Tax on carbon emissions

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Climate change is considered to be one of the biggest threats to humankind and might be the biggest challenge policymakers have to cope with. It can result in rising sea levels and more extreme weather events in the future. The main cause of climate change are greenhouse gases in the atmosphere that occur naturally, but the concentration of them is increased by human activity. One can argue that these greenhouse gases act similar to the glass in a greenhouse, thereby heating up the atmosphere and the world climate. The largest contributor to global warming is the greenhouse gas carbon dioxide. While it can be produced by nature (e.g. volcanic events) a big part of it is produced during economic activities by burning coal, oil and gas. Deforestation also acts as a big contributor to climate change as trees naturally absorb carbon dioxide (Causes of climate change n.d.).

As the social and economic costs of climate change are expected to be significant (Fankhauser and Tol 1997), the world is best advised to act on it.

Neoclassical economics: Externalities and policy advise

Neoclassical economics describes where climate problem comes from and how to solve it. The climate crisis resulting of an overproduction of carbon dioxide is a negative externality. Externalities are not reflected in the price mechanism which leads to economic inefficiencies. This means that the price structure does not reflect the social costs of carbon dioxide. The price is too low, leading to an overproduction of carbon dioxide which causes unnecessary social costs (climate change). That is an example for a market failure. Analytically, the problem is that the marginal social costs (MSC) are higher than the marginal costs (MC). The difference between those are the marginal external cost (MEC). A profit-maximizing firm normally produces at a price which is equal to the marginal costs, not taking the external costs into account. For having an efficient production level again, the price must equal the marginal social costs. The marginal social costs are the sum of the marginal cost of production and the marginal external cost of producing carbon dioxide (Pindyck and Rubinfeld 2013). For further and graphical demonstration see Appendix 1.

Neoclassical economics provide policymakers with different ideas of dealing with externalities and reaching an efficient market allocation again.

There are emissions standards, which give a legal limit of how much carbon dioxide a company can produce. Policymakers could also introduce an emission fee, which would result in a fee for every unit (e.g. per metric ton) of carbon dioxide produced by a company. The third option are tradable emission permits, which determine a specific amount of carbon dioxide that can be produced in an economy. Companies can buy certificates which allow them to emit carbon dioxide, but these certificates are limited (Pindyck and Rubinfeld 2013).

In this term paper I want to analyze the emission fee which can also be called an emission tax. I want to specifically analyze two aspects of a carbon tax. First, I will analyze the efficiency of a carbon tax, questioning if such a tax would be able to meet certain emission goals. Second, I will focus on distributional effects. I will be comparing the tax to other instruments if I find that necessary. After the analysis I will focus on one state which is using a carbon tax to further discuss the practical implications of introducing such a tax.

An emission tax is already being used in a few countries. Examples are Germany or Sweden. The goal of such a tax is to increase the price of products, which are produced by emitting carbon dioxide. As described above, neoclassical economic theory would argue that the optimal result would be a price for carbon dioxide that equals the marginal social costs. This leads to companies reducing costs by reducing emissions and results in an efficient market allocation. Hence there is no market failure anymore. This of course only works in case the marginal social costs are known by the government and therefore the level of the tax can be determined.

Does a carbon tax guarantee to reach the emission reduction goals?

Probably the most important question when analyzing a carbon tax is if it is able to reach CO2 reduction goals. Using it, the government is able to increase the price of emitting carbon dioxide into the atmosphere. This suggests that less carbon dioxide will be produced as the demanded quantity of it will decrease. There is empirical evidence for this statement. A meta-analysis on the price elasticity of energy conducted by Labandeira, Labeaga and López-Oterodemand showed that on average the short-run elasticity is – 0.21 and the average long-run elasticity of energy equals –0.61 (Labandeira, Labeaga, and López-Otero 2017). This gives reason for the argument that even though the demand is inelastic, an increase of the price would still lead to a reduction of the quantity. The inelastic demand however suggests that the price has to increase significantly in order to have an impact on the quantity. As a consequence, carbon taxes have to be very high in order to work.

Also troubling is that when policymakers are controlling the price, the effect of the quantity cannot be exactly determined. As stated above, it can be expected that quantity will decline when prices go up. But it is difficult to figure out how high of a tax policymakers need to introduce, to reach certain CO2 reduction goals. Economic models and econometric analysis can make predictions about this, but uncertainty remains. In other words, a carbon tax does guarantee to reduce emissions, but there is uncertainty of how it should be implemented.

This suggests that controlling the quantity and not the price would be better to ensure reaching C02 reduction goals. If controlling the quantity, reaching CO2 reduction goals is certain while the development of the carbon price is uncertain. It is very reasonable however that prices will rise as there is less quantity. A mechanism doing that would be an emission trading system. It works by releasing a certain amount of tradable emission permits that give permission to companies to produce CO2. Given the problem of the carbon tax described above, this system seems more suitable to cope with the overproduction of CO2 in an economy as it rather focusses on the quantity and not the price of CO2.

If rightly calculated however, a carbon tax might be able to ensure reaching the emission reduction goals in the country where the tax is paid. But is that enough? Companies could react to a carbon tax by shifting their production to countries where such a tax is not implemented. Another option is to import intermediate goods, rather than producing them domestically. New publications show that a quarter of the world's carbon dioxide emissions are being outsourced in that way (Hasanbeigi, Morrow, and Shehabi 2021). Britain, for example, was able to cut its emissions within its own borders by one-third during 1990 and 2015. The biggest reason for this success story is that energy-intensive industries have been migrating to other countries. If taking imports into account the British Carbon footprint has actually increased by a small margin during that time (Plumer 2018). As most C02 reduction goals (e.g. Paris climate agreement) only take emissions into account which are produced within the state's borders, a tax on CO2 can reach these goals, but it might not help to stop global climate change.

This problem could be solved by establishing the same carbon tax in every country in the world. However, the odds of that happening are extremely small. A minimum tax on carbon among the developed countries would seem more realistic. Especially given the current developments with the global minimum corporate tax among OECD countries, international cooperation on such issues seems possible.

Another solution might be border carbon adjustments in form of tariffs for countries with high carbon taxes. They would protect the carbon intensive industry and not force them out of their countries. By introducing these tariffs, the risk that companies from countries with no carbon tax could sell their products for less money in countries with high carbon taxes is reduced. This system could however cause other problems like international trade conflicts which might even result in trade wars (Holmes, Reilly, and Rollo 2011). This could seriously hurt the global economy. Additionally, carbon adjustment tariffs could have dramatic consequences for low income countries as it could strongly affect their exporting industry (Brandi 2010).

In this regard I would also favor an international emission trading system which allows the trade of carbon certificates between different companies in different countries. A good example is the emission trading system of the European Union. If this system would be extended to all economic sectors within the EU and if other nations with carbon intensive industries would also join it, this can be a promising tool to reduce global carbon production.

In conclusion, there is no guarantee of reaching specific emission reduction goals with a carbon tax. Because of the reasons mentioned above, I think that a global emission trading system is more efficient to combat climate change. A carbon tax still remains a useful tool but there is less uncertainty when working with an emission trading system. I want to stress that if introducing a carbon tax, it should be accompanied with an international component. A global minimum carbon tax similar to the global minimum corporate tax could also be very promising.

Distributional effects of a carbon tax

The distribution effects of a carbon tax on different social classes must be taken into account when designing such a tax. Recent studies suggest that a carbon tax has different effects on income groups across different countries. While for few countries a carbon tax might be neutral or slightly progressive, it is a rather regressive tax in most countries. This is especially true for carbon taxes in developed countries. Consequently, low income households tend to be more affected than high income households (Wang et al. 2016). One possible explanation for this is that low income households have less substitution possibilities. Additionally, when it comes to their basic needs, they tend to have a higher consumption of energy-intensive products (Wang et al. 2016).

Another finding is that people living in rural areas are more effected by the tax than people living in urban areas. People living in rural areas have greater energy needs as they for example have to cover longer distances to go to work every day and might not rely on good public infrastructure. They also tend to be relatively more poor, which means that they are more affected by a regressive tax (Fremstad and Paul 2019). These consequences of affecting poor people and people living in rural areas relatively more, make the implementation of a carbon tax difficult. The public could perceive an introduction of such a tax to be unfair. One example that I want to mention is the yellow vest movement in France which had its origin in protesting against a proposal of increasing the French carbon tax. They were claiming it would have an disproportionately high effect on the working and middle-class (Andersson and Atkinson n.d.). They eventually reached their goal in preventing the increase. Another example would be Hillary Clinton not wanting to add a carbon tax to her climate change plan in her campaign for the US presidency. This was most likely due to a lack of public support for that policy (Plumer 2016).

There might be a possibility of making a carbon tax more popular among citizens. The distributional effects described here do not include the revenue raised by such a tax. The state could use that revenue for supporting those who are affected most by it. It could do that by lowering other taxes or by directly subsidizing these groups. These actions do not change the financial incentives caused by such a tax as

emitting CO2 would still be more expensive. They could however lead to more support for a carbon tax in the population and thus make implementation easier.
To conclude, a carbon tax tends to be regressive and has bigger effects on the rural population. This makes it harder to introduce, as it might be perceived to be unfair. This problem could be solved by using the tax revenue to disburden those affected most by it. I do not think the distributional effects of carbon taxation are something worrisome in the long term as compensation is definitely possible.

Carbon tax in practise: Sweden

There are already several countries using a carbon tax to combat climate change at the moment. I will focus my research on the carbon tax implemented in Sweden as it is currently being the highest. I will analyze the effects of the tax on carbon emissions, on distribution and on tax revenue. Additionally, I will have a look at economic growth in Sweden given the carbon tax.
The effects of the Swedish carbon tax on carbon emissions are generally promising. Sweden introduced the tax at a rate of 30 US$ per ton of carbon dioxide. The country successively increased it to the level of 132 US$ where it is today (Andersson 2019). 90% of the tax's revenue comes from gasoline and motor diesel consumption. Consequently, the transportation sector is the most effected one by the tax. This is also due to other economic sectors not having to pay the full tax rate. The transport sector, being Swedens biggest CO2 contributor, is fully covered by the carbon tax (Andersson 2019). Sweden shows that a carbon tax is an efficient method to decrease CO2. Studies show that after introducing the tax, emissions caused by the transport sector have decreased by a margin of roughly 11% in an average year. 6% of that due to the carbon tax alone (Andersson 2019). The goal of the Swedish government by introducing the tax is thereby achieved: less carbon is emitted. This gives reason to the idea that carbon taxes are working and are a useful tool to fight global climate change. If all sectors would have to pay the tax rate which the transportation sector has to pay, the results could be even more promising concerning carbon reduction.
The effects of the Swedish carbon tax on distribution are fitting well with what I described about distribution above. As the majority of carbon taxes, the Swedish carbon tax is a regressive tax. It also has a bigger effect on households living in more sparsely populated areas than average households (Brännlund and Nordström 2004). This should be no surprise as they are more dependent on cars as transport than households living in bigger cities. Transportation is the sector affected most by the Swedish carbon tax.
The effects on the Swedish tax revenue are somehow surprising. Estimates show that the tax revenue is about 2.2% of the national GDP (Yang et al. 2021). While this is a massive income for the Swedish government, one also has to consider the effects it has on revenues of other taxes.

A model-based report issued by the Swedish government showed that the effect of increasing the carbon tax on overall tax revenue is not as clear as it seems. An increase of the Swedish carbon tax would cause increases and decreases in revenues from other tax bases. According to the authors this is due to substitution effects concerning inputs and products. This reduces the use of inputs and products resulting in substantially less energy taxes being paid (Harrison and Kristroem 1997). This result challenges the idea of compensating the citizens that are affected the most by the carbon tax using the tax revenue. If an increase in the tax rate does not lead to more tax revenue politicians have to introduce other taxes or cut expenditures in order to compensate the most affected.

The effects on economic growth in Sweden are rather difficult to determine. In general, the introduction of a carbon tax did not stop the Swedish economy from growing. Between 1990 and 2010 carbon emissions decreased by 8% while economic activity increased by 51% (Sterner 2020). This does however not rule out the possibility of the tax having prevented even further economic growth. We simply do not know how the economy would have grown without the implementation of the carbon tax.

In conclusion, it is safe to say that the Swedish carbon tax was successful in reducing carbon emissions within its own borders. This finding generally supports the idea of a carbon tax being used to combat climate change.

Conclusion:

My research suggests that a carbon tax is most likely to reduce carbon emissions within the country's own borders. It thereby can be a valuable asset for solving the climate crisis. There are however a few concerns about the ability of it to ensure reaching global carbon reduction goals. I stressed the uncertainty of how high a price should be to reduce a specific amount of carbon. An emission trading system has strong advantages in that regard. More troubling are however the outsourcing possibilities of carbon production to other countries with no or lower carbon taxes. This could lead to a very high carbon tax in one country having no contribution to global carbon reduction. The only solution can be a minimum carbon tax in all industrial countries.

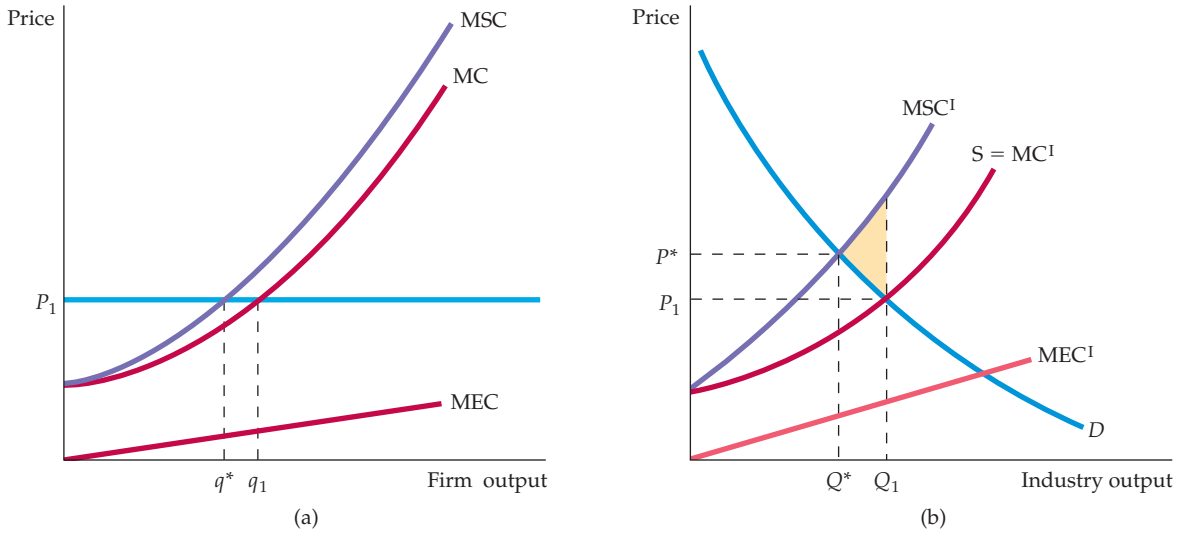
Another problem is the public perception of carbon taxes as it tends to affect poor people more than wealthy people. This can lead to social tensions. If there is more total tax revenue due to the introduction of the carbon tax, it could be used for compensating those affected most by it. If that is not the case additional money has to be spent on that issue. I do think that with clever social compensation policies this problem is possible to solve.

In the long-term development countries should choose either a carbon tax or an emission trading system if interested in reducing carbon emissions. While I stressed that a trading system can have conceptual

advantages over a tax, I would consider both systems very helpful if they are paired with an international component. One key takeaway from my research should be the importance of solving the climate crisis on a global level.

Appendix:

Appendix 1:



(Pindyck and Rubinfeld 2013)

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