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A Global CO_2 Tax for Sustainable Development?

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Abstract

The Rio+20 conference in 2012 called for goals of promoting green industries and improving the quality of institutions worldwide. Is a global CO_2 tax the best global solution for achieving this twin goal? As most countries in the world are highly corrupt, an adequate regulatory instrument should be able to work in a simple way that does not rely on strong formal institutions for enforcement. We argue that this is the case for a global CO_2 tax. A uniform CO_2 tax can be introduced as a "painted" energy tax that provides the needed incentive to switch from brown to green industries and minimizes the risk of carbon leakage. The achievement of the specific 2-degree target level is discussed as an example implying huge tax revenues that may be invested in better institutions. In perspective, the idea of having one instrument solving one problem will probably ease forthcoming political discussions and sustainability conferences substantially since the focus is on one issue rather than many.

Keywords: Rio+20, sustainability, CO_2 tax, energy tax, institutions, green industries, corruption, enforcement, political feasibility, renewable energy, carbon leakage, 2-degree level

1. Introduction

One future main challenge for political decision-makers all over the world is to agree on a common regulatory instrument that may ensure a sustainable development (UN, 1987). 20 years after the 1992 Rio conference on sustainability, the focus is again on trade-offs between economic and environmental goals. Two main themes in the Rio+20 conference was how to establish well-functioning institutions and facilitate the growth of green industries (UN, 2011).

Whether institutions are well-functioning or not can be measured by the level of corruption. Corruption is defined as "the misuse of public power for private gain" (Rose-Ackerman, 1999, p. 91). The term "private gain" relates to receiving money or valuable assets, but it may also encompass increases in power or status. Receiving promises of future favors or benefits for relatives and friends can also be considered private gains (Lambsdorff, 2007, p. 16). The strong negative effects of corruption in a society are well documented when it comes to economic growth, health, political legitimacy and the well-being of citizens. Also, corruption hampers the provision of public goods such as increased environmental quality in terms of CO_2 reduction (Svendsen, 2011).

About 85 per cent of the world's population lives in a state that can be described as corrupt, despite a wide understanding that corruption is likely to increase transaction costs, create perverse incentive structures and hamper economic growth (see North, 1990; Meon & Sekkat, 2005). Basically, the enforcement problem is worsened when national authorities are corrupt: The higher the corruption level in a country, the higher the risk of cheating because bribing the authority is easier for the emitter. Corruption levels vary considerably across countries. Overall, a north-south divide exists: The further south, the more corruption according to Transparency International (2013). Even if sanctions are formally in place, they will not be imposed in corrupt countries. The risk of corruption and cheating is a ticking bomb under most regulatory instruments.

As argued by Oates and Schwab (1988), enforcement systems rely on precise monitoring and well-functioning sanction mechanisms, typically based on the economic incentive of fines. If these two conditions are not met because of corruption, sources may find cheating profitable. Furthermore, local authorities may have strong free-rider incentives to protect their "own" firms against strict enforcement. Overall, local firms may be given substantial room for cheating (Daugbjerg & Svendsen, 2003).

The traditional way of controlling pollution has been regulation in the form of standards or "Command and Control (CAC)" (Daugbjerg & Svendsen, 2001). Setting CO_2 standards for individual firms implies that producers can violate their individual standards by bribing the regulating authority. The same argument holds for emission trading systems. The only difference between standards and emission trading is that the producer in the latter case has been granted the property right to freely trade emission allowances in the market (Svendsen, 1998). Even worse is the instrument of subsidization. In the presence of corruption, it is possible to receive excessive subsidies from the regulator without actually reducing CO_2 units and then split the profits with the corrupt bureaucrats and/or politicians in question.

What this paper adds to the literature is the suggestion that a global CO_2 tax is the most likely political solution because it can be introduced as a painted energy tax, can dampen the carbon leakage problem and provide the right economic incentives to switch from brown to green industries. A painted energy tax means that a CO_2 tax can be imposed at the central level on fossil fuels according to their CO_2 contents. Next, the resulting tax revenues may be invested in better institutions. We use the case of a specific 2-degree target level as an empirical example showing the substantial size of the tax revenues.

In doing this, the traditional gap between economists and political scientists is bridged. Economists are experts in suggesting optimal solutions to societal problems in economic terms. They tend, however, to forget about the reality of political and administrative friction. In contrast, political scientists tend to focus on institutions and the political and administrative feasibility of a given policy proposal but often forget to take into account the economic benefits and costs from doing so. Producers, for example, will try to increase their profits by actively lobbying for more market protection, typically by establishing different types of market barriers or avoiding costly environmental regulation (see e.g. Tullock, 1967). In this way, the paper is in line with Cropper and Oates (1992). They were the first to point to the need of taking political reality into account when using the standard approaches of environmental economics.

Thus, the main research question is as follows: Can a global CO_2 tax secure the Rio+20 twin goal at the global level? In the following, we argue that one bold but straight forward solution could be to impose a uniform tax on pollution and, in this way, use one instrument to solve one problem (Avi-Yonah & Uhlmann, 2009). A uniform tax simply means that all polluters are taxed at the same level (Pigou, 1920; Kerkhof et al., 2008). Such a single-minded focus in future climate negotiations could lower transaction costs and pave the way for a great leap forward. Furthermore, the revenue from uniform green taxation can be used in productive ways such as improving institutional quality and/or lowering other distortive taxes, for example, income taxes (Daugbjerg & Svendsen, 2001).

The so-called "double dividend" from green taxation increases environmental quality at least-cost and, at the same time, lowers other distortive taxes. See, for example, Siriwardana et al. (2011) on the impact of a carbon tax on the Australian economy. Taxes may, in theory, not be distortive if designed as lump-sum taxes, but such a policy is rarely, if ever, found in reality. Furthermore, green taxation is consistent with the Polluter-Pays-Principle, which is, for example, valid in the EU. This means that the polluter should bear the costs that a given production inflicts on any society within the EU (Svendsen, 2003).

In the following, the gap between the disciplines of economics and political science is bridged by focusing on a CO_2 tax as the best possible economic solution, which is, at the same time, politically and administratively feasible in the global perspective. We do this by first showing how CO_2 taxation works and how it promotes the switch from brown to green industries, thereby increasing the use of renewable energy (Section 2). Carbon leakage has been the Achilles heel of international negotiations, but a uniform CO_2 tax can help solve this problem (Section 3). Then, we provide some estimates on the size of an actual CO_2 tax at the global level for achieving the specific target of a 2-degree level (Section 4). Finally, a conclusion is given (Section 5).

2. Tax and Renewable Energy

2.1 The Tax

At the beginning of the last century, the English economist Arthur C. Pigou (1920) suggested that the introduction of a tax could reduce the substantial problems of smog in London. Pigou showed this by looking at pollution as a negative externality where private costs were lower than the social costs. Therefore, the price of pollution should be included to confront the polluter with a price that reflected the actual marginal social cost. An environmental tax, which was calculated as the difference between the polluter's private marginal cost and the marginal social cost, would thus internalize the externality in the economic calculation of overall society. Pigou's original recommendation is still valid: By imposing a uniform CO_2 tax levied directly on the use of fossil fuels, producers will reduce their pollution to the point where the marginal cost of reducing their CO_2

pollution by an additional unit is equal to the tax rate. The cost of the last unit of CO_2 reduction is therefore the same for all producers.

Figure 1 shows how a Pigou tax works. We can compare the tax solution with a uniform reduction obligation (CAC regulation) where each emitting source will have to reduce the same amount to see the cost efficiency property of a tax. This is done in Figure 1, where we have two emitting sources, A and B, and show their marginal reduction cost curves as MRC_A and MRC_B, respectively. Source B has higher reduction costs than source A. Under the CAC regulation, both sources reduce $\bar{q}$, while under the tax system with tax rate t, the high cost source reduces less (and pays the tax for a larger part of its emission), and the low cost source reduces more, denoted by q_B^t and q_A^t. In this way, the uniform CO_2 tax allocates reduction in accordance with how costly it is to reduce CO_2 emissions, and therefore, the total cost from regulation is minimized. Moreover, the tax meets the Polluter-Pays-Principle since the sources pay for all their emission compared to the CAC, where this is not the case.

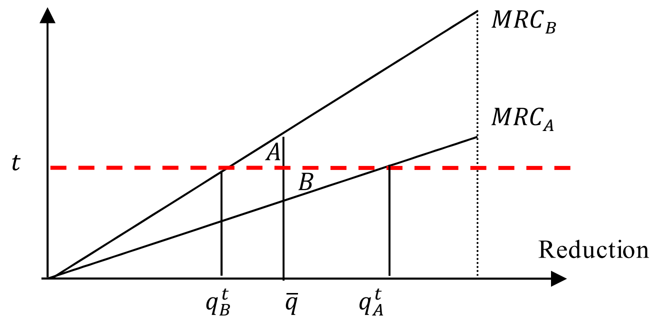

Figure 1. The uniform tax solution

As mentioned, the existence of such a uniform CO_2 tax at the global level would mean that firms would reduce emissions up to the point where the tax rate equals the marginal cost of reducing one extra pollution unit. Therefore, the cost of reducing the last pollution unit would be the same in all firms in all countries, and the carbon leakage problem would be counterbalanced. Moving production from one country to another to avoid CO_2 regulation would no longer pay. The CO_2 tax would be the same in both countries.

Furthermore, a differentiated tax solution would, beside the effect of carbon leakage, not be optimal in economic terms. As long as tax rates are not uniform across countries, the global society can save major costs by having the flexibility of shifting pollution reductions from high-taxed to low-taxed polluters so that all emitters would face one identical tax level only. When marginal reduction costs are the same for all polluters, it no longer pays to shift pollution reduction between different emitters. The firm, however, faces an extra operating cost (Daugbjerg & Svendsen, 2001). We will return to potential political opposition against carbon leakage in Section 3.

2.2 The Switch From Brown to Green Industries

How does a global CO_2 tax affect the potential shift from brown (non-renewable fossil fuels) to green industries (renewable energy)? Figure 2 shows what happens in this so-called switch point theory (Brandt & Svendsen, 2006).

The vertical axis measures the cost per unit energy, for example, Mega Watt, produced. The horizontal axis measures time. Marginal costs for energy production based on fossil fuels (coal, oil and gas) rise over time as these sources are exhausted (MC_{fossil}). Assume for simplicity, that the marginal costs for MW production based on renewable energy are constant at the price of p^*. Within our interval, we simply expect that, with the existing technology, it is possible to produce one extra unit at the same marginal cost ($MC_{renewable}$). In fact, as technology improves over time, it is more likely that marginal costs for renewables will decline rather than stay constant. Given these simplifying assumptions, however, it is cheaper to use fossil fuels rather than renewables as an energy source until some future point in time, t^*. After the switch point t^*, renewables become increasingly cheaper compared to fossil fuel-based energy.

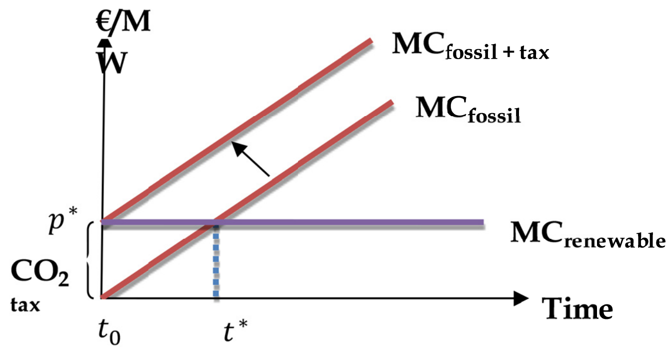

Figure 2. The shift from brown (fossil fuels) to green (renewable energy) when taxing CO_2

The use of renewable energy sources and sustainable development may be speeded up if the environmental costs are added to the price of fossil fuels, for example, by taxing fossil fuels. Figure 1 shows how governments can accelerate the switch point by adding a CO_2 tax. If the tax is added on top of the MC_{fossil} according to the Polluters Pay Principle, the line will shift. MC_{fossil} will be raised according to the added tax, and the new switch point now occurs earlier on in time, at t_0, which could be today.

The CO_2 tax may ensure both the double dividend and the transition to renewable energy and more green industries. Thus, the economic part gives a green light for the global use of this instrument. Next step is to consider the political feasibility of a global CO_2 tax in relation to political negotiations (Section 3) and to calculate the size of tax revenues available to countries (the 2-degree level (Section 4)).

3. International Negotiations and Carbon Leakage

Concerning reality and international negotiations, the concern for competitiveness in the world market has so far prevented the introduction of a common CO_2 tax in the EU. When the EU Commission launched a $15 tax directive proposal in May 1992, this proposal was opposed by several member states. Following a meeting on October 5, 1994 between the ministers of the environment in the EU, the Danish minister of the environment stated publicly that the proposed common CO_2 tax in the EU was dead. Great Britain is against common EU taxes in principle and wishes to deal with the CO_2 problem on its own. Spain demands the right to increase its CO_2 emissions by 25 per cent because its industrial level is lower than that of other EU member states. Portugal and Greece have argued against the CO_2 tax for the reason that taxation could slow economic growth. Spain, Portugal and Greece refuse to accept further production costs until they reach an economic level similar to that of the more wealthy northern EU members.

Overall, one may argue that the potential loss of competitiveness and jobs to non- or less CO_2-regulated areas, a phenomenon which labelled "carbon leakage", was the prevailing argument in the EU debate (Svendsen, 2003). As the main objective of industry is to maximize profits, industry in the EU is, of course, concerned with competitiveness and the minimization of environmental expenses.

Similar to individual EU countries, the US has been particularly concerned about the carbon leakage problem, especially the participation of the developing countries. Large countries such as China and India should also join the agreement to avoid industry moving out to these non-regulated areas. Such carbon leakage would undermine any attempt to reduce CO_2 emissions worldwide. The US expressed strong concerns about the Kyoto Protocol not placing any restrictions on emissions from developing countries (Brandt, 2013).

If the Kyoto Protocol enters into force, the extra price on top of fossil fuels will encourage firms to invest in developing countries outside the agreement, thus "exporting" or "leaking" CO_2 emissions. To avoid this carbon leakage, the US is very concerned about having large developing countries such as China and India join the agreement (Brandt & Svendsen, 2002).

The problem of carbon leakage both from the US and the EU is worsened by globalisation, that is, the fact that multinational companies operate in many different countries. Globalisation has been an on-going process in the capitalist system since World War II, and the free flow of capital leads to competition among national states to attract investments. Again, this leads to more harmonised conditions eliminating "national peculiarities". Also environmental policies must be standardised. Otherwise carbon leakage and distorted competition will take place because firms will begin locating and producing outside the regulated area. Multinational firms have gradually grown stronger and have more policy impact than national interest groups because of their size and international co-operation, which facilitates, for example, the sharing of lobbying costs (George & Bache, 2001). Multinational firms, strengthened by globalisation, know that they can avoid environmental costs if necessary, for example, by moving production and CO_2 emissions from Germany to China (Svendsen, 2003).

4. The Specific Target of a 2-Degree Level and the Size of CO_2 Tax

A specific example of sustainability may be found in the case of the 2009 Copenhagen meeting. Here, the international society adopted a target of limiting the increase in the global mean temperature to below 2 degrees Celsius (compared to the 2000 level). According to climate scientists, this target can be re-formulated as not allowing the concentration of CO_2 in the atmosphere to exceed 450 ppm (IPCC, 2009). According to the EU (2008), the 450 ppm target is the level of concentration where there is a likelihood of 50 per cent that global warning will not increase more than 2 degrees.

In comparison, the current concentration is about 400 ppm (2013 level), and over the last 10 years, the concentration has increased by 2 ppm per year. Consequently, by an unchanged emission of CO_2, the 2-degree target will be exceeded in 2037 (IEA, 2011). To make things worse, over the last 10 years, global emission has increased by 2 per cent per year (NOAA, 2012). Therefore, the target might be reached even earlier than 2037. This is in particular problematic since, once exceeded, even a zero-emission situation cannot reverse the amount of CO_2 in the short run because of the slow decay of CO_2 in the atmosphere.

A uniform tax implies that all emitting sources of CO_2 will be treated equally regardless of process or region and eligible to the same cost of emissions. Nordhaus (2010 and 2011) calculates the optimal path of a global carbon price ensuring that the temperature will not exceed the 2-degree mark (see Table 1).

Table 1. Carbon price in the 2-degree scenario (Nordhaus, 2010) (2010 prices, \$/ton CO_2)

Year	2015	2025	2035	2045	2055	2105
CO_2 tax (\$/ton)	24.24	43.63	69.32	107.04	160.04	277.18

Over time, the tax will rise from about \$24 in 2015 to \$277 in 2105. The implication of this price structure is that global emissions will remain at the 2005 level until 2025. After that, emissions will fall to almost zero in 2055. Note that since global emissions are currently increasing, a continued delay in emissions reduction implies the necessity of a higher carbon price to achieve the 2-degree target.

To put these figures into perspective, in the current EU emission trading system, the price of 1 ton of CO_2 has ranged between 5-15€ (approx. 7-20\$). Therefore, a tax on CO_2 in 2025 is more than a doubling of that price and should be levied on all emissions.

How will this tax affect different countries, and how are the incentives to reduce emissions through the development and implementation of new and cleaner technology? We illustrate the consequence of a tax for different countries by using the IPAT identity. This identity is given by:

$$\text{Impact} \equiv \text{Population} \cdot \text{Affluence} \cdot \text{Technology}.$$

Using this identify for CO_2 emissions for a given country, we have that:

$$CO_2 \text{ emission} \equiv \text{Population} \cdot \text{Affluence} \cdot \text{Technology}$$

where we consider $\text{Affluence} = \frac{GDP}{population}$ and $\text{Technology} = \frac{CO_2}{GDP}$. Inserting and reorganizing:

$$\frac{CO_2}{population} \equiv \frac{GDP}{population} \cdot \frac{CO_2}{GDP}$$

This equation tells us that per capita emission can be decomposed to economic performance (GDP/capita) and technological level (how much CO_2 is needed to produce one unit of GDP).

For our purposes, we make the IPAT measure country specific and use the following notations. Given emission in country i $E^i_{CO_2}$, and uniform tax rate t_u (measured in \$/ton CO_2), the total tax payment (revenue) in country i (R^i_t) is given by

$$R_t^i = t_u \cdot E_{CO_2}^i$$

Inserting:

$$\frac{R_t^i}{P^i} \equiv \frac{GDP^i}{P^i} \cdot t_u \cdot \frac{E_{CO_2}^i}{GDP^i}$$

In such a tax system, lowering the CO_2 intensity of the economy is rewarded by creating incentives to develop and implement cleaner technology and, in general, decouple CO_2 emissions from economic growth. In Table 2, we show the equation for four countries at a 10$/ton CO_2 tax.

Table 2. IPAT measures for different countries for a 10$/ton CO2 tax (2009 Figures)

Countries	GDP ($)	CO_2 (ton)	pop	GDP/pop ($)	CO_2/GDP Ton/$	t*CO_2/GDP	Tax payment/pop
USA	1.39E+13	5.3E+09	3.07E+08	45305.1	3.81E-04	3.81E-03	172.7
China	9.05E+12	7.69E+09	1.33E+09	6797.8	8.49E-04	8.49E-03	57.7
India	3.73E+12	1.98E+09	1.19E+09	3132.9	5.31E-04	5.31E-03	16.6
Denmark	2.11E+11	4.57E+07	5.52E+06	38268.0	2.16E-04	2.16E-03	82.7

Note: Tax payment is calculated for unchanged emission levels.

Source: World Bank (2013).

The technology indicator (CO_2/GDP) shows that Denmark holds four times as much economic value per emitted CO_2 than does China while the US only has a little over twice as much as China. While the US does not have any significant price systems for carbon, there are several price mechanisms in place for Denmark such as CO_2 taxes and other energy taxes combined with the European Emission Trading System. Overall, we would expect that the CO_2/GDP in both the US and China will slowly fall over time.

In Figure 3, we illustrate how a tax can help decoupling economic performance (measured by GDP) from environmental degradation (measured here by the CO_2 emission).

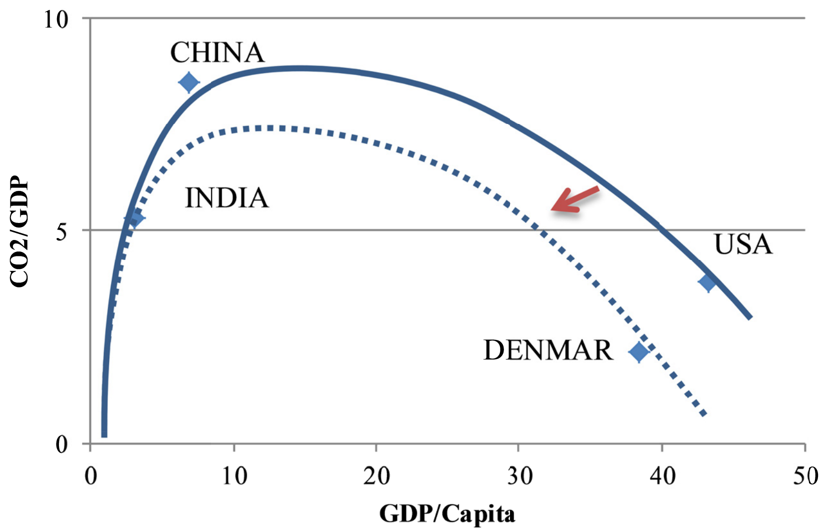

Figure 3. The development in environmental performance as a function of economic performance

The unbroken line indicates the development in environmental performance as a function of economic performance, while the dotted line represents the effect on this relationship by introduction of a tax. As the economy grows, the total tax payment will increase, and CO_2 reduction will be relatively costly for India, China and the US. Denmark and the US have comparable GDP/capita, but citizens in the USA emit more than twice as much CO_2 per capita on average as do citizens in Denmark. The dynamic incentives prevailing in a tax system suggest that technological progress will support energy savings, hence decoupling CO_2 emission from economic growth. As a caveat, part of the Danish reduction in CO_2 might be caused by leakage effects. Such effects will be eliminated in the global uniform tax system.

In case of a progressive increase in the uniform tax over time, as suggested by Nordhaus, we can reinterpret Figure 2. Even if the private cost from using conventional energy does not increase over time because of the increase in CO_2 tax, the cost of using conventional energy also increases, and eventually, the less CO_2-intensive energy sources will become competitive.

The size of the tax revenue in terms of real value will, however, vary greatly among various regions because of the major difference in wage and labor costs. In the developing countries, for example, the minimum wage could be as low as of one hundredth compared to the developed countries. Therefore, the impact on the profit will not be the same across countries, and one may, in perspective, consider building the global tax based on some universal GHG-emissions indicators that are fair to all countries (Moghaddam et al., 2013).

5. Conclusion

The Rio+20 conference in 2012 called for better institutions and more green industries. The main question was whether a global CO_2 tax was the best regulatory tool for achieving these goals. Overall, our bold conjecture was that a global CO_2 tax should be applied. Rather than standards, emission trading and subsidies, such a "painted energy tax", could work even in a setting of low-quality institutions. Implementing such a global CO_2 taxation will be relatively easy even when national institutions are of low quality as it can be imposed at the central level according to the CO_2 content in fossil fuels. By doing this, the risk of corruption and cheating is reduced significantly. Concerning the shift from brown to green industries, CO_2 taxation promotes an earlier shift to renewable energy from fossil fuels, thereby promoting a more sustainable production. Furthermore, competitiveness is not ruined when all countries are taxed the same, meaning that the carbon leakage argument applied by producers in international political negotiations is severely weakened.

The 2-degree target level from the 2009 Copenhagen meeting served as an illustrative example where the CO_2 tax had to rise from about $24 in 2015 to $277 in 2105. The increase in the tax rate over time also favors the less CO_2-emitting technologies, as shown in Figure 2. As the tax rate increases, the strength of such industries in the political area also increases, and hence, more support for an increase in the CO_2 tax can be expected over time, making the tax system a politically feasible solution.

These major tax revenues generated could then be invested thoroughly so that a double dividend would be achieved from improved environmental quality and less distortion elsewhere in the economy. Developing countries with low-quality institutions may, in particular, find CO_2 taxation highly attractive as an easy tool to collect taxes. When CO_2 taxation has been implemented, part of the revenue may be invested in better institutions, for example, by fighting corruption effectively. In perspective, focusing on one instrument as a reply to the Rio call is most likely to grease forthcoming political negotiations on a sustainable future. Complex political negotiations on many issues and many instruments have so far not proven a fruitful way to move forward.

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