Pricing carbon: The challenges

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In this chapter we provide examples of how carbon taxes can be very efficient in reducing fossil fuel consumption and resulting emissions, focusing on the Swedish experience that shows a significant decoupling of carbon emissions from GDP growth. But only a few countries have seriously implemented carbon taxation. This leads us to discuss political challenges of carbon taxes such as strong lobbying by fossil fuel stakeholders; opposition from the public because of the price impacts of a tax; transparency as to the effects on winners and losers; and the perception that taxes reduce welfare and increase unemployment. The chapter then reviews some of the policy responses to these challenges that share some ambitions and features of carbon taxes but are perhaps easier to implement. These include the removal of fossil fuel subsidies; sectoral carbon taxes such as fuel taxes; cap and trade, exemplified by the EU Emissions Trading System, and regulation; and, finally, the promotion of renewable energy sources exemplified by the German Energiewende. The chapter is concluded with a discussion on lessons learnt and some implications for the international negotiations and the COP in Paris.

1 Introduction

The climate problem can seem, paradoxically, quite simple. There are a series of activities that generate externalities and these should be priced according to the polluter-pays-principle. This could be done through taxes or cap and trade (CAT). There are confounding and complicating aspects such as non-carbon gases and emissions from land use and forestry, but at its core, the problem is simple. Yet there has been

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little progress to date in halting the carbon emission rate. Part of the reason is due to politics – some policies are unpopular and therefore policymakers might prefer to deny the underlying problem or procrastinate. There are also powerful fossil fuel lobbies in many countries that influence politics in a very direct way. At the international level, unilateral action is slow and negotiations have several times come to a standstill when burden-sharing and fairness aspects are discussed. Against this background it is instructive to review the experiences hitherto. In this chapter we will briefly review the experiences of carbon taxation at the sectoral and national level, cap and trade in the European Union, and the *Energiewende* in Germany.

2 Carbon tax

A tax on carbon is the most cost-efficient policy in order to reduce carbon emissions according to economists. It is generally more efficient than direct regulation of technology, products, and behaviour, as it affects consumption and production levels as well as technologies, it covers all industries and production and provides dynamic incentives for innovation and further emissions reductions. In addition, the tax revenue can be used to facilitate the transition toward renewable energy, cover administrative and implementation costs, or lower taxes on labour. A tax also continuously encourages industry to reduce emissions in comparison with CAT that only incentivise industry to reduce their emissions to the point of the cap. Furthermore, a tax is easy to incorporate in the existing administration, unlike a cap and trade programme that requires new administrative machinery.

Carbon taxes have existed internationally for 25 years. Finland was the first country to implement a carbon tax in 1990 and the rest of the Nordic countries followed in the early 1990s. Despite the positive aspects of carbon taxes, only a handful of countries beside the Nordic countries have implemented a general tax on carbon of at least US$10/$tCO_2$ to date: the UK, Ireland, Switzerland, and the province of British Columbia in Canada (World Bank 2014). In Sweden, the carbon tax is roughly US$130/$tCO_2$ as of April 2015. The tax is significantly higher than any other carbon tax or CAT permit price across the globe, and it appears to have been very effective in the sectors where it applies. It applies in particular to transport, where gasoline and diesel are taxed strictly in proportion to carbon emissions, but also to commercial use and residential heating as well as partially to industry.[2]

In Sweden and the rest of EU28, buildings contribute to a large part of carbon emissions since almost 40% of final energy consumption comes from buildings (28% residential buildings and 12% non-residential buildings) (European Commission 2014). More than half of all buildings in Sweden are heated by district heating, which in itself is very efficient compared to individual heating of each building. In the last few decades the district heating system has been greatly expanded and a good deal of fuel switching has occurred. Fossil fuels have been phased out and today it relies almost solely on waste and renewable energy sources – thanks to the carbon tax implemented in 1991. The share of oil used for heating decreased in the 1980s to reduce exposure to oil price shocks, but at that time oil was mainly replaced by coal and natural gas. It was not until the carbon tax was introduced that biofuels became the main source of energy for district heating and emissions dropped. Since 1980, output has almost doubled in the district heating sector while carbon emissions have decreased by 75% (Svensk Fjärrvärme 2015). The latest decrease in emissions came in 2003 after the implementation of the Tradable Renewable Electricity Certificates scheme.[3] Together with the carbon tax and building regulations, this scheme has reduced average energy usage in buildings in Sweden significantly.

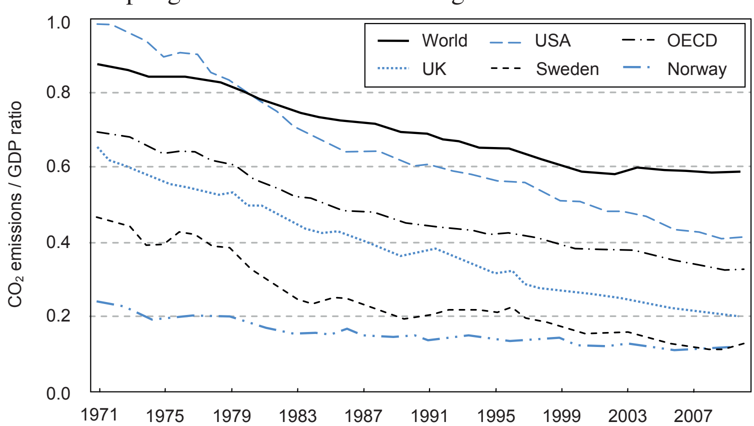
The likelihood that a carbon tax will be the only instrument in place on a global scale looks minuscule. As discussed in Chapter 15 of the latest (fifth) IPCC Assessment

2 Industry pays reduced (but still high by international standards) carbon tax rates but also has exemptions and major industries participate in the EU ETS instead of paying taxes in order to avoid double taxation.

3 The Tradable Renewable Electricity Certificate scheme was introduced in Sweden in 2003. For every MWh of renewable electricity generated, producers obtain a certificate from the state. These are then sold in an open market, where the market determines the price. Certificates therefore represent extra revenue for renewable energy producers. Buyers, mainly electricity suppliers, have quota obligations to purchase certificates. Renewable energy that qualifies under the scheme includes wind power, certain hydropower, certain biofuels, solar energy, geothermal energy, wave energy and peat in CHP plants. New generation plants qualify for 15 years, and quota levels are defined until 2035. In 2012, Sweden and Norway created a joint electricity certificate market with a common target of increasing renewable electricity production by 26.4 TWh between 2012 and 2020. The two countries contribute with 50% of financing each, however the market will decide where and when new production will occur. Since its inception, the Swedish-Norwegian certificate system has already contributed with 10.3 TWh of new renewable production capacity (Swedish Energy Agency 2015).

Report, countries normally rely on a combination of several instruments with different targets simultaneously, as exemplified by the experience of the Swedish building sector, described above. Therefore, it is difficult to assess the efficiency and environmental impact of carbon taxes. In Sweden, between 1990 and 2007, there was a decline in CO_2 emissions by 9% while the country's economy experienced a growth of 51%. There was a strong decoupling of CO_2 emissions and economic growth and the carbon intensity of GDP was reduced by 40% (Johansson 2000, Hammar et al. 2013). However, it is important to note that these figures reflect only emissions from production within countries. Products manufactured abroad and consumed in Sweden are not taken into account. Looking at emissions domestically, the Swedish carbon tax has so far proven to be both cost effective and efficient in achieving the commitment in the Kyoto Protocol. Greenhouse gas emissions have decreased by 22% since 1990, and the next domestic goal is to decrease emissions by 40% from 1990 to 2020 (Naturvårdsverket 2015). As Figure 1 shows, there is a clear trend over the last 40 years of decreasing CO_2 emissions per unit of GDP. Sweden's emissions per unit of GDP are about one-third of the world average.

Figure 1 Decoupling of carbon and economic growth



Source: IEA (2012).

3 Political challenges with carbon tax

In the 1990s, the EU tried to implement a tax but failed for several reasons. Ministers of finance are notoriously unwilling to compromise on taxes and give up their prerogative on tax issues to supra-national authorities. Taxes are viewed as a national concern and central for domestic economic policy. Another reason was the reluctance of letting the EU decide on yet another area of policy, moving the decision-making power from the national to the European level. But let us not forget that, in the 1990s, climate change was not the burning issue it is today, which made it hard to implement effective policy that would substantially reduce carbon emissions. This has led many to the unsubstantiated conclusion that carbon taxes do not work and are impossible to implement.

Globally there are even more reasons why countries have failed to implement carbon taxes: (i) strong lobbying by fossil fuel stakeholders; (ii) opposition from the public because a tax will raise prices; (iii) transparency as to the effects on winners and losers compared to the much less visible cost of regulations (Brännlund and Persson 2010); (iv) a perception that taxes reduce welfare and increase unemployment due to lower levels of consumption and production (Decker and Wohar 2007); and (v) possible institutional path dependencies that led to favouring cap and trade (Paterson 2012). In the absence of direct carbon pricing, countries have tried a number of other responses outlined below.

3.1 Response 1: Removal of fossil subsidies

Closely linked to taxes, but at the other end of the green fiscal reform scale, is the major issue of removing energy subsidies. Not only do energy subsidies damage the environment in various ways, they also discourage investment in renewable energy and energy efficiency, and impose a large fiscal burden (Coady et al. 2015). Subsidies need to be financed and this usually happens by increasing public debt or taxes on labour or goods. Subsidies also crowd out essential public spending on, for example, health and education. Some view energy subsidies as a way of providing support for low-income households, but subsidies are a highly inefficient way to support disadvantaged groups since the rich capture most of the benefits (Sterner 2011). Of course, there are political challenges in compensating the losers of a subsidy removal reform, but that discussion is beyond the scope of this chapter. Either way the current low oil prices provide a unique opportunity to shed such subsidies (Fay et al. 2015).

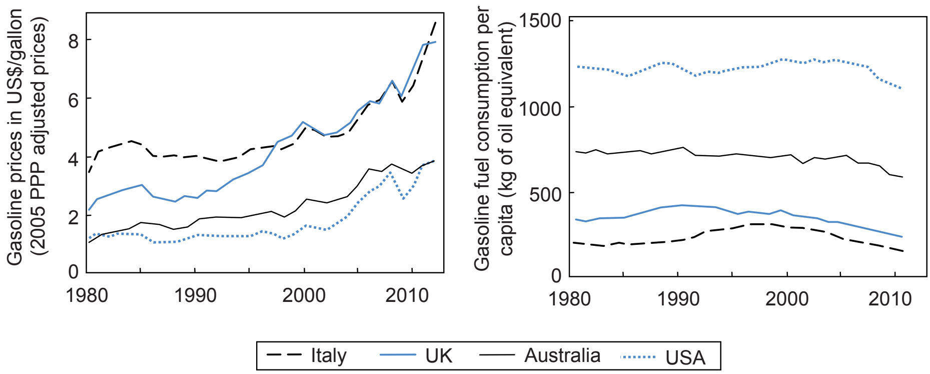
3.2 Response 2: Fuel taxation

Instead of a carbon tax, a closely related policy instrument that also has a major impact on carbon emissions is excise taxes on goods that have a high fossil carbon content. The prime example is a fossil fuel tax. A fuel tax is essentially a tax on carbon in the transport sector – a tax that is sometimes easier to implement than a carbon tax. As a result, there are more taxes on fuel than carbon around the world and, consequently, more studies and evidence of the performance of fuel taxes. Studies conclude that fuel has low price elasticity in the short run of somewhere between -0.1 and -0.25. This means that if the price of fuel increases by 1%, consumption would decrease by between 0.1% and 0.25% during the first year of implementation. This low effect is probably due to slow-moving structures such as habits, infrastructure, or technology. However, in the long run, surveys have shown the price elasticity of fuel to be about -0.7 on average (Graham and Glaister 2002, Goodwin et al. 2004).

In Europe and Japan, fuel taxes have reduced CO_2 emissions by more than 50%. According to various studies, fuel taxation is the policy that most likely has had the greatest impact on global carbon emissions (Sterner 2007). Fuel taxes not only impact total consumption by changing individual behaviour (e.g. driving fewer miles), they also create incentives for companies to invent fuel saving technology and greener cars. In Figure 2 we see how fuel prices affect demand in two high fuel-price countries (Italy and the UK) and two low fuel-price countries (the US and Australia). The two extremes are Italy and the US, with Italy having a fuel price three times that of the US. The US, on the other hand has a per capita consumption more than four times that of Italy.[4]

4 Per capita consumption is of course not *only* affected by prices, but prices *are* important (Sterner 2011).

Figure 2 Gasoline prices and gasoline fuel consumption per capita in four countries



A commonly used argument against fuel taxes is that they are regressive, that those who are poor pay a larger share of their disposable income on fuel and taxes. Sterner (2011) has empirically shown that this is not generally the case – in many developing and low-income countries, fuel taxes are *progressive* and a valuable source of revenue for the state. The progressivity depends on location, the design of the policy, and the type of fuels covered. In Europe, the distributional effects are basically neutral while studies in the US do actually display some regressivity (Metcalf 1999, Hassett et al. 2009). However, if the US government would take action and recycle the revenue from fuel taxation back to consumers, fuel taxation could be made progressive (West and Williams 2012, Sterner and Morris 2013).

3.3 Response 3: Cap and trade, and regulation.

In contrast to a tax, cap and trade (CAT) regulates the quantities of emissions, not the price – an advantage for a regulator who really wants to be assured of a given decline in emissions. The idea is that permits to emit CO_2 are created and allocated to industries, giving them the right to emit CO_2. They need a permit for every ton of CO_2 they emit. If they reduce their emissions they can sell their excess permits, while they would have to buy permits if their emissions are above the quantity of permits they own. Permits in a CAT programme are allocated either by auction, free allocation, or a mix of both approaches. With an auction, the government raises revenue just as with a tax, while there is clearly no revenue raised with free allocation. In the latter case the decision-maker must however decide on a mechanism for the free allocation. One of these is benchmarking that is roughly in proportion to output, and another is grandfathering based on historical emission levels. Each comes with some advantages and disadvantages.

The EU Emissions Trading Scheme (ETS) is the world's largest carbon CAT programme, covering roughly 45% of the EU's total GHG emissions (European Commission 2013). Estimates of the emission reductions achieved by the first (2005-2007) and second (2008-2012) phases of the programme, calculated relative to forecasts of emissions, have in general been modest (Ellerman et al. 2010, Anderson and Di Maria 2010, Georgiev 2011). In a recent paper, Bel and Joseph (2015) conclude that the main driver of decreasing emissions was the Global Crisis in 2008/2009 rather than the EU ETS. The effectiveness of the EU ETS is often considered to be compromised due to a lenient allocation of permits in the first two phases. It seems to have been politically difficult to put in place a tight cap on the programme. However, in its third phase the cap will be reduced by 1.74% annually. Hence we know that emissions will fall relative to historical levels. Currently, permit prices are still low – though those who defend CAT say that this is due largely to ancillary policies and external conditions.

Unfortunately, carbon CAT programmes have not been the success story many had hoped for. The caps have been set too high, and as a consequence the prices of permits have been too low to achieve sufficient reductions. One reason for this is heavy lobbying from the industry. Industry has also lobbied for grandfathering (IPCC 2014). Burtraw and Palmer (2008) calculate that if as little as 6% of the pollution permits in electricity generation are grandfathered and the rest are sold by auction, industry profits would be maintained. Allocating more than about 10% for free leads to windfall profits. CAT has been found to be regressive to a certain degree, but, at least in richer countries, poor people generally have their cost offset by social welfare programmes (Blonz et al. 2012).

Politicians are worried that a tight cap will hurt their industries. If they were to agree to a tight cap and the economy would boom, the big concern is that this would lead to rocket-high prices of permits. Such concerns lead to over-allocation because companies and politicians want to avoid very high prices. Many politicians do not trust CAT to work or they are concerned about agreeing on a cap that is too tight. Instead (or in addition), they implement other types of regulation such as renewable energy certificates to complement the policy and this in turn contributes to the low permit prices. Hence, unlike carbon taxes that can be complemented with other policies, CAT schemes cannot easily be complemented in this way.

In the US, attempts to introduce CAT have succeeded in some states, notably California, but at the federal level they have so far failed. The US is currently turning instead to fairly large-scale implementation of simple regulation in various areas related to climate change emissions.

An interesting and important question is how different national instruments such as cap and trade or carbon taxes will operate within international agreements. Up till today, most negotiations have focused on quantitative allocations or undertakings by different countries. This might be realised through a linking, for instance, of cap and trade schemes. The issues involved are however far from straightforward. It is difficult to link schemes without a full agreement on future targets (which is the most contentious part of the international negotiations).[5] There are therefore alternative suggestions about structuring international negotiations around agreed minimum prices (Nordhaus 2015, Weitzman 2014).

3.4 Response 4: Promoting renewable energy

Progress on effective policy instruments and on international treaties is thus in general poor. Both taxes and CAT are strongly resisted. Becoming carbon neutral is not only about reducing our carbon emissions. It is also (and perhaps more importantly) about creating new energy infrastructure made up of renewables such as solar, wind, and hydro.[6] Up till today, renewables have needed government support to be a viable option for households and industry, but the price gap between fossil and renewable energy is

5 See Green et al. (2014) or Stavins (2015) for different views of the pros and cons of linking CATs across jurisdictions.

6 See the chapter by Toman in this book for a more elaborate review of approaches to increase the use of renewables.

decreasing very quickly.[7] We believe this is a vital issue to discuss in combination with taxes because of the dynamic effect of relative prices between renewable energy and fossil fuels. When renewable energy becomes cheaper than fossil fuels the market takes over the transition. Since the price gap is now small, this can be induced by carbon taxes or subsidies on renewables – or a combination of both.

The political power in subsidising renewable energy in order to close the gap between fossils and renewables has been well demonstrated by Germany. For at least 15 years,[8] Germany has pursued energy transition (*Energiewende*), an initiative to facilitate the transition from nuclear- and coal-powered energy generation to renewable sources within the next four decades. Targets include reducing GHG emissions by 80-95% compared with 1990, increasing energy efficiency to reduce usage by 50%, and increasing the share of renewable sources in energy consumption to 80%. The transition focuses mainly on increasing solar and wind power as these sources are the most cost-efficient renewable technologies to date (Agora Energiwende 2013). Between 2000 and 2014, the share of renewable energy consumption increased from 6% to 27% (BDEW 2014).

So far, even though the use of renewables has increased dramatically, carbon emissions per kWh have not dropped very much. This is because Germany is trying to reduce carbon emissions and phase out nuclear power by 2022 simultaneously (Agora Energiwende 2014). A positive externality from the Energiewende is a lower cost of renewables for the rest of the world through know-how and technological innovation. However, the initial levels of the feed-in tariff implemented in 2000 guaranteed 20 years of fixed and very high prices for solar and wind producers, and people rushed to install solar panels and expand wind farms. This caused the desired expansion in

7 According to Bloomberg New Energy Finance (2014), the average global cost of solar PV electricity has fallen by more than 50% in the past five years, while the cost of wind power has fallen by about 15% in the same time period. The cost of electricity generation from coal and natural gas has not changed significantly during this period. The estimated global cost of electricity generation from wind power is close to that of coal power, while the cost of natural gas generation is still lower than both wind power and coal. The cost of solar PV electricity is currently roughly twice as that of natural gas. However, that will change if the trend of rapidly falling system costs continues. Note that electricity generation costs vary widely locally.

8 The *Erneuerbare-Energien-Gesetz* (Renewable Energy Sources Act or EEG) was adopted in 2000.

supply of electricity, but the subsidy became more expensive as supply increased. The tariffs have been lowered considerably but the cost (shared amongst all households) is still quite substantial. Early investors were able to guarantee a very good return on their investment.

The *Energiewende* technology policies have been very successful in increasing supply and bringing down the price of renewables. This has shifted the balance of power among lobbies, weakening the fossil lobby and strengthening the green lobbies and thereby making other policies such as carbon taxes more likely. There are, however, difficulties when transitioning to renewable energy sources at a national level – solar and wind are intermittent, and energy in general is expensive to store. These are challenges that a renewable energy system has to address and this is going to require considerable modifications of the traditional utility business model, including incentives for storage, transmission, and time-of-day pricing to help steer demand.

4 Lesson learned – now what?

When carbon taxes felt politically out of reach, policymakers decided to opt for cap and trade – to set a quantity of emissions rather than a price. What we have learned, however, is that it is as difficult to negotiate a quantity as it is a price. With a quantity it is more apparent who are the 'winners' and 'losers' in a negotiation. Previous negotiations have come to a standstill because of distribution and fairness aspects. In the global context, large countries such as India will benefit if quantities are allocated on a per capita basis, whereas countries with large historical emissions such as the US will benefit from grandfathering.

To facilitate the negotiation process in Paris, there are, as mentioned above, academics who argue that the focus should shift towards prices rather than quantities. A variety of reasons are mentioned, for instance to make the treaty and its implementation more incentive compatible (Nordhaus 2015) or because it is easier to negotiate just one number rather than a quantity (Weitzman 2014). When discussing quantities, it is not apparent what the related cost would be for industry, while a price is, in this sense, more transparent. It is possible that the future regime and negotiations will include many instruments (possibly for different parts of the climate change complex – different sectors, gases, etc). The aim of the negotiations might include not only quantitative commitments but also a price floor – or possibly a tax per tonne of carbon. Countries will then be free to opt for just the minimum level or – a higher level as in the case of Sweden – to raise the bar and encourage consumers to become energy efficient and industry to invest in research and development of new technology. The price floor would increase the global efficiency of carbon mitigation and reduce the risk of leakage and pollution havens, while at the same time the market would receive a clear signal to invest in renewable energy technology and emission abatement.

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