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THE EU EMISSION TRADING SCHEME: A PROTO-TYPE GLOBAL SYSTEM?

Denny Ellerman[1]
Massachusetts Institute of Technology

Abstract

The European Union Emission Trading Scheme (EU ETS) is the world's first multinational cap-and-trade system for greenhouse gases. As an agreement between sovereign nations with diverse historical, institutional, and economic circumstances, it can be seen as a prototype for an eventual global climate regime. Interestingly, the problems that are often seen as dooming a global trading system—public opposition to international financial flows associated with cross-border allowance trades and institutional readiness—haven't appeared in the EU ETS, at least not yet. The brief experience of the EU ETS suggests that the more serious problems for a global system are those of (1) developing a central coordinating organization, (2) devising side benefits to encourage participation, and (3) dealing with the interrelated issues of harmonization, differentiation, and stringency. The pre-existing organizational structure and membership benefits of the European Union provided convenient and almost accidental solutions for two of these problems—the need for a central institution and side benefits—but these solutions will not work on a global scale and there are no obvious substitutes. The EU ETS has successfully confronted the third set of problems: differentiating responsibilities among participants, increasing the stringency of emissions caps, and harmonizing allocations within the trading system. From a global perspective, the answers that have been and are being worked out in Europe indicate what may be feasible on a broader, global scale.

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Introduction

The European Union Emission Trading Scheme (EU ETS) can claim to be first in many respects. It is the first cap-and-trade system for greenhouse gases (GHGs) and it has resulted in by far the largest emissions trading market yet created. These attributes alone make the EU ETS worthy of study, but it is another first that provides the motivation for this paper: The EU ETS is the world's first multinational cap-and-trade system. As such, it can be seen as a proto-type for the multi-national GHG emissions trading system that is often advanced as a possible architecture for an eventual global climate regime (Aldy and Stavins, 2008). While the EU ETS is in only its fifth year of existence, experience to date with this program provides a preview of the issues that are likely to appear in a global system, suggests some useful precedents, and offers evidence that some problems may not be so difficult after all.

Two important similarities

Two features make the EU ETS appropriate for study as a prototype for a global emissions trading system: the weak federal structure of the EU and the significant disparities in economic circumstance, institutional development, and political will that exist among its member states. The EU is not a strong federal union like the United States of America. Its member states are independent nations that display and exercise the principal attributes of sovereignty. While some authority in some domains has been ceded to central European institutions, the basic decision-making entity in the EU remains the Council of Ministers, which consists of the relevant ministers of the member states with carefully negotiated voting rights. The ETS Directive (European Council, 2003), which provides the legal basis for the EU ETS, can be seen—like all EU directives—as a specialized multi-national agreement within the broader framework of the Treaties that established the EU itself. Although surely different in many particulars, a global trading regime can be expected to exhibit a similarly high degree of decentralization.

Just as the EU can mistakenly be seen as possessing a stronger federal structure than what political realities allow, so can the common adjective " European" mask a significant degree of diversity. The demarcation between East and West in Europe is not as marked as that between North and South globally, but there are instructive similarities. The difference in per capita income between the richest and poorest nations in the EU spans a significant part of the difference that would exist among the major emitting countries of the world. The per capita income of Romania and Bulgaria is only a third higher than that of China and one-fifth that of the wealthiest EU nation, Ireland, which has per capita income 5 percent higher than that of the United States.[2]

More than a decade of concerted efforts to transform institutions so that they conform to Western European norms has diminished East–West disparities, but the results have been uneven and remaining differences make participation in the ETS more of a challenge for some EU members than for others. Even greater differences exist in the degree of political will to address climate change and the priority accorded to reducing GHG emissions in different European countries—not only between East and West, but perhaps also between the southern and northern members of the 15 West European nations. How all of these nations came to adopt a mandatory cap-and-trade system is the question that makes the EU ETS experience interesting and highly relevant in considering how to bridge the economic, institutional and political differences that individual countries will bring to a global regime.

A brief recap of the EU ETS

The EU ETS is a classic cap-and-trade system in that it establishes an absolute limit on covered emissions, along with tradable permits—called European Union Allowances (EUAs)—that convey the right to release those emissions. Under the EU ETS almost all EUAs are distributed for free to affected installations; in turn, affected

[2]In contrast, the difference between the US states with the lowest and highest gross state product (Mississippi and Connecticut) is a factor of two. Luxembourg is excluded in the EU comparison because of a high concentration of corporate and financial activity that causes that country's per capita GDP to be 75 percent higher than that of Ireland. Delaware is excluded from the US comparison for the same reason. The international comparisons are based in International Monetary Fund (IMF) statistics for 2005 using purchasing power parity exchange rates.

installations are obligated to report their emissions and to surrender an equal number of allowances annually. The coverage of the EU ETS is partial in the sense that the system includes only carbon dioxide (CO_2) emissions from electricity generation and most industrial activities. Notably, emissions of other types of gases and emissions from transportation, buildings, the service sector, and agriculture are not presently included, although it was envisaged from the beginning that additional GHGs and sectors would be incorporated over time. In its current form, the EU ETS covers about 45 percent of the EU's total CO_2 emissions and a little less than 40 percent of its total GHG emissions.

The EU ETS was conceived in the late 1990s as a means of ensuring that the then 15 members of the EU (EU15) could meet their commitments under the Kyoto Protocol in the First Commitment Period (2008—2012). In surprisingly short time, this idea matured into a cap-and-trade system featuring a three-year "trial" period (from 2005 through 2007) and a subsequent "real" five-year trading period (2008 through 2012) that would coincide with the Protocol's First Commitment Period. This first "real" period would be followed by subsequent five-year trading periods.

More significantly, the EU ETS has grown from the original 15 member states to include 30 countries. This expansion was accomplished in three steps: the accession of ten mostly East European member states to the EU on May 1, 2004; the subsequent expansion of the EU to include Romania and Bulgaria at the beginning of 2007; and the inclusion of three of the four nations constituting the European Economic Area (Norway, Iceland, and Liechtenstein) beginning in 2008.

The choice of a cap-and-trade system in Europe and the particular structure that it assumed are the result of four factors. First, European governments came to recognize in the late 1990s that further measures would be needed if the EU15 were to meet their common Kyoto obligations and that these additional measures would need to be adopted at the European level. Second, an EU-wide carbon tax was off the table since proposals to enact one had failed in the 1990s—in part because fiscal matters, unlike regulatory measures, require the unanimous agreement of all member states. Third, early experience with the US trading system for sulfur dioxide (SO_2) and the embrace of trading in the

Kyoto Protocol made trading a logical approach. Fourth, the recognition that member states not only lacked experience with trading systems, but also the infrastructure necessary to support such systems prompted the adoption of the trial period to develop these prerequisites.

There is now an abundant literature that reports on, analyzes, evaluates, and criticizes the performance of the EU ETS.[3] For purposes of this discussion, the key accomplishments of the EU approach are that a uniform price for CO_2 exists across the system, that this price is taken into account by most owners of affected facilities when making operating and investment decisions, and that the requisite trading infrastructure—including emissions registries and procedures for monitoring, reporting, and verification—are in place. In short, an effective mechanism for limiting GHG emissions in the covered sectors exists and it is being used to effect progressively more significant emission reductions.

The rest of this paper addresses five important aspects of the EU ETS as a potential prototype for a multinational system. The first aspect concerns a novel contribution of the EU ETS: the use of a partial, and time-limited, first or "trial" trading period from 2005 through 2007. The second aspect involves the role of a central coordinating entity. The third and fourth aspects concern the related issues of club benefits and appropriate differentiation in the face of increasing stringency. The fifth and last aspect concerns an anticipated problem that hasn't appeared so far in the EU ETS context: public opposition to cross-border financial flows related to emissions trading.

The trial period approach

The use of a trial period to launch the EU ETS is a novel feature and one that commends itself for consideration in the context of a global cap-and-trade system. The concept of, and rationale for, a trial period was articulated in an early EU Green Paper on GHG trading (European Commission, 2000).

[3] For more comprehensive reports, the reader is referred to the Symposium on the EU ETS in the initial issue of the *Review of Environmental Economics and Policy* (Ellerman and Buchner, 2007; Convery and Redmond, 2007; and Kruger *et al*., 2007); Convery, Ellerman and De Perthuis, 2008; and Ellerman and Joskow, 2008.

> "As emission trading is a new instrument for environmental protection within the EU, it is important to gain experience in its implementation before the international emissions trading scheme starts in 2008."

Although formulated in the specific context of EU efforts to meet Kyoto Protocol obligations, this statement could apply equally to any nation that is adopting a cap-and-trade system as an instrument for limiting GHG emissions. Furthermore, even those already in a broader system might consider a trial period advantageous for ensuring that the requisite infrastructure and experience are in place before an acceding country becomes a fully participating member.

The EU ETS trial period was defined by two key characteristics. First, it preceded a more serious commitment and, as the name suggests, it was conceived as a rehearsal for the real thing—in this case, reducing the EU's CO_2 emissions sufficiently in 2008-12 to ensure compliance with the Kyoto Protocol. In a broader context, the same approach could be used to rehearse for full-fledged participation in a global system. Second, the trial period was self-contained in the sense that allowances from the trial period could not be banked for use in the subsequent "real" period. Conversely, allowances could not be borrowed from future real periods for use in the trial phase. . The inability to bank or borrow between the two periods virtually assured that the allowance price at the end of the trial period would be either zero (if actual emissions were less than required to meet the EU-wide cap because left-over allowances would have no value in the subsequent trading period), or the penalty price in the opposite case (that is, if emissions exceeded the cap, some firms would have to pay the penalty price for not surrendering enough allowances to cover emissions since they could not borrow from the next trading period).[4] Generally, the inability to bank or borrow would be considered a serious defect; however, if the purpose of a trial period is to gain experience and to establish the requisite monitoring, reporting, and enforcement infrastructure, restricting trading with subsequent compliance periods is more understandable.

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[4] Recall that the final net position is known with certainty only after it is too late to correct any imbalance. The requirement to cover short positions and the incentive to sell non-bankable surpluses will ensure a price discovery process between the end of the compliance period and the surrender date that will result in this binary outcome.

The problems that are likely to be encountered in setting up an international cap-and-trade system should not be minimized. Institutionally, EU member states must be considered more prepared and capable of implementing such a system than many of the prospective participants in a global system. Even so, there were numerous difficulties in setting up the European system. The biggest problem was a lack of data at the installation level. Emissions data were needed both for the allocation of allowances to covered installations and, more importantly, to determine the total number of allowances to be distributed by each member state (Ellerman, Buchner and Carraro, 2007). For instance, the EU ETS turned out to have a surplus of allowances in the trial period largely because the baseline used to project future business-as-usual emissions was highly uncertain. In fact, an important benefit of the trial period was that it provided more reliable data on actual emissions for included installations. Verified emission reports for the first year of the trial period, 2005, became the baseline by which the European Commission judged the acceptability of proposed caps for the subsequent (2008–2012) period.

The trial period was even more important for new East European member states where the institutional preparation for participating in an emissions trading system was arguably not as complete as among the EU15. This has rightly been raised as an important issue in considering the feasibility of a global trading system (Kruger *et al*., 2007). Data deficiencies in Eastern Europe were greater than they were for the EU15 and most of the East European governments required more time to set up the requisite infrastructure for trading and enforcement. Poland's registry did not go on line until 18 months after the start of the EU ETS; Romania and Bulgaria, which became participants in the last year of the trial period, did not have everything in place in time to participate effectively in 2007. One of the most encouraging aspects of the EU ETS is the evidence that participants and governments in countries with less institutional capacity can acquire the necessary infrastructure and become full-fledged participants within a few years.

Important lessons from the EU ETS trial period concern not only the creation of the requisite trading infrastructure, but also the issue of program coverage. While an economy-wide, comprehensive system that includes all sources is an ideal that may be practicable in some instances, the more likely reality is that the power sector and large

industrial facilities are the most promising candidates for early inclusion in a global system. This was the case in the EU ETS. In keeping with the concept of a trial period and recognizing the problems involved in setting up a system, the European Commission proposed from the beginning to start with those sectors that could most easily implement a trading system. In the EU case, existing directives concerning large combustion plants and integrated pollution prevention and control provided a usable regulatory framework—one that already implied control of GHGs and energy efficiency, albeit by other means (European Commission, 2000).[5] This is not unlike the situation in developing economies where power plants and large industrial facilities are invariably the first sources subject to pollution controls.

Moreover, for those nations already in a global system that seek to extend its reach and to effect large GHG emission reductions in other countries, the arguments for initial partial coverage will be strong. The power sector is often the largest source of emissions in a country and inclusion of large industrial sources will be highly desirable to avoid leakage and to lessen competitive concerns on the part of nations already participating in the global system. Initial partial coverage need not preclude a later, more comprehensive system, although the issue will be whether an initial partial approach makes it more difficult to arrive ultimately at comprehensive coverage.

Expanding program coverage over time is clearly envisioned in the EU ETS and indeed, some expansion has already occurred. Opt-in provisions were included in the original ETS Directive and a number of additional sources and even some other gases have been opted in, although the numbers are small. A more significant change will be the inclusion of aviation sources. As of 2012, the EU ETS will expand to include in-flight emissions for all flights originating or terminating in the EU.[6] In addition, the post-2012 amendments to the ETS Directive, which were agreed at the end of 2008, will include

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[5] The ETS Directive explicitly amends the Integrated Pollution Prevention and Control Directive to prohibit any member state from establishing a GHG emission limit for any plant included in the EU ETS and it further stipulates that member states are allowed to forego imposing energy efficiency requirements on plants included in the EU ETS.

[6] The aviation sector is not completely integrated into the EU ETS because of the inclusion of emissions for international flights, which are not subject to the Kyoto Protocol. A "gateway" will be established that will allow EUAs to be used for compliance in the aviation sector, but restrict the use of allowances issued to the aviation sector to that sector alone.

chemicals and aluminum, two industrial sectors that were initially excluded from the EU ETS. These two expansions of scope increase the coverage of the EU ETS by about 15 percent and 5 percent, respectively.

Experience with the EU ETS has demonstrated once again that rehearsal has merit. Although not currently envisaged as a feature of a global trading system, similarly constructed trial periods would seem to be a desirable feature, particularly when questions exist concerning the institutional readiness of newly acceding nations. For many of the same reasons as prevailed in the EU ETS, the trading programs implemented by newly participating members in a global system are likely to provide only partial coverage of emissions sources. Expanding coverage to additional sectors will be no easier than expanding the geographic scope of a trading system, but failure to achieve the ideal of full coverage initially is no reason to forego what is practicable.

Defining the center

Kruger *et al*. (2007) note that "the model of decentralization in the EU ETS has broken new ground in our experience with emissions trading regimes across multiple jurisdictions." In that model, cap-setting,[7] allocation, monitoring, reporting, verification, registries, and enforcement are all the responsibilities of the constituent member states, albeit with varying degrees of guidance, review, and approval by the European Commission. Among the most important issues to be decided in the design of a global trading system is the role and identity of a central authority. Again, experience from the trial period of the EU ETS suggests some potentially workable solutions.

In considering this issue, it is important to avoid the caricature of the European Commission as an over-staffed and over-bearing bureaucracy that is slowly but surely snuffing out national prerogative and diversity. While the Commission enjoys the power of initiative with respect to EU legislation, along with the duty to ensure that existing EU laws are observed by member states, the ultimate decision-making institution is the

[7] The system-wide cap in a decentralized system, such as the EU ETS during the first and second compliance periods, is the sum of the member state "caps" or of the total number of allowances issued by participating countries. Cap-setting is the process of agreeing upon these member state totals.

European Council of Ministers, which represents the governments of member nations.[8] In the end, the Commission is the agent of the whole and its success depends on both the powers granted to it by the still sovereign member states and on the manner in which those powers are exercised. In the case of the EU ETS, a careful distinction must be made between the role played by the Commission in the just-completed trial period and the ongoing evolution of that role.

The Commission's role in the trial period

The ETS Directive is unusual as an EU directive in endowing the European Commission with specific and carefully circumscribed functions that are additional to its general powers as an executive agent under the European Treaties.[9] The most important of these specific functions concerns the National Allocation Plans (NAPs) in which member states determine the total number of allowances to be issued and how they will be distributed. The ETS Directive gives the European Commission power to review and reject NAPs within a limited period of time after the member state notifies the Commission that its NAP is complete.[10] This power has proved to be important. Without it, the final EU-wide cap in both trading periods to date would have been higher— by about 15 percent in the initial trial period and 10 percent in the subsequent real period. Not surprisingly, the Commission's power to review and reject the allowance budgets developed by member states is carefully circumscribed. NAPs are to be assessed against various provisions and a set of criteria specified in Annex III of the ETS Directive— which is to say, as agreed previously by the member states meeting in Council. The ETS Directive also established a committee of member state representatives to provide the Commission with their opinion on the NAPs submitted by member states.

So far the Commission has exercised its power to review and reject with considerable discretion. In practice, it has focused on three criteria (out of eleven): the

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[8] A succinct summary of the roles of EU institutions and of the EU's decision-making processes can be consulted at: http://europa.eu/institutions/decision-making/index_en.htm.

[9] Most EU directives are simply 'transposed' into national law with the Commission's role limited to ensuring conformity of the resulting national laws with the EU directive.

[10] This provision is emblematic of the delicate balance between the power of the center and the prerogatives of constituent members in the EU. Technically, the Commission never "approves" a member state's NAP; it is considered approved unless rejected during the Commission's review.

total number of allowances member states propose to issue (to guard against cap inflation), the list of installations to be included and their allocations (to ensure inclusiveness), and the absence of ex-post adjustments in allocation. [11] Equally important has been what the Commission has chosen not to insist upon. Despite appeals for a more "harmonized" approach, allocation to installations was sensibly left to individual member states. The committee process established by the Directive has also proved useful in letting an individual member state know how other member states viewed its NAP and thereby enabling the Commission to perform its role as agent of the whole more effectively (Zapfel, 2007). Finally, no NAP has been formally rejected. Instead an expedient of "conditional approval" and "approval with technical changes" was devised whereby a NAP could be approved conditional on the adoption of certain changes, which have usually been negotiated previously and out of sight. When the NAP process for the first period was over, all of the Commission's required changes had been accepted; and only two member states, Germany and the UK, took the Commission to court on relatively technical matters.

Assessing the NAPs of member states was not the only significant function that the Commission performed in the trial period. Equally important were its efforts to educate member states and to facilitate and coordinate their participation. Zapfel (2007) describes the "active role" that the Commission took "to assist and guide" member states in the preparation of their NAPs and in eliminating "know-how gaps" so as to make informed decisions on technical issues. This involved commissioning studies on various aspects of allocation, issuing an unofficial paper elaborating how to prepare an allocation plan, and developing amplifying guidance on the review criteria. In addition, the Commission was always available and frequently looked to as a source of information, expertise, and informal guidance. These frequent and intense bilateral contacts provided a means for sounding out various NAP features, narrowing differences, and facilitating final agreement.

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[11] What became the Commission's effective ban on ex-post adjustment presents an interesting use of discretion. At best, this ban is implicit in the ETS Directive and the Annex III criteria. Ex-post adjustment would have frustrated the creation of an efficient EU-wide emissions market by substituting an ex-post administrative redistribution of allowances within each member state for trading among installations in an EU-wide market.

The evolution of the Commission's role

The first round of NAP development could best be described as a negotiation between individual member states and the Commission in which both sides were trying to agree on an allowance total in the face of large data uncertainties and some confusion over what installations met the definition for inclusion. Moreover, the absence of any international obligation to limit GHG emissions in these years allowed for a more relaxed approach to cap-setting.

All of this would change in the second round of NAP submissions for the 2008–2012 trading period. Decisions about the cap became more serious since the EU now had a legally binding obligation to comply with the limits imposed by the Kyoto Protocol. Also, definitional issues concerning what installations were included had been largely resolved by the time the second-period NAP notifications were due in June 2006. But the most important factor in changing the Commission's approach was the release, in May 2006, of verified emissions data for 2005. These data revealed that EU-wide emissions were lower than previously thought. Despite the significant reductions that the Commission required in the "caps" proposed by member states, it became evident that the finally approved totals for some member states, mostly in Eastern Europe, had involved significant errors in assumed baseline emissions. As a result, the Commission decided that the point of reference for member state caps in 2008–2012 would no longer be the first period totals but 2005 verified emissions. Additionally, the Commission responded to criticisms about inconsistency and lack of transparency in the negotiation of member state caps for the trial period by adopting a single, carefully calibrated emissions model to project business-as-usual (BAU) emissions in 2010 (the midpoint of the second trading period) based on verified 2005 emissions data combined with expected rates of economic growth and reductions in carbon intensity (European Commission, 2006).

All of these factors caused interactions between the Commission and member states to take on a different tone in the second-period NAP exercise. Caps were no longer set on the basis of a negotiation—rather they were based on an evaluation of whether the totals proposed by member states were consistent with model projections based on

verified 2005 emissions. If they were not, and if member states could not present either (a) a good reason for departing from the Commission's methodology or (b) evidence of an error in the Commission's calculations, the totals were adjusted downward. In taking this approach, the Commission effectively put itself in the position of determining member state allowance totals and thereby the EU-wide cap. Member states might challenge Commission decisions, but the burden of proof was shifted heavily against them. This did result in more legal challenges to the Commission's NAP decisions: Nine of the ten East European countries have sued the Commission over the caps imposed on them, although one, Slovakia, withdrew its suit after a slight upward adjustment was made to its total.

The trend toward greater centralization of decision-making with respect to the ETS was taken much farther in the post-2012 amendments that were agreed in late 2008. Under these amendments, the NAP process is largely abandoned—instead, the overall EU-wide cap for the 2013–2020 period and its apportionment among member states are specified centrally in the amended Directive. Auctioning (at the member state level) will become the primary means for distributing national allowance budgets, with some provisions for the transition and for exceptions.

Questions for a global system

Experience with the EU ETS suggests that over-arching treaties and agreements, such as the Kyoto Protocol and the European Burden-Sharing Agreement, may not be enough to create an effective cap-and-trade system.[12] Assuming that political will or other motivations are sufficient to support action, some entity must act as agent for the whole and educate, facilitate, and coordinate on behalf of the overall system—hopefully with the vision, ability and political realism that have characterized the European Commission's role in the development of the EU ETS. That experience also raises two questions: Is the greater degree of centralization now being pursued in the EU ETS

[12] The European Burden-Sharing Agreement, agreed in 1998, redistributes the Kyoto Protocol's common European target of 8 percent emission reductions below 1990 levels among the EU15 in a manner more closely fitting national circumstances. These redistributed targets vary from +27 percent for Portugal to -28 percent for Luxembourg.

necessary in a global system? And what institution would play the role of a central authority or facilitator in such a system?

Within Europe, the view is that the ETS trial period was deeply flawed and that greater centralization is the remedy. In part this view reflects a vision of a stronger European political structure that could avoid the messiness of decentralized decisions, but it also reflects some of the real problems of the trial period. Yet, despite a high degree of decentralization, the ETS trial period did succeed in imposing a price on slightly less than half of Europe's overall CO_2 emissions and in creating a mechanism for effecting greater reductions in the future. The question for a global system is not so much what degree of centralization is desirable, but what is politically feasible. What may be possible in the EU will likely not be feasible in a broader global system under which participating nations will retain significant discretion in deciding national emission caps, maintain separate national registries, and administer monitoring, reporting, and verification procedures at a national level. For a global system, the trial period of the EU ETS provides a more realistic precedent than the more centralized system to which the EU ETS is evolving.

The more difficult question is this: What institution could assume the functions that the European Commission performed in the ETS trial period on a larger global stage? In many ways, the Commission's role in establishing the ETS was accidental. It was not set up for this purpose; yet it was there when the occasion demanded and it played its role brilliantly. The Commission can perform the same functions for further accessions within Europe and it would likely represent the EU in any future international negotiations concerning linkage with trading systems in the United States or elsewhere. Nevertheless, the European Commission cannot serve as the center for an emissions trading system that extends beyond Europe. Perhaps some entity will emerge out of negotiations to link the EU ETS with other national- or regional-level trading systems, much as the WTO grew out of the expansion of trade, but there should be no doubt that some center for a global system will be needed. Otherwise the result will be a system far more disjointed and dysfunctional than the trial period of the EU ETS is sometimes portrayed as being—or the result may be no system at all.

Importance of club benefits

It is not the case that all member states of the EU were equally resolved to address climate change from the beginning and that all are happy with the EU ETS. The UK and Germany, two of the largest EU members, advocated a voluntary trading system for the trial period in order to preserve existing voluntary arrangements in these countries. Spain, Italy, and some other EU15 states agreed to emission targets in the European Burden-Sharing Agreement that seem to have been viewed more as aspirations than as hard numbers to be achieved by later policy commitments. Finally, the East European member states, which joined after the system had been designed, had other priorities and—with the exception of Slovenia—faced no problems in meeting their commitments under the Kyoto Protocol. That the result was a mandatory trial period in which all EU members participated is surprising, not least because, in the EU, various forms of exception are the rule. Club benefits—that is, the advantages that go along with membership in some group—largely explain this result.

The story behind the EU ETS has been told elsewhere (Skaerseth and Wettestad, 2008), but several elements are important from the standpoint of constructing a larger global system. First, it is worth noting that the story of how nations came to participate is a little different for the EU15 and the new member states. For the EU15, a longer experience of working together and a set of prior commitments were important in shaping their participation in the ETS. The EU had taken a prominent position in favor of action on climate change at, and subsequent to, the Rio de Janeiro Conference in 1992. Moreover, this position had wide-spread public support in Europe, especially after the withdrawal of the United States from the Kyoto Protocol in 2001. The governments of the UK and Germany might advocate for voluntary participation in the trial period, in large part due to the strong positions taken by their respective industries, but neither government would have been willing to scuttle the deal given their existing positions on climate change and their broader interests in the EU. As it was, agreement on mandatory free allocation, a temporary opt-out provision, and pooling made mandatory participation more palatable to industry and gave the EU15 governments the excuse they needed to

drop their insistence on a voluntary trial period.[13] Southern member states (Spain, Portugal, Italy, and Greece) that could best be characterized as "going along" with the climate policy advocacy of their more northern neighbors up to that point, were too enmeshed in the broad benefits of the EU to give serious consideration to ignoring the EU ETS Directive (although for a while it looked as if Greece and Italy might do so).

The situation was quite different for the new member states. They were not part of the Burden-Sharing Agreement and, with the exception of Slovenia, none faced any problems in meeting its Kyoto Protocol obligation. New members had lower per capita income and faced less public demand for environmental protection, especially for a global problem. Finally and more significantly, these countries were not at the table as voting members when the ETS was negotiated and agreed. When accession became a reality, the common East European reaction to the EU ETS was that it was designed by and for the EU15 and that its provisions did not really fit the circumstances of the new member states (Jankowski, 2007; Chmelik, 2007; Bart, 2007). The Directive was, as characterized by Jankowski, "an ill-fitting suit," which all nonetheless agreed to wear, albeit amid much and continuing protest.

Notwithstanding this discontent, none of the unhappy new member states has pursued their differences to the point of withdrawing from the EU ETS. The first period NAP cuts were accepted without more than complaint and while the second period cuts have been followed by serious legal challenges to the Commission's decisions, these appeals are being pursued through common European institutions. In the meantime, the plaintiff countries are participating in the trading scheme on the Commission's terms pending the outcome of their legal challenges. How these challenges will play out is anyone's guess, but it is hard to imagine any of the plaintiffs leaving the trading system in the event of an adverse decision. Too much would be called into question. More importantly, the presence of the new member states as voting members when the post-2012 amendments were decided did influence the outcome. The transitional free

[13] Pooling refers to an arrangement whereby individual installations would join together to form an entity that would be collectively responsible for reporting emissions and receiving and surrendering allowances on their behalf. It was anticipated that this arrangement would accommodate voluntary agreements in some sectors. In fact, there was little pooling.

allocation to electric utilities in most new member states is one result, as is the award of extra emissions rights, all within the EU-wide cap, for new member states with particularly large post-1990 emissions reductions.

The dissonance between the official positions of the governments of new member states and their actions can only be explained by the broader benefits of belonging to the EU. Whatever the perceived disadvantages of mandatory participation in the ETS, those disadvantages pale in significance when compared to the benefits of free flows of labor and capital and access to broader markets that come with being a member of the EU club. As Bart (2007) noted perceptively, the EU ETS was "just another obligation in the long march to the EU." In sum, though the club benefits of EU membership cannot be extended to the world, one lesson of the European experience is that similar side benefits will be needed to induce and maintain participation in a global system.

Stringency, differentiation, and harmonization

Club benefits largely explain how the EU ETS has grown from the initial 15 member states to the 30 that now participate. The continuing challenge will be to keep everyone in the system when emission reduction targets become more stringent, as any serious policy that attempts to deal with climate change will require. In particular, a conflict has already emerged between the two reasonable objectives of differentiation and harmonization—and it can be expected to get worse as program requirements become more stringent. The same conflict will surely arise in a global system—a prospect that lends particular interest to the resolution found in the EU ETS.

Differentiation and harmonization defined

Differentiation is a well-established concept in climate policy: It originates in the reference to "common but differentiated responsibilities" among nations in the UN Framework Convention on Climate Change. "Responsibilities" refers to the burdens or costs that would be assumed by countries of differing economic and historical circumstances under the Framework. In a multinational trading system, differentiation would be expressed by differences in the quantity of allowances assigned to a nation

relative to what that nation's emissions would otherwise be.[14] Nations assuming greater responsibilities will accept lower national "caps" and thereby incur a greater cost burden than nations with less demanding totals.

"Harmonization" entered the climate policy lexicon only with the implementation of the EU ETS, but this issue will arise in any global system also. Harmonization refers to the proposed remedy—presumably through a benchmarked allocation—for what is perceived as the unequal treatment of like facilities as the result of a decentralized free allocation of allowances. It is intended to address the concern that awarding more allowances to an installation in one country than to an identical installation in another country is at the least unfair and may create a competitive distortion.[15] The concept of harmonization, which implicitly presumes equality of treatment, calls the whole principle of differentiation into question. If all facilities are to be treated equally, how can countries be differentiated? And, even if harmonization could be achieved for some particular sector, as several industries argue should be done in a global system, the burden of differentiation would then fall more heavily on non-harmonized sectors.

The evolution of differentiation and harmonization in the EU ETS

The EU ETS is evolving from a trial period that could be characterized as having not very stringent targets, imperceptible differentiation of cost burdens, and no efforts at harmonization, to a post-2012 system that will feature increasing stringency, significant differentiation, and near complete harmonization. The lack of stringency in the trial period is well-known but the lack of differentiation is not. In theory, the caps in place for the trial period were to reflect the lesser of predicted BAU emissions or a "Path to Kyoto" trajectory that was consistent with each member state's emissions-reduction commitment under the European Burden-Sharing Agreement (BSA). In reality, the absence of good data, the inherent difficulties of prediction, and pressing deadlines for implementation

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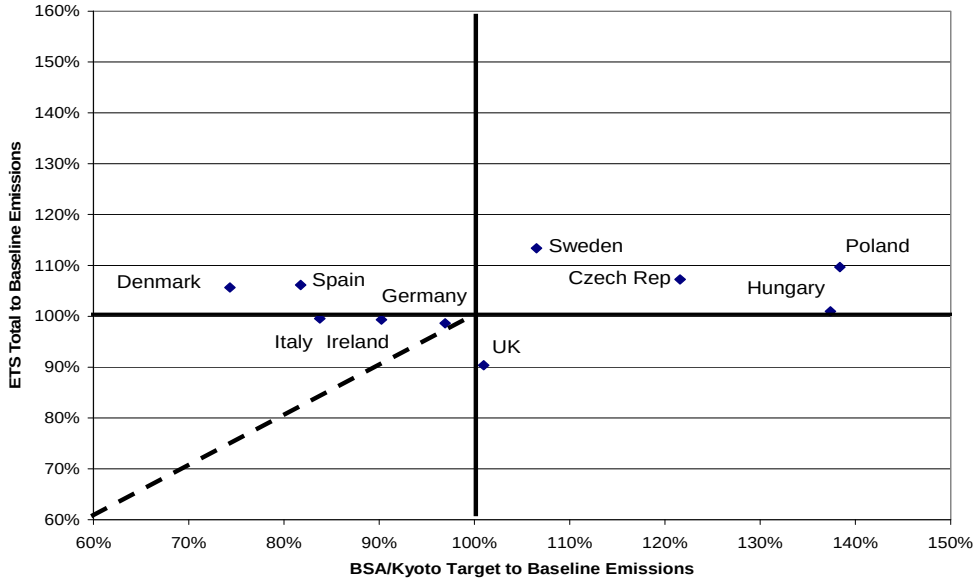
[14] A nation's emissions may be higher or lower than its "cap" depending on the uniform allowance price and the nation's marginal cost of abatement, but the total cost will be greater or smaller depending on the number of allowances issued by that country.

[15] The claim of competitive disadvantage ought to lack validity for a fixed, lump-sum allocation, but it is firmly asserted and believed by many in the political process. The decision to continue free allocation for installations in trade-impacted sectors in the post-2012 EU ETS is an example of the efficacy of this argument.

frustrated any efforts to differentiate across the burdens imposed on individual member states during the trial period, as shown by Figure 1.

Figure 1. Relation of NAP1 totals to baseline emissions and the Kyoto/BSA targets



Source: Ellerman, Buchner, and Carraro (2007)

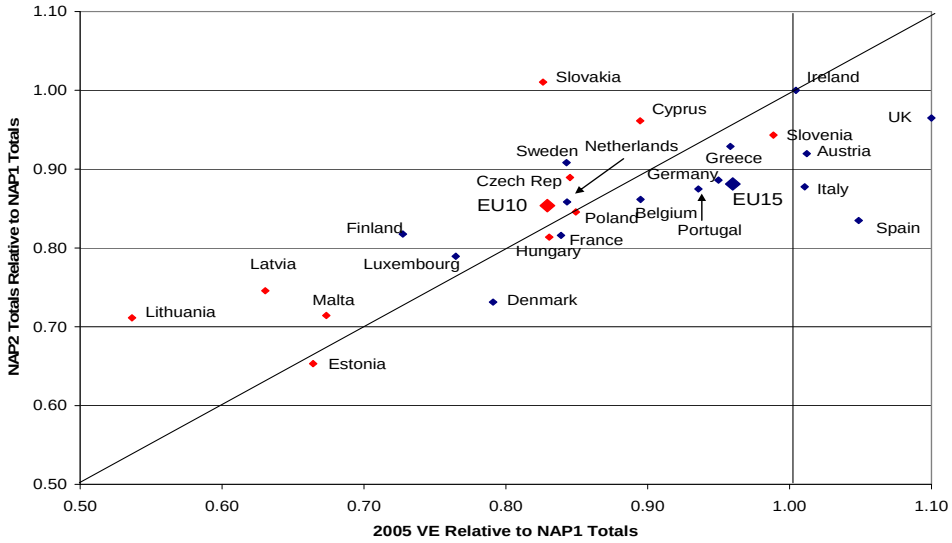
Figure 1 plots the trial period caps for ten representative member states in relation to their Kyoto/BSA targets (horizontal axis) and to baseline or recent historical emissions for sectors covered by the ETS (vertical axis). Countries to the left of the vertical axis—that is, those with a constraining Kyoto/BSA target—might be expected to have an EU ETS total that would place them in the lower left-hand quadrant along the dashed diagonal. In fact, the caps of these countries look no different in stringency than those of the countries to the right of the vertical axis.[16] Recent emissions were a more important determinant of member state NAP totals for the ETS trial period than the country's Kyoto/BSA targets.

This lack of differentiation would change with the second NAP round (NAP2) that set member state allowance totals for the 2008–2012 period. For this period, the cap for the original EU15 plus the ten mostly East European countries that joined in 2004 was

[16] The UK took an explicit leadership position early in the trial period by adopting a more demanding NAP that it hoped would set an example for others.

set at a level 5 percent lower than verified emissions in 2005 and 12 percent lower than the first period cap. Figure 2 shows the relationship between 2005 verified emissions (horizontal axis) and the second period national totals (vertical axis), where both are expressed as ratios of the first period totals.

Figure 2. NAP2 national totals in relation to NAP1 totals and 2005 emissions



Note: NAP1 and NAP2 refer to the total allowances (EUAs) that each member state could allocate in the first and second trading periods. VE refers to verified emissions.
Source: Compiled by the author.

For nearly all member states, both their 2005 verified emissions and the second period totals are less than in the first period. As is clearly evident from Figure 2, the lower a member state's 2005 verified emissions, the lower the quantity of emissions allowances reflected in that state's NAP for the second phase. However, differentiation starts to appear in the graph, as indicated by different countries' perpendicular distance from the diagonal. Spain has the most demanding target with 2005 emissions 6 percent above, and a NAP2 total 17 percent below, its first period total. Slovakia and Lithuania have the least demanding NAP2 totals. More generally, new member states are mostly above and to the left of the diagonal line, indicating less of a burden, while EU15 member states are below and to the right of the line, indicating more of a burden. The separation between the two groups is not complete, but the position of the larger diamonds—which aggregate NAP2

emission totals for the ten newer member states and the original EU15, each taken as a group, indicate that some differentiation has occurred. On average, the second period totals for the ten newer members are 3 percent higher than 2005 emissions, while those for the EU15 are 7 percent lower.

Still greater stringency and increased differentiation will result from the recently agreed post-2012 amendments (European Commission, 2008).[17] Starting in 2013 the overall, EU-wide cap is set to decline indefinitely at a rate of 1.74 percent per year such that emissions by 2020 would be 21 percent below 2005 verified emissions. At the same time, the amendments are designed to achieve greater differentiation by assigning the allowances to be auctioned to participating member state governments according to an agreed formula.[18] Eighty-eight percent of the allowances to be auctioned would be allocated to member states in proportion to their 2005 verified emissions. Another 10 percent would be distributed for the purpose of "solidarity and growth within the Community" in amounts that would increase the allowance total for some member states by percentages that range from 2 percent for Italy to 56 percent for Latvia. The remaining 2 percent would be awarded to nine new member states for which 2005 emissions were 20 percent or more below the 1990 level (i.e., all except Slovenia, Cyprus, and Malta).

The amendments state that the basis for most of this differentiation is GDP per capita; the same basis for differentiation has also been proposed for a global system (Jacoby *et al*., 1999) and, as noted in Frankel (2007), underlies the targets in the Kyoto Protocol. Figure 3 shows the 2020 allocation of the EU-wide cap, assuming full auctioning, in relation to per capita income on a purchasing power parity basis.

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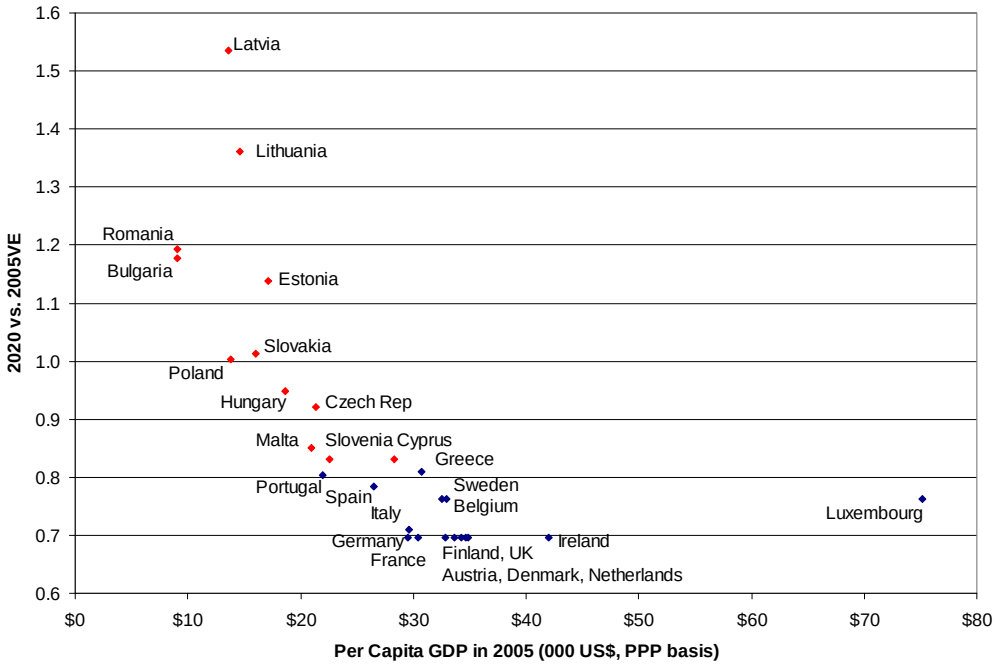
[17] These amendments are part of an "energy-climate package" that includes a series of other measures some of which, such as the Renewables Directive, overlap with the ETS while others apply exclusively to sectors not in the ETS. In particular, member state governments are required to take measures to limit non-ETS sector emissions to levels varying from +20 percent to -20 percent from the 2005 baseline so as to achieve an EU-wide reduction for these sectors of 10 percent below 2005 levels by 2020. All of these measures are aimed at ensuring that the EU meets its overall target of reducing total GHG emissions 20 percent below 1990 levels by 2020. The coordination, internal consistency, and efficiency of these measures leave much to be desired.

[18] The differentiation formulas apply to auctioned allowances only and since the portion to be auctioned expands over time, they should eventually apply to all or nearly all allowances. The number of allowances available for free allocation will depend on the transitional measures in place, the number of trade-exempted sectors, and the allocation rules for those sectors. The discussion in the text assumes full auctioning in 2020 for the sake of illustration.

Figure 3. 2020 auction rights in relation to 2005 emissions and per capita GDP



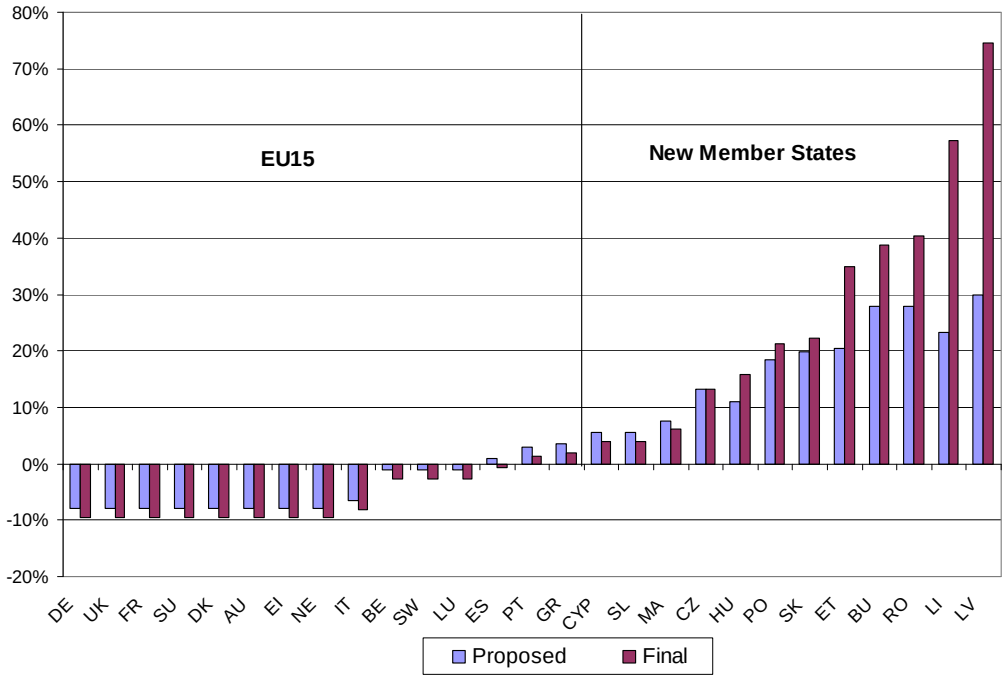
Source: Compiled by the author.

Under the 2008 amendments, most of the East European countries would receive an allocation that would be equal to or greater than their 2005 emissions. Relatively better-off new member states—Hungary, Czech Republic, Slovenia, Malta, and Cyprus—would receive fewer allowances, but still more than any of the EU15. Among the latter group, Luxembourg must be set aside because of the tax-advantaged activity that gives it an artificially high per capita GDP. Otherwise, it is clear that the EU15 states are assuming more of the cost burden of reducing CO_2 emissions. Most of these relatively high-income member states would receive allowances equal to 69.5 percent of their 2005 emissions (or 88 percent of their share, if allowances were simply awarded proportionate to 2005 emissions, of an EU-wide cap designed to reduce emissions 21 percent below 2005 levels by 2020).

The post-2012 amendments represent the first instance in which the beneficiaries of differentiation in a multinational system had a vote in determining the degree of

differentiation. Much can and should be written about the role of the new member states in the final agreement, but the net effect is shown in Figure 4.

Figure 4. Redistribution of auction rights from a proportional allocation



Source: Compiled by the author.

The percentages indicate departures from an apportionment of the EU-wide total that would be strictly proportional (that is, where each state's allocation would be set to 21 percent less than its 2005 verified emissions). The initial Commission proposal contained significant differentiation as indicated by the first column for each member state. Under this proposal, 10 percent of the EU-wide cap would be reserved for redistribution in a manner that would result in a net subtraction for twelve EU15 countries in favor of three, lower-income EU15 countries (Greece, Spain, and Portugal) and all of the new member states. In the negotiation of the final package, the East European new member states prevailed in arguing that member states whose 2005 emissions were at least 20 percent below 1990 emissions should receive some recognition. An additional 2 percent of the EU-wide was reserved for this "early action" redistribution, which redounded to the

benefit of eight of the East European new member states, and particularly to the three Baltic states, plus Romania and Bulgaria.

The post-2012 amendments also present a coherent attempt to deal with harmonization. From 2013 on, installations will fall into either of two categories: those subject to the basic rule of full auctioning and an exceptional category for trade-impacted sectors. There will be no free allocation to the electric utility sector starting in 2013 with some transitional derogation for new member states through 2020. The phase-out of free allocation to other industrial sources will be slower—20 percent auctioning in 2013, 70 percent in 2020, and 100 percent in 2027—with the transitional free allocation based on an EU-wide benchmark. Allocation to all of these installations will be eventually harmonized with zero free allocation. This is not the allocation rule that those advocating harmonization had in mind, but it is an easy and obvious one to administer. Exceptions will continue to apply to installations in sectors or sub-sectors that meet pre-specified criteria for being "trade-impacted;" these installations will receive a free allocation equal to 100 percent of a harmonized best available technology standard. Those sectors or sub-sectors will be determined by the Commission, after consultation with the European Council, by the end of 2009 and every five years thereafter.

The most interesting feature of recent changes in the EU ETS is the coupling of increasing differentiation with increasing stringency. If a global approach is to be "broad then deep" (Schmalensee, 1998), participants will find themselves in a situation not unlike that of the EU member states. An initial broad phase, like the trial period of the EU ETS, may not require much differentiation; however, as the system enters the deep phase (more stringent emission reduction requirements), differentiation will become an increasingly important issue. In its recently completed negotiation of amendments for the post-2012 period, the EU ETS has provided a preview of the magnitude of differentiation that may be required. In this case, 12 percent of the system-wide cap will be redistributed in a manner that will require the "leader" countries to give up 9.5 percent of what they would receive under a proportional entitlement in order to allow the less committed, less wealthy, or otherwise deserving beneficiaries to receive as much as 50 percent more than they would otherwise be entitled to under a strictly proportional system.

Financial flows

Before concluding, note should be taken of the absence, in the EU context, of a problem that has commonly been anticipated for a global trading regime. A trading system implies trade among participating entities and accompanying financial flows between participating nations. These flows are likely to be larger to the extent that differentiation creates differences in the apportionment of the system-wide cap that go in the same direction as comparative advantage in abatement. For instance, modeling exercises commonly predict that the cheapest abatement options will be found in the same developing countries that most analyses assume will be the beneficiaries of global differentiation. The concern is that these two factors would combine to create large international flows of capital at a level that is politically or otherwise untenable. A remarkable feature of the EU ETS is that there has been virtually no notice of the cross-border financial flows that have occurred as a result of emissions trading.

Despite all the birthing problems of the EU ETS, the market for EUAs has been very liquid and has resulted in cross-border financial transfers among entities within the participating member states. The 25 x25 matrix attached as an appendix provides a table of the country of origin of all the EUAs surrendered during the three years of the trial period.

Several points are immediately obvious. First, most of the allowances issued and surrendered were *not* traded outside the member state in which they were issued. Of the total 6.15 billion EUAs surrendered, 5.79 billion (94 percent) were surrendered in the issuing member state, as indicated by the diagonal entries in this matrix. The off-diagonal entries are the international flows, which accounted for only 354 million EUAs or 5.8 percent of the total. The small share of international trading reflects what could be expected and is usually observed with free allocation. That is, most entities that receive free allowances keep them for later surrender against their own emissions. Typically, only the allowances left over after the installation covers its own emissions, or those needed to cover emissions when its allocation is not enough, are traded. The difference between allowances issued and emissions to be covered at installations in different

countries can be measured. The sum of the shorts (emissions > allowances) for all installations for the entire trial period was 650 million EUAs and the sum of the longs (emissions < allowances) at installations with surplus EUAs was 810 million (Trotignon and Ellerman, 2008). At a minimum, 650 million allowances were redistributed from longs to shorts. This figure, slightly more than 10 percent of the total allowances issued, largely explains the relatively small scale of the international transfers.

While the quantity of allowances traded internationally is very modest relative to the total quantity of allowances issued and surrendered, the scale of international transfers is large compared to what would have been required to ensure the compliance of the four member states that were short for the period as a whole: the UK, Italy, Spain, and Slovenia. For all installations to be in compliance in these four countries, EUAs sufficient to cover at least 88 million tons would have had to flow across EU borders. The actual level was four times higher. Even if the many off-setting flows between trading pairs are eliminated, the sum of net flows is 217 million, two and a half times the minimum international transfer required for compliance by all covered sources. If national preferences for keeping allowances within domestic borders had been strictly observed, there would have been only four member states importing allowances. In fact, 22 of the 25 member states were importers of EUAs in some amount, although only seven were net importers.[19]

Another way of looking at this phenomenon is counting how many of the off-diagonal cells in the matrix shown in the appendix are filled. There are 600 such cells of which 470 (78 percent) are occupied and thus indicate a cross border transfer. For most pairings, trade goes both ways and for many member states the net flows with various trading partners are not all in the same direction. For instance, Germany is a net importer in the aggregate and in trading with most partners, but it is a net exporter to the UK, Italy, and Spain.

[19] The net importers were the UK, Spain, Italy, Germany, Austria, Ireland, and Slovenia. Germany, Austria, and Ireland were net importers despite being long for the period as a whole due to a phenomenon that occurred in all member states: some surplus allowances at long installations appear never to have entered the market. See Trotignon and Ellerman (2008) for a more complete discussion.

Market intermediaries and institutions largely explain the abundance of cross-border transactions. Installations with a deficit or a surplus looked to market intermediaries to obtain needed EUAs, or to dispose of excess EUAs, and these intermediaries operated at a Europe-wide scale. For instance, a UK firm that had a surplus might sell to a broker or at an exchange with the result that the surplus allowances could as likely be sold to a firm that was short in Spain as to a firm that was short in the UK. With EUAs good for compliance regardless of origin and with zero transportation costs, surplus allowances were as likely to cross a border as not.

The absence of any public concern about international allowance flows can be largely attributed to their small scale relative to the total number of allowances in play and to the indifference that buyers and sellers exhibited concerning the national origin of EUAs. The UK was by far the largest importer of EUAs, with net imports totaling 107 million tons for the period as a whole, which was equal to 14 percent of the UK's verified emissions. Placing a value on these imports is difficult given the variability in EUA prices at different points in time, but the year when the allowance import bill was highest in value terms was 2006, when EUA imports would seem to have created a £350 million (≈ €500 million) outflow of funds from the UK. While this might be seen as a large amount, it pales in comparison to payments for other goods and services imported to the UK in 2006, which totaled about £415 billion.[20] Payments to foreigners for allowances were less than one-tenth of 1 percent of the total bill for imported goods and services. The amount in future years could be larger due to higher EUA prices and perhaps higher levels of imported allowances, but this flow would still be a small part of total payments abroad for goods and services. One Euro-skeptic organization in the UK, which regards the EU ETS as emblematic of all that it dislikes about Brussels, has consistently criticized the transfers to the rest of the EU that are implied by the UK's short position in allowances (Open Europe, 2006), but this complaint has failed to find any traction either with the public or the government. Several other aspects of the EU ETS have caught the attention of the public and governments—windfall profits, over-allocation, high initial

[20] Given as US$768 billion in IMF Statistics.

prices—but not international flows of funds as a result of cross-border allowance trades.[21]

Conclusion

Europe has demonstrated that it is possible to construct a multinational cap-and-trade system that encompasses sovereign nations with considerable disparities in economic circumstance and degrees of willingness to adopt climate change measures. At the same time, the European experience points to the problems that exist in multinational systems and in doing so reveals the distance to be traveled in replicating something similar on a global scale.

The encouraging aspect of the EU ETS experience to date is the evidence it offers that some of the problems often cited as impeding a global system may not be that serious. The institutional disparities between East and West in Europe are not as great as those between North and South on the global scale, but they are still large. It took more time to put the regulatory infrastructure needed to support trading in place in Eastern Europe than it did in the West, but it was done and companies in the new member states are not only complying, but are increasingly learning to price CO_2 into their operational and investment decisions. The EU's adoption of a multi-year trial period has set a useful precedent for dealing with issues of institutional readiness that could be employed in a global system.

Another problem that didn't appear is political or public opposition to the financial flows that accompany international trading. Most of the allowances issued by individual member states were surrendered in the same country and international transfers were a small percentage of the total, though they were larger than what might have been expected assuming a national preference for avoiding cross-border trades unless absolutely necessary. The widespread use of cross-border transfers for compliance reflects the role of intermediaries, which operate in an EU-wide market, in redistributing the differences between allocations and emissions that existed for all installations.

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[21] For a more complete discussion of these other controversies, see Ellerman and Joskow (2008).

Surplus allowances were as likely to end up in another member state as in the one in which the selling installation was located; similarly allowances purchased to cover emissions were as likely to come from surpluses at installations in other member states as from other installations in the same country.

The more problematic question raised by the EU ETS, when seen as a prototype for a global system, is how to reproduce what was essential for success in Europe: namely, a pre-existing central structure and a well established set of powerful side benefits. The European Commission cannot perform the same role on a global scale, nor can the benefits of participation in the EU be extended beyond Europe. Perhaps, a central institution suited for administering a global system will emerge out of bilateral agreements that might link the EU ETS with comparable systems outside of Europe. In any case, some central authority or institution will be needed to review regulatory actions, to coordinate periodic adjustments of the system-wide cap, and to negotiate with new participants. The side benefits for participation may not need to be as powerful as those associated with becoming a member of the EU, but the experience in Europe suggests that something more will be needed than an over-arching treaty and an appeal to common concern about climate change. This is not a unique challenge. In diplomacy, issues are inevitably linked and inducements will be needed if there is to be a global climate regime.

Mechanisms developed to address the differentiation of responsibilities among nations (such as cap setting and allowance allocation) could also serve to deliver incentives for participation, but the EU ETS did not operate this way. The first step was to get everyone in and then to deal with the tensions between stringency, differentiation, and harmonization. In the recently negotiated amendments to the ETS Directive for the post-2012 period, increasing stringency is accompanied by greater differentiation and harmonization is to be achieved by phasing out free allocation in favor of auctioning with appropriate exceptions for trade-impacted sectors. How well this will work in Europe and whether it could be applied on a global scale have yet to be seen, but at least the problem has been engaged and a pertinent example is being established.

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APPENDIX: Origin and disposition of surrendered allowances, 2005-07 (million tons)

Phase 1		Originating from ...																													
		AT	BE	DK	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES	SE	GB	CY	CZ	EE	HU	LV	LT	MT	PL	RO	SK	SI	Total		Imports	%
Surrendered in ...	AT	91.63	0.20	0.11	0.20	0.52	1.03		0.00	0.05		0.83	0.01	0.03	0.05	0.26		0.30	0.00	0.03	0.14	0.13		0.42		0.31	0.02	96.27		4.64	1%
	BE	0.21	148.38	0.17	0.12	0.96	0.80	0.01	0.04	0.95	0.38	0.23	0.08	0.75	0.03	0.08		0.46	0.17	1.49	0.01	0.66		6.89		0.07		162.92		14.54	4%
	DK	0.00	0.15	72.62	0.15	0.10	0.65			0.01		0.85	0.11	0.15	0.21	0.37		0.43	0.02	0.06		0.02		0.08		0.11		76.09		3.47	1%
	FI	0.20	0.11	0.06	114.34	0.87	0.22	0.25		0.07		0.15	0.14	0.03	0.34	0.78		0.93	0.26	0.02	0.06	0.21		1.09		0.10		120.24		5.90	2%
	FR	0.01	0.07	0.04	0.29	379.71	0.15	0.12		0.07		0.13	0.07	0.43	0.02	0.26	0.04	0.25		0.02		0.12		1.73		0.13		383.67		3.96	1%
	DE	0.48	4.02	0.87	2.83	6.72	1391.19	0.08	0.86	1.26	0.27	7.34	0.96	0.96	1.21	8.40	0.01	7.06	1.35	2.53	0.28	2.39		5.31		1.67		1448.08		56.89	16%
	GR	0.02	0.01			0.06	0.00	212.91				0.01	0.02			0.03				0.01		0.01		0.84		0.02		213.93		1.03	0%
	IE	0.08	0.02	0.06	0.29	0.12	0.06		64.04	0.19	0.01	0.09	0.18	0.02	0.00	0.43	0.02	0.06	0.56		0.04	0.03		0.06		0.03		66.38		2.33	1%
	IT	0.46	1.18	0.66	1.07	6.45	5.42	0.26	0.09	629.12	0.01	1.16	1.19	1.54	0.57	4.13	0.23	3.68	2.05	1.08	0.85	1.14		6.83		2.84	0.05	672.06		42.94	12%
	LU										7.88																	7.88		0.00	0%
	NL	0.12	2.98	0.27	0.79	2.30	2.84	0.08	0.02	0.15	0.02	216.80	0.08	0.38	0.23	2.72	0.05	1.79	0.58	0.38	0.23	0.75		2.44		0.93	0.00	236.94		20.14	6%
	PT	0.01	0.15	0.01	0.01	0.05	0.06			0.06		0.04	99.44	0.28	0.00	0.46		0.22	0.00	0.00	0.01	0.00		0.01		0.02		100.84		1.40	0%
	ES	0.27	1.68	2.47	3.77	5.92	3.47	0.13	0.13	1.05	0.10	3.74	3.32	499.67	0.91	4.69	0.01	3.54	1.06	1.13	0.56	0.74		8.21		1.64		548.22		48.55	14%
	SE	0.01	0.03	0.07	0.36	0.09	0.19	0.01			0.01	0.01	0.01	0.00	57.05	0.18		0.08	0.15	0.00	0.01	0.08		0.12		0.01		58.46		1.41	0%
	GB	0.41	10.09	4.69	5.11	20.59	11.29	1.17	0.16	3.45	0.26	18.52	1.78	2.60	1.20	619.10	0.14	13.83	5.29	2.81	0.75	5.40		17.76		4.33		750.72		131.62	37%
	CY																15.73											15.73		0.00	0%
	CZ	0.00	0.08	0.07	0.04	0.07	0.12			0.12		0.26	0.23	0.03	0.07	0.96	0.01	247.03	0.11	0.48	0.01	0.10		2.02		0.61		252.42		5.39	2%
	EE		0.02	0.00			0.03								0.02				39.94					0.04				40.05		0.11	0%
	HU		0.01			0.14	0.03					0.02	0.00	0.02		0.01		0.15	0.04	78.63				0.24		0.02	0.00	79.30		0.67	0%
	LV																	0.03		0.00	8.55	0.06				0.00		8.64		0.09	0%
	LT		0.03	0.05	0.00	0.39	0.18	0.00		0.03			0.01			0.01		0.00	0.00	0.03	0.02	17.98		0.39		0.01		19.13		1.15	0%
	MT																						3.96					3.96		0.00	0%
	PL	0.04	0.18	0.10	0.00	0.26	0.20	0.02	0.00	0.05		0.02	0.02	0.09	0.01	0.62	0.01	0.17	0.00	0.08	0.04	0.02		620.34		0.25		622.53		2.19	1%
	RO		0.01		0.03	0.05	0.04	0.18	0.13			0.23		0.01	0.18	0.01		0.74	0.04	0.25		0.07		1.37	55.24	0.03	0.03	58.65		3.41	1%
	SK	0.00	0.03		0.00	0.22	0.02			0.08		0.01			0.01	0.05		0.07	0.10	0.01	0.11	0.20		0.17		74.30		75.37		1.07	0%
	SI	0.04		0.02	0.00	0.02	0.40	0.00		0.02		0.09	0.02	0.06	0.04	0.19		0.02	0.07	0.01	0.04	0.02		0.19		0.00	25.37	26.61		1.24	0%
	Total	93.99	169.42	82.36	129.40	425.61	1418.40	215.23	65.47	636.74	8.94	250.53	107.66	507.06	62.14	643.75	16.25	280.83	51.78	89.05	11.73	30.13	3.96	676.55	55.24	87.44	25.49	6145.13		354.16	100%
	Exports	2.36	21.03	9.74	15.07	45.90	27.21	2.32	1.42	7.62	1.06	33.73	8.21	7.39	5.09	24.65	0.52	33.79	11.84	10.42	3.18	12.15	0.00	56.22	0.00	13.14	0.11	354.16			
	%	1%	6%	3%	4%	13%	8%	1%	0%	2%	0%	10%	2%	2%	1%	7%	0%	10%	3%	3%	1%	3%	0%	16%	0%	4%	0%	100%			

Source: Trotignon and Ellerman (2008). Note: units in million EUAs