thresholds, guaranteeing that we will not go over them. This reflects a general advantage of a 'cap and trade' system: it is easier to adjust to certain conditions. This is because there are two 'levers' that the policymaker can use: the 'cap' and the amount of money for which the permits are traded. With a carbon tax, on the other hand, it is more difficult to respond to market conditions.[1]

Another unique problem for climate change is that it requires global cooperation. If we model two different countries who both have the choice to either reduce CO_2 emissions, or to free-ride on the emission reduction done by the other country and to continue emitting. If we assume that free-riding leads to a higher payoff than cooperating and reducing emissions, we can represent their payoffs in the following table.

	Cooperate	Free-ride
Cooperate	3, 3	1, 4
Free-ride	4, 1	2, 2

Table 1: Climate change as a prisoners' dilemma.

The orange cell reflects the Nash equilibrium in this game. Luckily, it is unlikely that this prisoners' dilemma actually occurs, given that there already have been so many international agreements on climate action. Although there might not be enough public support for an international carbon tax, the European Union has been quite successful with its international Emission Trading System.

[1] (Pan et al., 2024)

Finally, the way that certain outcomes were evaluated in this essay was by using the criterium of Pareto-efficiency. Unfortunately, in the case of the environment this is particularly problematic as there is a difficulty in deciding who will be included in the general utility function. If we weigh the utility of future generations just as heavy as the utility of the current generation, the costs of abatement policy will be borne by the current generation, but the benefits will be gained by the future generations. Currently, as future generations are not represented in policy-decisions – they do not get to vote, for instance – their utility probably has too little weight.

Usually, this problem is approached by discounting the utility of future generations. People assume that due to technological progress, climate change will not affect people in the future as much as it would now. And that, because of their technological progress, they will already have a higher utility than we have today. Therefore, it would not seem fair to value their utility as much as the utility of the current generation. To measure this, economists compare how people value future consumption with present consumption.

In conclusion, there should be government intervention in the environment to address market failures as a result of externalities. Both a Coasian or a Pigouvian approach could resolve the market failures. However, although a carbon tax might be cheaper to implement, a 'cap and trade' system might be more desirable because of public support, flexibility, which is required in the case of the environment because of, for instance, tipping points, and the incentive to innovate.

Olivier Berg

Bibliography

Pan, J., Cross, J. L., Zou, X., & Zhang, B. (2024). To tax or to trade? A global review of carbon emissions reduction strategies. *Energy Strategy Reviews*, *55*, 101508. https://doi.org/10.1016/j.esr.2024.101508

I have a few questions:

- *To what extent should I explain more basic economic concepts in my essay (e.g. Pareto-efficiency, MRT, MRS etc.)?*
- *How original should an economic essay be? I feel like the points I make have probably already been made hundreds of times and I am not really contributing to the discourse.*