DOI: 10.1007/s10272-018-0735-6

End of previous Forum article

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Shifting Paradigms in Carbon Pricing

Carbon pricing is essential to achieve a reduction in global CO_2 emissions. A carbon price can either be set directly via a carbon tax (price control) or be achieved through a cap-and-trade system (quantity control).[1] While there has been much debate about the relative merits of each approach, cap-and-trade systems have been favoured in the political arena.[2] In principle, they offer the most straightforward way to achieve a country's emission reduction target by simply setting the cap at the remaining emission budget. Existing emissions trading schemes (ETSs) can be found in Europe, California and Québec, for example.[3]

The simple textbook theory of emission trading schemes is characterised by what we call "the old paradigm of carbon pricing". In a nutshell, the old paradigm of carbon pricing rests on two main pillars:

1. Emissions trading is the most cost-efficient instrument to achieve a certain emission target.

   Under an ETS, each firm will abate emissions up to the level at which the associated cost of abating a further unit equals the price of the emission permit. This minimises abatement costs, as emissions will be reduced for those firms with the lowest marginal abatement costs.

2. Under an ETS, no additional emission reduction policies are needed.

   If internalising the emissions externality is the sole aim of policymaking and the cap of the trading scheme is

1 A.C. Pigou: The economics of welfare, Basingstoke 2013, Palgrave Macmillan; and W.J. Baumol, W.E. Oates: The Theory of Environmental Policy, Cambridge 1988, Cambridge University Press.

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2 N.O. Keohane: Cap and trade, rehabilitated: Using tradable permits to control US greenhouse gases, in: Review of Environmental Economics and Policy, Vol. 3, No. 1, 2009, pp. 42-62; R.N. Stavins: Addressing climate change with a comprehensive US cap-and-trade system, Hamilton Project Discussion Paper, Brookings Institution, 2007; G.E. Metcalf: A proposal for a US carbon tax swap, Hamilton Project Working Paper, Brookings Institution, 2007.

3 For an overview, see the expanded version of this paper: B. Knopf, K. Burghaus, C. Flachsland, M. Jakob, N. Koch, O. Edenhofer: Shifting Paradigms in Carbon Pricing – long version, 2018, available at http://www.oecd.org/naec/paradigm.htm.

chosen so as to internalise the pollution externality, the price sets the correct incentives for the decarbonisation of the economy. No additional emission reduction policies are necessary. Under a fixed cap, such policies would be ineffective anyway, as they would simply shift emissions in space and time (referred to as the "waterbed effect") and dampen the allowance price.[4] Simply adjusting the cap downwards or eliminating allowances can enhance environmental stringency.

Our characterisation of the old paradigm deliberately emphasises a number of challenges emerging from real-world experience with ETSs, which are not adequately addressed by the textbook theory of emissions trading. Driven by new scientific insights, the old paradigm has experienced a substantial transformation in recent years. Modern environmental economics has developed a rich and nuanced body of knowledge surrounding effective carbon pricing. However, this is sometimes ignored in the policy debate. Therefore, it is important to show how new approaches can deal with the challenges in order to reap the full potential of ETSs.

This paper identifies important challenges to the old paradigm. It then reviews recent developments in the academic literature as well as their practical implementation. Finally, by highlighting how carbon pricing needs to be embedded into the bigger picture of economic transformation and public finance, it offers direction for future debates.

Problems and challenges of the old paradigm

Existing ETSs do not operate under textbook conditions. In many markets, prices for the emission of greenhouse gases (GHG) have been far below the levels anticipated in the initial programme design.[5] In the European Union Emissions Trading System (EU ETS) – the first and, to date, the largest market for GHG emissions – the carbon price has been stuck at around €5/tCO_2 for about four consecutive years, despite the recent substantial surge.[6]

Low prices are problematic when they result from systematic market or regulatory failures that preclude an ETS from working efficiently. The price signal is then distorted. It can no longer ensure that long-term reduction targets (set by the cap) are achieved at the lowest cost to society, because it fails to optimally incentivise mitigation efforts, investments and R&D over time.

There are two potential distortions inherent in an ETS that are largely overlooked by the classic old paradigm. First, market participants may systematically have insufficient regard for long-term strategies, i.e. myopia.[7] The unwillingness or inability of market participants to consider the long term leads to carbon prices that tend to be determined by short-term conditions, with no regard for the expected future costs of compliance. When allowances are relatively abundant in the present compared to the future, myopia will induce prices that are too low to be dynamically cost-effective.

Second, there might be distortions from systematic regulatory uncertainty in the government-created ETS market.[8] In fact, the scarcity of emission permits in an ETS is not determined by the market, but by political decisions concerning the stringency of the cap. Any policy announcement that provides additional information on the overall stringency of the cap can trigger sharp price jumps, irrespective of whether the contemplated cap change actually happens. Thus, mere speculation about the political commitment to the envisaged long-term cap can become a decisive factor in determining the ETS price. If concerns about a relaxation of the cap in the future (or the long-run survival of the programme in general) are prevalent, current prices in the EU ETS are likely to be lower than their cost-efficient benchmark.

The distortions due to myopia and regulatory uncertainty are not mutually exclusive. For instance, substantial regulatory uncertainty is likely to encourage market participants to focus on the short term and to discount the long term. The key threat of such mutually reinforcing distortions is that the resulting price, for example, in the EU ETS, might remain very low for several years and possibly even decades. Such a situation is very likely to lead to a lock-in of carbon-intensive infrastructure such as coal-fired power plants. To realise the envisaged long-term cap, EU ETS prices in the mid-to-long term must rise rapidly to bring about sufficient abatement, albeit at signifi-

4 D. Burtraw, C. Holt, K. Palmer, A. Paul, W. Shobe: Expanding the Toolkit: The Potential Role for an Emissions Containment Reserve in RGGI, RFF Report, Resources for the Future, 2017.

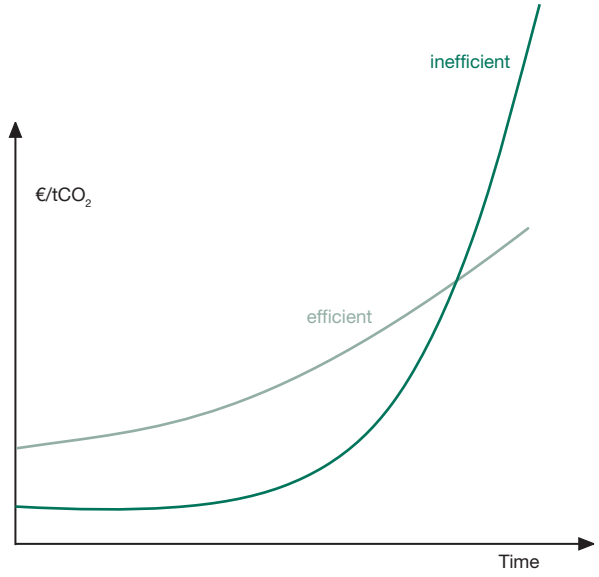
5 W. Acworth, J. Ackva, D. Burtraw, O. Edenhofer, S. Fuss, C. Flachsland, C. Haug, N. Koch, U. Kornek, B. Knopf, M. Montes de Oca: Emissions Trading and the Role of a Long-run Carbon Price Signal: Achieving Cost-effective Emission Reductions under an Emissions Trading System, ICAP, 2017.

6 S. Fuss, C. Flachsland, N. Koch, U. Kornek, B. Knopf, O. Edenhofer: An assessment framework for intertemporal economic performance of cap-and-trade systems: lessons from the EU-ETS, in: Review of Environmental Economics and Policy, forthcoming.

7 S. Kollenberg, L. Taschini: The European Union Emissions Trading System and the Market Stability Reserve: Optimal Dynamic Supply Adjustment, CESifo Working Paper No. 5380, 2015.

8 S. Salant: What Ails the European Union's Emissions Trading System?, in: Journal of Environmental Economics and Management, Vol. 80, 2016, pp. 6-19.

Figure 1
Stylised illustration of two EU emission allowance price paths



Source: O. Edenhofer, C. Flachsland, C. Wolff, L.K. Schmid, A. Leipprand, N. Koch, U. Kornek, M. Pahle: Decarbonization and EU ETS Reform: Introducing a price floor to drive low-carbon investments, MCC Policy Paper, 2017.

cantly higher social costs (see the dark green "inefficient" ETS price curve in Figure 1). It is questionable whether such a steep price increase would be politically tenable, and consequently, it might eventually lead to a relaxation of the cap in order to alleviate the economic burden. This would ultimately threaten not only the credibility of the policy scheme but the achievement of climate targets in general. Regulated firms may bet on such a self-fulfilling prophecy, which would create a morally hazardous situation.

Tangible empirical evidence suggests that regulatory events associated with potential cap adjustments can explain the precipitous downward price jumps in the EU ETS that cannot be explained by the classic old paradigm.[9] This new research suggests that confidence in political support for the emission trading programme is critical to price formation in real-world ETS markets. Economic agents' short-sightedness is difficult to assess. Looking at power companies, their hedging suggests maximum planning horizons of five to six years. Similarly, futures markets in the EU ETS are only available through the early 2020s. Altogether, anecdotal observations indicate that – concurrent with observations in other sectors in the economy – the planning horizons of market participants are much shorter than in the old paradigm.[10] This type of behaviour also applies to financially constrained households.[11]

Additional policies necessary?

Although any supplemental policy measures are, from a theoretical point of view, ineffective in achieving further emissions reductions, members of existing ETSs use a variety of additional instruments. One main reason for this is their heterogeneous preferences.[12] In a multilateral setting, countries with a higher willingness to pay for climate policy may try to achieve greater emission reductions through additional policy measures. For instance, within the EU ETS, the UK has introduced the Climate Change Levy, establishing a carbon price support rate for EU emissions allowances which functions as a national price floor with a current level of £18/tCO_2.[13] Sweden established a general carbon tax in 1991 (though it made exemptions for some sectors after the implementation of the EU ETS).[14]

The old paradigm is not wrong in questioning the effectiveness of such additional policy measures. However, it does not provide a satisfactory solution to the problem of how to reconcile heterogeneous preferences.

There seems to be a certain perception that heterogeneity among ETS members can be addressed through interstate transfers. For instance, in the EU ETS, a large share of auction revenues are distributed directly to member states according to a fixed grandfathering rule. Further transfer rules additionally modify this basic distributional choice, e.g. the so-called Kyoto bonus and the Solidarity and Growth transfer. Eastern European member states, in particular, benefit from these additional transfers (see Figure 2). These are states that were not yet members of the EU when the ETS was negotiated and whose energy infrastructure is predominantly outdated (inter alia older, less-efficient plants and a higher dependence on coal). New research

9 N. Koch, G. Grosjean, S. Fuss, O. Edenhofer: Politics matters: Regulatory events as catalysts for price formation under cap-and-trade, in: Journal of Environmental Economics and Management, Vol. 78, 2016, pp. 121-139.

10 S. Fuss et al., op. cit.

11 B. Baugh, I. Ben-David, H. Park: Disentangling financial constraints, precautionary savings, and myopia: household behavior surrounding federal tax returns, NBER Working Paper No. 19783, 2014.

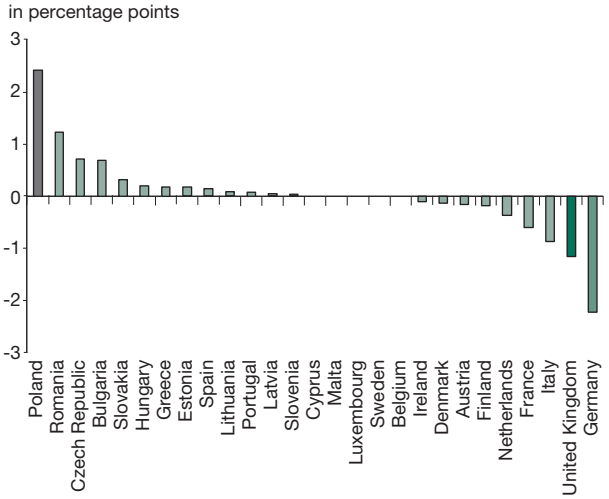
12 Another reason would be additional market failures; see B. Knopf et al., op. cit.

13 HM Revenue & Customs: Carbon Price Floor: Reform and Other Technical Amendments, Policy Paper, 2014, available at https://www.gov.uk/government/publications/carbon-price-floor-reform.

14 OECD: Sweden. Highlights 2014, Environmental Performance Reviews, 2014, available at http://www.oecd.org/env/country-reviews/highlights.htm.

Figure 2

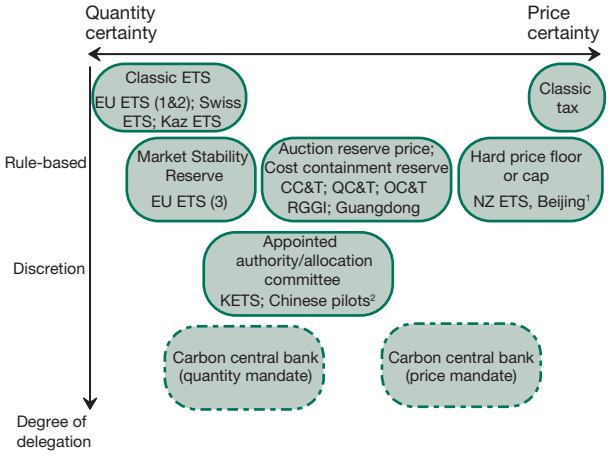
Change in EU ETS members' shares due to Solidarity and Growth transfers



Source: M. Dorsch, U. Kornek, C. Flachsland: Enhancing Climate Policy Ambition Using Strategic Transfers: Allowance Allocation and Revenue Spending in the EU, ETS, Working Paper, 2018.

Figure 3

ETS governance space – an empirical mapping of tools to adjust the allowance market



Notes: A box with a solid line denotes a governance model that has been implemented. A box with a dotted line represents one that has been proposed. [1] As the government is not required to maintain the price floor, this is not a strict hard price floor. [2] The regional ETSs in China are pilot programmes with the main aim of testing options for the national system.

Sources: W. Acworth, J. Ackva, D. Burtraw, O. Edenhofer, S. Fuss, C. Flachsland, C. Haug, N. Koch, U. Kornek, B. Knopf, M. Montes de Oca: Emissions Trading and the Role of a Long-run Carbon Price Signal: Achieving Cost-effective Emission Reductions under an Emissions Trading System, ICAP 2017; G. Grosjean, W. Acworth, C. Flachsland, R. Marschinski: After Monetary Policy, Climate Policy: Is Delegation Key to EU ETS Reform?, in: Climate Policy, Vol. 16, No. 1, 2016, pp. 1-25.

suggests, however, that transfers may be insufficient. First, current transfers in the EU ETS are not large enough and would probably need to be higher than is currently politically feasible to compensate income differences between member states. Second, even sizable interstate transfers are insufficient if heterogeneous preferences for emissions reduction, rather than, or in addition to, heterogeneous income levels, affect a member state's willingness to pay for climate policy.[15]

Advanced climate economics: addressing ETS efficiency failures

There are a range of options identified in a recent report by the International Carbon Action Partnership that can be, and have been, implemented to combat the market and regulatory imperfections identified above.[16] Of the 18 emission trading schemes operating today, most systems have diverted from the ETS textbook model and include a mechanism to add price stability to the allowance market.[17] This can at least partly be seen as a response to potential systematic distortions. Most notably, newer ETSs directly protect themselves against price drops that have plagued the EU's pioneering market.

The theoretical set of implementation options to enhance regulatory credibility and reduce uncertainty can be mapped in a two-dimensional ETS governance space (see Figure 3).[18] The horizontal dimension represents the extent to which an ETS design option targets the allowance quantities or prices. At one end of the spectrum is a pure ETS where prices have no limits and the quantity of allowances is fixed. At the other end is a carbon tax with a fixed price but uncertain emission reductions. In between are many different hybrid options – for example, ETSs containing price floors, corridors or cost containment reserves. The vertical dimension refers to the degree to which institutions are involved in adjusting the market and the extent to which governance of the ETS has been delegated by the government. In a textbook ETS market, there is no delegation of governance; the

15 O. Edenhofer, C. Roolfs, B. Gaitan, P. Nahmacher, C. Flachsland: Agreeing on an EU ETS minimum price to foster solidarity, subsidiarity and efficiency in the EU, in: I. Parry, K. Pittel, H. Vollebergh (eds.): Energy Tax and Regulatory Policy in Europe: Reform Priorities, Cambridge MA 2017, MIT Press.

16 This section draws on W. Acworth et al., op. cit.

17 A. Eden, C. Unger, W. Acworth, K. Wilkening, C. Haug: Benefits of Emissions Trading – Taking Stock of the Impacts of Emissions Trading Systems Worldwide, ICAP, 2016.

18 G. Grosjean, W. Acworth, C. Flachsland, R. Marschinski: After Monetary Policy, Climate Policy: Is Delegation Key to EU ETS Reform?, in: Climate Policy, Vol. 16, No. 1, 2016, pp. 1-25.

government (legislative or executive, depending on the jurisdiction and the nature of the change) implements changes directly. However, the market could also be partially adjusted automatically via a rule-based mechanism or by an independent body.

Hybrid price-based control options allow the maintenance of ETS prices within a pre-determined range. By doing so, they seek to combine the benefits of a pure ETS with those of a pure carbon tax. To respond to low prices, setting a minimum (floor) price is a common feature of the ETSs operating in North America (California, Québec, Ontario and RGGI) and has also been used in Chinese pilot programmes (e.g. Guangdong). The floor price in these ETSs is implemented within the allowance auctioning system as an auction reserve price, i.e. the allowances in the auction are only released when the auction price is above a pre-specified minimum level.

A carbon price floor would address the problem of shortsightedness if the price path set by regulation is in line with social preferences, i.e. higher in the short term (and lower in the long term) than at present. A carbon price floor also reduces regulatory uncertainty by introducing a much clearer short-term signal of the commitment of regulators to actually implement the announced long-term cap, and to avoid the "hockey stick" price curve scenario outlined above. With a clear price trajectory set by regulators, individual investment projects will face less uncertainty in their internal investment planning, e.g. when applying for bank loans. However, a carbon price floor would also very likely be subject to regulatory changes. There must be clear rules for revising carbon floor rates based on transparent assessments by dedicated expert bodies.[19]

Some ETSs have also defined an upper ETS price limit. This can enhance regulatory stability by avoiding excessive costs, as these could threaten the continuation of an ETS. The most common mechanism is a cost containment reserve (RGGI, California, Québec and Ontario), which releases a limited number of additional allowances from a reserve into the market when certain trigger prices are reached; once the reserve is empty, however, prices can rise above the set limit. Others (New Zealand ETS) operate with a hard price cap that guarantees the upper price level by releasing an unlimited number of allowances at a set price. Lower and upper price controls can also be combined (price collar), as is done in the North American systems (California, Québec, Ontario and RGGI).

Quantity-based control measures automatically add or subtract allowances from the market according to predefined triggers based on the quantity of allowances in circulation to indirectly affect price formation. In the EU ETS, this Market Stability Reserve (MSR) will be implemented in 2019. In the absence of market imperfections, participants would anticipate temporary allowance removal and react accordingly, which would prevent them from having any effect. If short-termism is dominating the ETS market, however, the MSR could cause prices to increase. Inversely, if regulatory uncertainty is at the heart of the persistently low ETS price, the MSR would not make a difference. Indeed, it may even intensify the problem due to the uncertainty over the re-release of allowances from the reserve.

Finally, some jurisdictions have delegated control of the ETS to an independent authority or executive committee (Korea, some Chinese pilot programmes). The relative independence of such a body is meant to shield it from political pressure and should enable it to build a reputation for announcing and enacting its policy on the basis of a clear and transparent framework. This is intended to reduce regulatory uncertainty and enhance confidence that the independent regulator will meet long-term goals.

Coping with heterogeneous preferences

We have already discussed how domestic policy instruments for emissions reduction within an ETS may undermine the effectiveness and performance of the system.

For additional national policies to result in actual emission reductions within an international ETS, permits would have to be withdrawn from the trading system. This would result in substantial additional costs and has the potential to generate conflicts among member states. For instance, France can be expected to support higher prices for emission permits, as this would increase the profitability of the nuclear power fleet operated by the state-owned power company EDF. Poland, on the other hand, would more likely oppose them, due to the negative effects on domestic coal-fired power plants and the consumers and industries reliant on them.

Introducing a minimum price within the EU ETS would be a solution to tackle the problem of member states with heterogeneous preferences wanting to implement domestic policies. With such a price floor, the unilateral measures could actually contribute to an overall emissions reduction at the EU level: Whenever the EU ETS operates at the

19 S. Brunner, C. Flachsland, R. Marschinski: Credible Commitment in Carbon Policy, in: Climate Policy, Vol. 12, No. 2, 2012, pp. 255-271; M. Jakob, S. Brunner: Optimal Commitment Under Uncertainty: Adjustment Rules for Climate Policy, in: Strategic Behavior and the Environment, Vol. 4, No. 3, 2014, pp. 291-310.

floor price (but only then), every national tax, renewable supporting scheme or efficiency standard would lead to additional abatement. The unilateral policies would be environmentally effective. A floor price would thereby allow national preferences such as high ambitions for mitigation to be addressed without undermining the environmental effectiveness of additional policies. The floor price would guarantee that a stable and sufficiently high allowance price would be delivered. The heterogeneous distribution of willingness-to-pay between richer and poorer countries that implement a joint or minimum price could then be addressed via transfer payments or through the initial allocation of emission permits.[20]

20 O. Edenhofer, C. Roolfs et al., op. cit.

Conclusion

The first pillar of the old paradigm of carbon pricing is the assumption that an emissions trading scheme is the most cost-efficient way to achieve a certain emission reduction target. However, it has become obvious that the old paradigm is unable to solve a number of challenges, e.g. market participants' myopia. The second pillar of the paradigm rests on the assumption that under an ETS, no additional emission reduction policies are needed. However, in practice, national emission reduction policies coexist within a supra-national ETS due to the heterogeneous preferences of member states with regard to their level of ambition on climate policy. In order to be effective, ETSs should be complemented by price-based control measures, such as a floor price, leading to a hybrid system with elements of both emissions trading and tax systems.