A literature-based assessment of the EU ETS

Executive summary

Introduction

This report on the EU Emissions Trading System (EU ETS) is a deliverable of the LIFE SIDE project (www.lifesideproject.eu) undertaken by the Florence School of Regulation – Climate between September 2016 and December 2018. The ultimate goal of LIFE SIDE is to support policymakers in the implementation and development of the EU ETS. The report has served the policy dialogue that LIFE SIDE has contributed to fostering (and benefited from in turn) and ithas been used in two training courses for policymakers held under the same project.

The report has a few intended features. First, it focuses on four topic areas selected (upon exchange with the Expert Group overseeing the project) in consideration of their relevance in the policy debate. The topic areas are: 1) Free allowance allocation, competitiveness effects and carbon leakage; 2) Interactions with other policies; 3) Low-carbon innovation and investment; and 4) The international dimension. The final chapter of the report is devoted to a broader evaluation of the EU ETSaccording to the core set of criteria recommended by the European Commission for evaluating EU policy action: relevance, effectiveness, efficiency, coherence, and EU added value. Second, the report draws as much as possible on empirical literature, as opposed to theoretical or ex-ante analyses. Third, the report is accessible to a non-specialist readership. Thus, both information on the relevant legislation and references to economic theory are provided to assist the reader in understanding the resultsand considerations presented.

The main findings of the report are summarised below. They are organised following the order of the chapters.

Free allowance allocation

Compared to the previous trading periods, the allocation rules adopted forPhase III (2013-2020) represent a quantum leapwith respect toboth economic efficiency and equity.Auctioning has become

the default allocation method for the electricity sector and, in general, free allocation is now limited to about 45% of all allowances. Free allocation itselfhas significantly improved with respect to economic efficiency thanks tothe centralisation of the system, whereby discretion in allocation decisions is minimised, and the application of emission efficiency benchmarks.These alone, it has been estimated, reduced the total quantity of free allowances by about 20% relative to Phase II (2008-2012).

Nevertheless, theliterature shows that the rule used for identifying the sectors at risk of carbon leakage, within which installations receive 100% of benchmarked emissions,is too lenient.That is, it results in too many sectors being classified as being at risk of carbon leakage, some of which are in fact most likely not at risk. This result is mainly explained by*a)*an obsolete assumptionabout future carbon prices and *b)*trade intensity,as an indicator of exposure to international competition,being considered on its own independentof carbon intensity.Moreover, free allocation should be calibrated to better account for firms' ability to pass through the costs of regulation. Indeed, the literature shows that significant levels of cost pass-through also characterise some manufacturing sectors, not only the electricity sector. The EU-wide trade intensity indicator is an imperfect proxy for cost pass-through (in)ability, which heavily depends on product- and location-specific characteristics of the market.

Free allocation in the EU ETSalso presents featureswhich canaffect the dynamic efficiency of the system(i.e., its long-term cost effectiveness), though very few analysesprovide relevant empirical evidence.One study showsthatclosure provisions, whereby installations exiting the system forfeit their allowance endowments,most likely delayed installation exits in the first two trading periods. With reference to Phase III, a second study shows that allocation adjustments based on activity level thresholds, whereby allowance allocations are reduced after major output reductions, induced greater production.In the case of the cementsector (the only sector analysed),they resulted in lower emission efficiency.

As far as equity is concerned, free allocation has implications for distributional effects between countries, between and within industries, as well as between producers and consumers. The centralisation of the systemgreatly reduced the potential for distortions in the European market, though free allocation based on EU-wide parameters entails some heterogeneity in effective safeguards across countries. Further distributional effects have been offset through special provisions benefiting lower-income member states, including the redistribution of 12% of all allowances to be auctioned, the continuation of free allocation for the electricity sector and, as of Phase IV (2021-2030), the Modernisation Fund. The question of cost pass-through is relevant to equity too. Windfall profitsentail wealth transfers from consumers to producers. Moreover, while free allocation is substantially less generous for the manufacturing sectors off the carbon leakage list, no further differentiation is made among them. Thus, differences in cost pass-through not consideredby legislation may determine distributional effects across sectors.

The new or amended free allocation rules defined in the reform for Phase IV can be expected to further improve the efficiency of the allocation system. Carbon leakage risk will be assessed more accurately thanks to: a) carbon intensity and trade intensity considered together through a combined indicator; b) possible use of more disaggregated data, and c) possible consideration of complementary qualitative assessments of abatement potential, market characteristics and profit margins. Moreover, allocations will adjust for output variations exceeding +/-15%.

Competitiveness effects and carbon leakage

The empirical literature on competitiveness effects of the EU ETS and related carbon leakage is wide and growing. Yet, only two studies were found directly testing for carbon leakage; that is, testing for whether emissions increased outside the EU as a consequence of the EU ETS.Within the literature, two main sets of workshave been identified. The first considers a range of conventional indicators measuring economic outcomes linked to competitiveness, such as profits, exports, sales, employment and productivity. The second looks at the stock market to infer whether investors believe the EU ETS is beneficial or detrimental to profits. The two bodies of literature complement each other nicely.

By far, the most frequently encountered conclusion is that no evidence was found of negative effectson firms' competitiveness or of carbon leakage. Moderate to very low carbon prices provide the firstexplanation for this outcome. However, the role of generous free allocation, especially considering firms' ability to pass through opportunity costs of emission allowances, is not less important. A few studies find negative effects, but most of these are either characterised by uncertainty greater than ideal (being statistically different from zero only "at the 10% level") or are accompanied by words of caution due to specific data or methodological issues. At any rate, two studies prompt a warning that deserves attention.For Italy and Germany, they find FDI activity to be higher in the regulated sectors more exposed to international competition and less capital intensive. Positive effects are more frequently found, but they are usually explained by windfall profits rather than by increased productivity. Indeed, it remains unclear whether the EU ETS made firms in any sector or subsector more competitive through innovation orenergy efficiency improvements. By contrast, some of the studies analysing stock returns are particularly effective in showing that the combination of free allocation and the pass-through of opportunity costs resulted in profit increases. They do so through comparisons of estimated effects: *a)* between regulated and non-regulated sectors; *b)* between dirtier and cleaner producers within the electricity sector; and *c)* across the first two trading periods and Phase III.

The conclusions that can be drawn from this literature present three orders of limitations. First, most empirical analyses still only refer to Phases I (2005-2007) and II. This delay can be relevant considering all the changes that have taken place with Phase III. Second, estimates of sector-specific effects are relatively few. Sector-specific estimates are particularly valuable because they are better

suited to inform policy. Third, with few exceptions, existing estimates of competitiveness effects refer to short-term effects. Yet, the most relevant economic losses that unilateral carbon pricing might cause would unfold over the long term.

Interactions with other policies

The empirical literature analysing the interactions between the EU ETS and other policies is not wide. Within this literature, the subset extending beyond the electricity sector is particularly scant. Each of the empirical studies found focuses on one of the following questions: *a)* How much abatement was due to complementary policies rather than to the EU ETS?; *b)* What was the abatement cost of complementary policies?; and *c)* What was the impact of complementary policies on carbon prices?

Concerning the first research question, the findings of different studies are remarkably consistent with each other. They show that much greater proportions of emission reductionswere due to renewable energy(RES) and energy efficiency (EE) policies rather than to the EU ETS. Of course, differences in the amount of abatement vary depending on the magnitude of investmentsin the given country, and on whether only the electricity sector or all regulated sectors are considered. In any case, effectiveness in reducing emissions does not imply cost effectiveness. Here, the relevant studies agree in showing that abating emissions through RES deployment (specifically, electricity from renewables) was generally expensive and most likely costlier than would have been the case using the EU ETS alone. Yet, RES and EEpolicies can be considered as serving multiple objectives and, if so, the comparison of their abatement costs with the level of carbon prices is simplistic. Moreover, these policies are intended to address market failures, butthe benefits that they provide are difficult to quantify. As to the third research question above, only one study has taken it up. The authors find that variables related to marginal abatement cost theory, including electricity generationfrom renewables, explain only a small proportion of monthly variations in carbon prices. However, given the relatively high frequency of the data used, the long-termrelationshipslinking carbon prices to fundamentals remain untestedin quantitative terms.

The efforts of the EU to implement a mix of instruments that efficiently serves the objectives of climate and energy policies are clearly visible. With reference to the EU ETS, the Market Stability Reserve (MSR)tackles the side effect that other policies and, for that matter any relevant external factor, may have on the dynamic efficiency of the system. By introducing some flexibility into the supply of emission allowances, the MSR is expected to shelter the EU ETS from negative demand shocks and, thus, to prevent overly low carbon prices. Different views exist as to whether the MSR will be effective or whether it is the best possible approach in the first place. For the time being, the MSR's combination of a rule-based mechanism and the periodic revision of its parameters seems an appropriate solution considering the changing environment external to the EU ETS.

Low-carbon innovation and investment

The empirical literature on the effects of the EU ETS on low-carbon innovation and investment is significant in sizebut fails to offer a full picture of the state of things. Not a single ex-post analysis exists that comes up to the beginning of Phase III. This is regrettable because major regulatory changes, likely to benefit the system's dynamic efficiency, were introduced with the third trading period: notably, the switch from grandfathering to auctioning in the electricity sector and the application of emission efficiency benchmarks. Moreover, the number of econometric studies is particularly small. While both econometric and non-econometric analyses are needed, the relevance of the results in terms of statistical significance is only clear for the former. The shortage of suitable and accessible databases is the main reason for the scarcity of econometric contributions in this field.

Nevertheless, some conclusions can be drawn based on the literature on Phases I and II:

A) While the EU ETS alone did not stimulate major low-carbon investments, it did stimulate investments typically described as small-scale with short amortization times (e.g., three to five years), resulting in incremental emission reductions.

B) One prominent econometric study finds that the EU ETS brought about a substantial increase in the number of low-carbon patents filed by regulated firms. Patent counts as a measure of innovation output are not exempt from limitations, however.

C) In Europe, the observed surge in the total number of low-carbon patenting was primarily driven by rising energy prices. Similarly, energy prices were much more important determinants of decisions on low-carbon investment than carbon prices.

D) Heterogeneity in the propensity to innovate is significant across sectors and countries. However, evidence is scattered and there is not anything like a comprehensive mapping of low-carbon investments across Europe.

E) Low-carbon innovation efforts have focused on production processes much more than on products.

F) Free allocation appears to have hampered low-carbon investments. The main explanation relates to firms failing to recognise the opportunity cost of using free allowances for compliance. Moreover, an issue that largely concerned the electricity sector in the first two trading periods: new-entrant provisions could affect investment decisions by altering the economic ranking of possible investments in alternative technologies.

G) The EU ETS was generally internalised by firms and it successfully induced organisational innovations.

H) Credible long-term emission reduction targets are important triggers for low-carbon investment because they reduce regulatory uncertainty.

Some of the provisions in the recent reform for Phase IV and the MSR address full on the weaknesses of the EU ETS most relevant to dynamic efficiency. Whether these measures will prove effective is difficult to tell.A well-established view in environmental innovation studies, however,

does not seem to find sufficient space in the EU's climate and energy strategy. This view is that support to R&D should be strong and complementary to market-based instruments. There is a compelling economic case for complementing the EU ETS with stronger R&D policies.

The international dimension

The international dimension of an emissions trading system (ETS) pertains to the capacity of its regulation to produce economic or environmental effects overseas, whether through a formal linkage with other climate policies abroad or without. Since its inception, the EU ETS has exerted significant influence on the outside world. Under the Kyoto Protocol's (KP) regime, the recognition for compliance purposes of international emission credits generated by the Clean Development Mechanism (CDM) and the Joint Implementation (JI) was the most important initiative. The results of this experience have been mixed. On the one hand, the linkage to the Kyoto Flexible Mechanisms has extended the carbon price signal to countries and sectors not covered by the EU ETS. On the other, the inflow of international credits negatively affected the EU ETS, both through the dubious nature of the projects underlying some credits and by putting further downward pressure on already low carbon prices. The incorporation of Norway, Iceland and Liechtenstein (EFTA countries) is the second relevant experience in the early years of the EU ETS.

After Phase I (2005-2007), just as the EU ETS was emerging as a reference for similar systems, international negotiations for an agreement on the post-2020 climate change regime came to a standstill. The UNFCCC COP15 in Copenhagen (2009) marked the end of all hopes for a Kyoto-type regime extended to developing countries, but it was also the start of a process that led to the Paris Agreement (PA) six years later. After COP15, despite the difficulties of the international negotiations, the EU did not give up its ambition to be a leader in the fight against climate change and to strengthen the international carbon market through the EU ETS. It first conceived a project for an OECD-wide carbon market, which was not pursued after the proposal for a national ETS was rejected by the US Senate. Then, bilateral negotiations were engaged with Australia and Switzerland to link the EU ETS with the ETSs of those countries. The first linkage eventually did not happen because the new Australian government was opposed to it. The one with Switzerland is currently awaiting the final vote of the two parliaments. In the meantime, the EU has also contributed to international carbon market cooperation by providing capacity building programmes for setting up and managing domestic ETSs. Looking ahead, the PA's regime is radically different from that of the KP, also in ways that have important implications for the international dimension of the EU ETS. First, as many more are the countries that will need to implement policies for meeting their mitigation commitments, the PA multiplies the number of future opportunities for integration with other ETSs. Second, to achieve the

goal of climate stabilisation, the PA rests on international cooperation mechanisms, which to a large extent involves the integration of carbon markets.

So far, the small number of experiences with carbon market integration explains the scarcity of empirical studies that can be considered for assessing the international dimension of the EU ETS in quantitative terms. The only works found relate to the recognition of the CDM and JI emission credits. They mainly look at: the use of international credits by regulated firms; the savings and profits realised by the same; and the relationship between their prices and those of the emission allowances. This literature as well is rather scant, however, also because the use of international credits in Phase III (2013-2020) was strongly restricted. As concerns theoretical studies (not specific to the EU ETS), the wide literature on the linking of carbon markets is being sided by an emerging one focused on integration processes, rather than on their outcomes. Indeed, further learning is needed to facilitate the steps of streamlined carbon integration processes and their governance.

A multi-criteria evaluation of the EU ETS

The relevance criterion for policy evaluation refers to the correspondence between the objective of a policy and the needs of society. No doubt the EU ETS is relevant in this sense. The objective of the EU ETS is "to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner". The magnitude of emission reductions ensured by the EU ETS is sizeable given the scope and the long-term trajectory of its cap.This is consistent withthescientific consensus on the necessity ofreducing and eventually eliminating anthropogenic GHG emissions.As is generally true for any policy, economic efficiency is a principle expected to inform climate policies. Moreover, uncertainty about the exact entity and timing of the damages from climate change calls for precautionary policy approaches: by predetermining maximum emission levels, the EU ETS abides by this principle.

The effectiveness criterion refers to the success of a policy in meeting its objective. The mission of the EU ETS is to reduce emissions and to do so efficiently. Over the long term, efficiency entails low-carbon innovation and investment. The literature indicates that the EU ETS has contributed to emission reductions.However, there is no exhaustive or even highly consistent evidence on the magnitude of emission reductions attributed to the system.Firstly, econometric estimates of emission abatement are limited to Phases I and II.Secondly, while EU-wide applications tend to find emission reductions in the order of 2%-3% (of business-as-usual emissions), a few country-specific studies findreductions in the order of 15%-25%. Importantly, there is as yet no evidence of carbon leakage.As far as low-carbon innovation and investments are concerned, the EU ETS typically stimulated small-scale investments, resulting in incremental emission reductions. It also caused, as one study shows, a significant increase in the number of low-carbon patents filed by regulated firms.

The efficiency criterion refers to the benefit-cost balance of a policy. In the case of a cap-and-trade system, the theoretical conditions for maximum efficiency are *a)* that the price of allowances match the Marginal Social Cost of Carbon (MSCC) and *b)* that emissions be reduced at minimum cost.Certainly in recent years, carbon prices have been lower than most existing MSCC estimates (to be taken as indicative).This has been mainly due to the impact on allowance demand of the economic crisis and of RES and EE policies, given the rigidity of allowance supply.As concerns minimisation of total abatement costs, three factors are considered: efficiency of allowance allocation, efficiency of the allowance market, and the impact of the system on the economy (competitiveness effects). Efficiency in allocation has clearly improved with Phase III, though, arguably, margin for better targeted free allocation remains. The allowance market has generally performed well, andits efficiency is expected to further improve with allowance scarcity. Importantly, the EU ETS has not significantly affected,so far, the competitiveness of the regulated industries.

The coherence criterion refers to whether a policy is consistent with other policies, notably those having similar objectives, and with the relevant international context. The coherence of the EU ETS is thus evaluated with respect to RES and EE policies in the EU (internal coherence) and to the provisions of the Paris Agreement (external coherence). The question is not so much whether the EU ETS is consistent with the existing climate-energy policy mix (it is) as whether this mix is well balanced. However, there is no obvious answer to this questionbecause quantifying the benefits of RES and EE policies other than climate mitigation is all but simple. Looking ahead, the MSR should improve things by partially insulating the EU ETS from the effects of other policies. As to the Paris Agreement, not only is the EU ETS perfectly consistent with its provisions but it can also serve its successful implementation.

The EU added value criterion refers to whether undertaking a policy at the EU level provides additional value compared to what would result from similar national policies. While no counterfactuals exist, positive EU added value has most likely been attained given the economics of emission trading: the wider the coverage of the system, the more opportunities for cheaper emission abatement, which means lower total costs.