Auctioning of EU ETS Phase II Allowances: how and why?

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Abstract

The European Directive on the EU ETS allows governments to auction up to 10% of the allowances issued in Phase II 2008-2012, without constraints specified thereafter. This paper reviews and extends the long-standing debate about auctioning, in which economists have generally supported and industries opposed greater use of auctioning. The paper clarifies the key issues by reviewing six 'traditional' considerations, examines several credible options for auction design, and then proposes some new issues relevant to auctioning. It is concluded that greater auctioning *in aggregate* need not increase adverse competitiveness impacts, and could in some respects alleviate them, particularly by supporting border-tax adjustments. Auctioning within the 10% limit might also be used to dampen price volatility during 2008-12 and, in subsequent periods, it offers the prospect of supporting a long-term price signal to aid investor confidence. The former is only possible, however, if Member States are willing to coordinate their decision-making (though not revenue raising) powers in defining and implementing the intended pricing mechanisms.

Keywords: European emission trading, auctions, price floor
JEL classifications: D44, L10, Q52

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Auctioning in the EU ETS Key Findings

Auctioning in general:
- is likely to increase the macroeconomic efficiency of the EU ETS and offers scope to partially address its distributional impacts
- will have negligible competitiveness impacts
- reduces the distortions associated with free allocation and is correspondingly more compatible with EU State Aid legislation
- will have a smaller impact on EU ETS prices than allocation cutbacks without auctioning
- will increase management attention and thus market efficiency

Auctioning may also provide a hedge against projection uncertainties, reduce price volatility, and increase investor stability. The recent EU ETS market collapse is a dramatic manifestation of uncertainty in emission projections. Reserving some allowances for periodic auctions:
- could assist transparency and liquidity;
- offers a potential price cushioning mechanism (as in US transmission auctions), to create a more stable EU ETS market; and
- might facilitate ex-ante agreed target price ranges, thereby increasing predictability for investors

Auctioning poses no significant implementation difficulties
- either ascending-bid or sealed-bid auctions could be used and based upon extensive experience, for example with securities auctions
- should be open to as wide a group of bidders as possible
- the concerns of small bidders can be addressed, for example through reserves guaranteed at the strike price

For the longer term (post 2012), auctioning could also:
- help protect industrial competitiveness by enabling WTO-compatible border-tax adjustments
- help provide a long-term carbon price signal by recycling revenue into carbon contracts

1. Introduction

Whether governments could or should sell emission allowances, instead of giving them out for free, was one of the most hotly contested aspects of negotiating the original EU ETS Directive. It resulted in the compromise — after determined intervention by the European Parliament to raise the threshold — that governments could auction up to 5% of allowances in Phase I and up to 10% in Phase II (the Kyoto first period of 2008-12).

This compromise reflects two empirical facts about auctioning. The first is that economists almost uniformly recommend more auctioning. The second is that business tends to oppose it. The result is that despite all the academic recommendations, auctioning in emission trading systems is the exception rather than the rule.[1] In Phase I,

[1] The U.S. government auctions only 2.8% of allowances under its SO_2 program (McLean, 1997).

only four out of 25 Member States used auctions at all, and in only one case were auctions fully employed to the 5% limit.[2] This contrasts sharply with, for example, the willingness of European governments to auction licences for the European "third-generation" (3G) mobile telecommunications licences, where auctions raised enormous sums.[3] The difference in approach can largely be explained by three factors. First, emissions trading imposes costs on other sectors, producing strong lobbying by incumbents in these markets, whereas costs to other sectors by pricing the 3G spectrum were much smaller and less obvious. Second, emissions trading may affect national competitiveness in some export sectors. In contrast, competitiveness fears did not arise with the 3G auctions because international trade in spectrum licences (and downstream sectors) is obviously rather limited. Third, telecommunications is a fast-growing industry, where many powerful players were non-incumbents without the right to grandfathered allowances (Cramton and Kerr, 2002).

However, the political dynamics relevant to emissions allowance auctions may be changing. The great majority of participants in Phase I (as measured by turnover or emissions) are making substantial profits from the system of free allocations, as economists had predicted. Additionally, there are now potential legal pressures arising from state aid considerations as a consequence of these profits (see Johnston, this Issue). These considerations may increase the appeal of auctions. In this context, we re-examine the issues and arguments for and against auctioning, and also introduce some new considerations as follows:

Section 2 reviews six 'traditional' arguments concerning EU allowance auctions;

Section 3 considers how EU ETS auctions might be run, including an examination of the question of auction design;

Section 4 examines some new issues, including whether auctions might reduce competitiveness exposure (through allowing border tax adjustments); reduce price volatility, and support long-term price signalling.

2. The pros and cons of auctioning allowances

2.1 Economic efficiency, revenue recycling and the relationship to eco-taxation

Raising revenue from environmental policy is not a new idea. The classical recommendation is to tax activities with 'external' (such as environmental) costs, to make firms factor these costs into their decisions (Pigou, 1920). A secondary benefit of such eco-taxation, in addition to internalising the environmental externality, is that the

[2] Denmark auctioned 5% and used the revenue to purchase JI/CDM credits, Hungary auctioned 2.4%, Lithuania auctioned 1.5%, and Ireland auctioned 0.75%, with European-wide eligibility, to cover the administrative costs of the scheme.

[3] In the year 2000, the UK auction raised €39 billion (Klemperer, 2004) and the German auction almost €100 billion (1 billion = 1,000 million).

revenue raised can be 'recycled' to reduce other distortionary taxes on labour or capital in the economy.[4]

Despite the economic arguments for eco-taxation, implementation has been extremely patchy and highly contested.[5] The divergence between theory and practice has gradually led to a much deeper appreciation of the crucial importance of the political economy of instrument choice. Policy decisions are strongly influenced, for understandable reasons, by the creation and allocation of economic rents. Environmental taxes have struggled to win political acceptance because they attempt to combine two difficult feats: transferring the rents created by environmental constraints to the public purse, and providing incentives to change behaviour at the margins.[6] Attempting either feat alone, particularly the former, can generate strong opposition from powerful interest groups.

In addition to the political economy challenges, policies internalising the carbon price (including taxes, and trading schemes whether the permits are grandfathered or auctioned) may have unwanted interactions with other taxes.[7] For instance, imposing a carbon price by a tax or trading scheme raises the price of energy and derived products, which (other things being equal) reduces real wages and therefore labour supply. Some considerations and studies suggest this indirect 'tax-interaction' effect more than offsets the efficiency gains from revenue recycling, though the net effects remain disputed and context-dependent.[8]

But any policy that internalises the carbon price *without* raising revenue (such as emissions trading with free allocation) suffers these tax-interaction effects without the benefit of the revenue-recycling effect (discussed above).[9] Because auctioning allowances

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[4] This corresponds to a very simplistic statement of the 'double dividend' hypothesis. Various definitions are used in the literature, sometimes inconsistently, including 'weak', 'intermediate' and 'strong' forms. This terminology is avoided here. Tax-interaction effects are discussed below.

[5] See, e.g. Helm (2005).

[6] A 2006 Special Issue of the Energy Policy Journal (34:8) analyses the European experience with eco-taxation and points to deeper underlying issues about the degree of public understanding and trust in political processes. A Swedish survey also underlines that attitudes to carbon taxation are directly related to the degree of trust in politicians, more even than individual's own exposure to the taxes (Hammar and Jagers, 2006).

[7] See Bovenberg and de Mooij (1994), the critique by Fullerton (1997) and the reply by Bovenberg and de Mooij (1997), as well as Bovenberg and van der Ploeg (1994), Goulder (1995), Parry (1995) and Bovenberg and Goulder (1996).

[8] Parry (2003) finds that the tax-interaction effect dominates the revenue-recycling effect. This would be expected from the optimal tax theory result that broad taxes produce lower efficiency losses than narrow taxes (e.g. Diamond and Mirrlees, 1971). In practice, the net impact depends on a wide variety of assumptions about the current tax base, whether the economy is modelled as a fully-deployed equilibrium, etc (IPCC, 2001, Chapters 7 and 8).

[9] See Goulder, Parry and Burtraw (1997), Parry, Williams and Goulder (1999), Goulder, Williams and Burtraw (1999), and Fullerton and Metcalf (2001). The tax interaction effect could provide an argument for a carbon price that is below the Pigouvian level. It is not an argument for not raising revenue.

does benefit from the revenue-recycling effect, is almost certainly more efficient than free allocation, within the constraints of competitiveness effects. Thus, in practice, given that there is an emissions trading system in place, it is unambiguous that auctioning has the potential to improve the macroeconomic efficiency of the system.

Of course, efficiency considerations are merely the beginning, and we now examine five other considerations relevant to auctions, namely: the distribution of the economic rents created by CO_2 limits in the economy; competitiveness effects of auctioning compared to grandfathering; legal considerations; dynamic incentives, and transaction costs.

2.2 Rent distribution and equity considerations

Limiting CO_2 emissions puts a price on carbon and thereby increases production costs. Firms will pass a proportion of this marginal cost increase through to consumers. The proportion passed through depends upon the market structure.[10] When allowances are freely allocated to firms, some participating sectors will inevitably make profits.[11]

It is now beyond doubt that the electricity sector generally profits from free allowances under the EU ETS, unless it is subject to direct price regulation or regulatory threat in concentrated markets, because generators pass costs on to electricity consumers, including non-ETS sectors and domestic consumers. Whether other participating sectors may similarly profit depends upon two main factors: whether they receive enough allowances to cover any increase in their cost base; and the constraints on cost pass-through placed by international competition.[12] In practice, of course, these factors vary considerably between sectors, and indeed, companies and facilities within sectors. Non-participating sectors with high electricity consumption (such as aluminium) will face substantially higher costs due to higher electricity prices, and yet are not compensated through the receipt of free allowances.

Not only does the ETS have significant distributional consequences between the various sectors (participating or not), it is also clear that most of the economic rents from the current arrangements ultimately accrue to shareholders of the profiting firms, who tend to be wealthier than the general population. As such, in aggregate the current arrangements transfer resources from poor to rich.[13]

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[10] See the companion papers in this Issue by Smale et al. and Demailly et al., also Hepburn, Quah and Ritz (2006).

[11] Indeed, Smale et al. (this Issue) suggest that *most* participating sectors will profit.

[12] There is some indication that non-power sectors with significant emission levels are also able to pass through a proportion of the marginal cost increase. See, for instance, de Leyva and Lekander (2003).

[13] Parry (2003) points out that in the U.S. the top income quintile owns 60% of all shares with the bottom owning less than 2%. A survey commissioned by Wall Street Europe concludes that in the US 60% of households have equity ownership, while in Europe this number is only 18%. Likewise, while in the US 50% of population has more than Euro 50k private ownership excluding property, this compares to only 15% in Europe. (GfK Custom Research Worldwide, Sep/Oct 2004, 14383 people in 18 countries)

One of the widest economic misconceptions about auctioning is that it would simply add costs which would be passed through to 'downstream' companies and consumers.[14] Yet if firms maximise profits, then even with free allocation they pass on the opportunity costs of allowances to downstream prices. Changing from free allocation to auctioning will have little impact on product prices.[15] However, because auctioning raises revenue that may be reallocated, it has, prima facie, the *potential* to correct distributional impacts.

If auction revenues are employed to reduce general taxes, the distributional impacts will depend upon the nature of these other tax changes: for example, reduction in income tax would tend to shift revenue from electricity consumer to taxpayer, and if focused on the base rate might be somewhat progressive. Alternatively, direct dedication of the auction revenue to domestic consumers would give consumers an income stream that increases with higher CO_2 prices, thereby compensating for product (especially electricity) price increases. This might also increase public interest in and support for the ETS. Few generalisations are meaningful at this level, however, since each country will have different political preferences and considerations in the context of wider tax and consumer debates.

If revenues are earmarked within the business sector, distributional impacts will similarly hinge upon how these revenues are targeted. One example of national earmarking is the UK Carbon Trust, which receives revenues from the UK Climate Change Levy that is then used to support investment by UK companies in improving energy efficiency, and in the process of commercialising new and emerging low carbon technologies. The aim is both to reduce energy costs for British companies and enhance their longer-term competitiveness by accelerating the use of advanced technology. In general, the use of CO_2 auction revenues to support R&D, demonstration projects, regional development bodies and possibly also supporting infrastructure is likely to be viable under state aid rules.

However, the use of auction revenues to mitigate the impact on downstream sectors (such as aluminium) on a larger scale is likely to be somewhat limited by state aid considerations (see below). Nevertheless, by introducing an additional degree of freedom, auctioning some fraction of allowances creates the potential for a more equitable distribution of the economic rents associated with emissions trading.

2.3 Competitiveness effects

Just as it is widely (but usually wrongly) assumed that auctions lead to increased costs on downstream consumers, it is also widely assumed that free allocation helps to reduce

[14] Cramton and Kerr (2002) note that in the U.S. cellular communications licence example, prices happened to fell when the scheme shifted from free allocation to auctions because of an increase in competition.

[15] Some cost differential might be expected by the logic in section 2.5 below on the perverse dynamic incentives created by repeated free allocations. The fact that the assumption of profit maximisation does not fully capture reality is discussed in section 4.1.

potential adverse impacts of the EU ETS on the competitiveness of European industry relative to countries without CO_2 controls.

However, many participating sectors, such as the electricity sector, are not directly exposed to foreign competition, so competitiveness concerns are not directly relevant. Exceptions may apply to closure and investment decisions, which are affected by the allocation of free allowances — as illustrated at the example of the power sector in Neuhoff et al. (this Issue). Furthermore, although downstream industries are affected by increased electricity prices, recall that the electricity price increases they face should not differ much under grandfathering or auctioning.

Competitiveness concerns arise mainly in the sectors which (i) face significant cost increases, and (ii) are most exposed to competition from outside of the ETS. This includes industries like cement, steel, non-ferrous metals and some chemical products. Although the shift from grandfathering to auctioning does not normally have much impact on costs at the margin,[16] it does affect is the *gross revenues* of companies. Free allocation is essentially a one-off subsidy that helps companies maintain a good balance sheet in the face of higher operating costs. Auctioning reduces the scale of that subsidy. Alternatively, for companies which are not focused on near-term profit maximisation, free allocation provides a subsidy to fund the protection of market share by under-pricing (e.g. limit pricing, see Smale at al., this Issue), and auctioning reduces that capacity. As such, the general conclusion is that free allocation can act as a temporary subsidy to support firm balance sheets, but the choice between this and auctioning does not fundamentally change competitiveness in the longer term.

2.4 Legal considerations

As grandfathering and auctioning are mechanisms which allocate valuable assets, legal considerations are relevant. State aid considerations may place limits on the scope of free allocation. On the other hand, legal arguments might be put to support the view that firms have the 'right to emit' which cannot be taken from them, or that auctioning would adversely affect decisions that were made in reliance upon previous regulatory structures remaining in place.

The view that firms have a *right* to compensation for the establishment of, or changes to, the EU ETS, can be dispensed with rather quickly. It is clear that legislative bodies have the authority to change regulatory frameworks, particularly when regulated activities are harming others; indeed, there was never a 'right to emit' but only the freedom to do so until regulation provided otherwise. The argument that investors should be compensated for decisions made prior to the EU ETS (such as building a coal power station in 2000) relying upon the assumption that no new regulation would enter into

[16] As already noted, an exception may apply when the allocation method has perverse dynamic effects, as discussed in section 2.5.

force is only marginally more persuasive — it is well established that if government has a good public interest reason, it can restrain the use of an asset and there is no legal obligation to compensate as long as only the use is constrained but no expropriation performed.

Even if firms have no right to compensation, governments may wish to compensate adversely affected industry to enhance the credibility of their claims of investment certainty, and to continue to attract private sector investment. However, absent a specific justification, payments to industry may, prima facie, constitute state aid. A justification might be provided by analogy to the 'stranded cost regime' formulated and applied by the Commission under the 1996 electricity directive, which allowed for such compensation in the electricity sector. Similar arguments might be applied to other sectors.

If governments want to compensate investors for adjustment to regulation/legislation, this would motivate some free allocation of allowances during a transitory period to compensate investors that made investment decisions before there was reasonable expectation of carbon controls. Different views exist about when this was. Most of those involved in the international process would argue it to have been 1990[17] or a couple of years thereafter.[18] Later relevant landmarks include the adoption of the Kyoto Protocol in 1997, the EU's Green Paper on emissions trading in 2000, and the EU's ratification of the Protocol and adoption of the ETS Directive in 2002. Whatever year is considered applicable, however, as time passes fewer and fewer investments will be able to make the claim that costs were sunk before a reasonable expectation of carbon controls.

Far from having a right to compensation, the balance of legal arguments seem heavily (and increasingly) weighted to the view that any such compensation is prohibited under state aid rules. Indeed, European competition law may create pressures to reduce the free allocations to industrial emitters so that they are proportionate with the (otherwise) forgone profits from to the introduction of ETS (Johnston, this Issue).

Finally, requiring firms to pay for the right to pollute is consistent with the *polluter pays principle*, which starts from the premise that the right to a clean environment is owned by the public: from this basis, if firms wish to pollute the environment, they must purchase the right to do so from the public, rather than being given it for free.

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[17] The publication of the IPCC's First Assessment Report and the UN General Assembly Decision to launch negotiations on tackling climate change.

[18] The UN Framework Convention on Climate Change, which agreed on the nature of the problem and the need for action led by industrialised countries, was signed at the Rio Earth Summit in June 1992 and ratified by the US Senate later the same year, and entered into force a year later. It was also in the period 1990-1992 that the EU developed proposals for a carbon tax, later made conditional on action by other countries.

The clear conclusion is, therefore, that legal principles are a very shaky basis from which to argue against auctioning. On the contrary, legal considerations suggest that auctions may be favoured over free allocations.

2.5 Reducing distortions and perverse dynamic incentives

An additional problem with free allocation is that it can lead to rather perverse dynamic incentives. For instance, if future allowances are allocated as a function of present emission levels, firms have an incentive to emit more now in order to extract a larger allocation in the future.[19] Similarly, if free allocation to existing installations is relatively generous, while allocations to new installations are more restrictive (as it is in many Member States) incentives are created for plant lifetime-extension rather than plant modernization or replacement.[20] These perverse incentives are eliminated by certain allocation mechanisms (e.g. benchmarking or once and for all grandfathering), and such problems do not arise if allowances are auctioned.

This phenomenon arises in two other papers in this Issue. In the electricity sector, Neuhoff et al. (this Issue) illustrate that the sheer value of free allocations in a sequentially negotiated trading systems makes it hard to avoid some distortionary effects. Demailly et al. (this Issue) also confirm that if allowances are allocated as a function of production whether contemporaneously (as in 'output-based' allocation) or in the future (as with updating), output choices are correspondingly distorted. Auctioning would, obviously, reduce or eliminate these effects.

2.6 Transaction costs of allocation processes

The final 'traditional' area of dispute concerns administrative costs. The Phase I National Allocation Plans involved negotiation over allowances with a total asset value of almost €50billion/yr (assuming an average price of €20/t CO_2). Political decisions on how to allocate these assets between sectors and individual installations naturally creates intensive lobby activity by all participants to obtain the maximum possible share of the rents.[21] The time and energy devoted by companies, governments and indeed consultancy and research sectors to this enormous rent allocation process represents huge transactional costs.[22]

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[19] Additionally, if the rules provide for higher allocations to dirtier new entrants, then entrants have an incentive to construct more carbon intensive facilities than is economically efficient.

[20] This is analogous to the 'ratchet effect' in economic theory (Freixas et al., 1985) and clearly reduces the efficiency of the trading scheme.

[21] The need for lobbying may exacerbate the dynamic incentive effects discussed in Section 2.5 if firms make inefficient investment decisions to improve their bargaining position for free allowances.

[22] The relative paucity of published academic work on this huge scheme is evidence of this process – most academics and think tanks are caught in extensive consulting exercises for either governments or industrial participants on the rent allocation, rather than devoting their attention to forward looking studies on how to create innovation, least cost abatement and appropriate institutional changes.

Estimates of transactional costs must account for the fact that the allocation process imposes significant risks upon both firms and government. Many firms fear being 'caught short', and these fears may be amplified by their lack of experience and confidence in trading on the secondary market and concerns about the future availability of permits. The government (and the public at large) bear the risk that the allocation process will end up being unfair on some sectors, and overly generous to others. The government's response to this risk is to devote considerable resources to the process of 'allocation assessment'. Furthermore, transactional costs involved in free allocation are likely to increase in the future, as more complex allocation schemes (e.g. benchmarking) are employed to reduce other unwanted consequences.

In principle, auctioning more of the allowances reduces the volume of free assets open to lobbying, and therefore reduces the 'rent scrap' of these allocation negotiations. It would also help both firms and government manage their real and perceived risks — firms are less likely to be 'caught short' when they can buy permits at the next auction, and governments could redeploy their resources now spent on 'allocation assessment'. Of course, auctioning also involves administrative and other transaction costs. Thus, whether auctioning increases the overall implementation efficiency of the EU ETS may depend upon the design of the auctions, which we consider shortly.

2.7 Summary of the traditional arguments

Table 1 presents a summary of the arguments considered in this section. In addition to the reasons favouring some auctioning compared to 100% free allocation, it is notable that some auctioning might be preferred to simply cutting back free allocations by the same amount. If the market is liquid and — as considered below — auctions are open to all bidders, the choice between buying at auction and buying on the secondary market may make little difference to individual companies. However, at the economy-wide level, auctions release allowances into the market and thus do not raise the carbon price as much as cutbacks of the same quantity. They also have more desirable characteristics in terms of macroeconomic efficiency, distribution and lessening of perverse dynamic incentives, as discussed. We now turn to examine how allowance auctions might be designed.

Table 1: Summary of issues

Issue	**Favours**
Static efficiency	Auctions
Distribution of rents	Auctions in theory, free allocation in practice
Competitiveness	Depends upon use of auction revenues
Legal considerations	Auctions
Dynamic incentives	Auctions
Transactions costs	Uncertain, favours auctions in medium term

3. How to auction EU ETS allowances

The allocation of EU ETS allowances has several features in common with the sale of government securities such as T-Bills and Gilts, provided Member States do not impose strong restrictions on participation.[23] In both cases there is a large number of potential bidders and a large number of identical goods which can subsequently be traded on a secondary market. Member States therefore have an opportunity to create a very competitive and efficient auction environment, as in the case of securities. Bearing in mind these similarities, we discuss some basic issues for the design of EU ETS auctions.

3.1 Multi-unit auction design

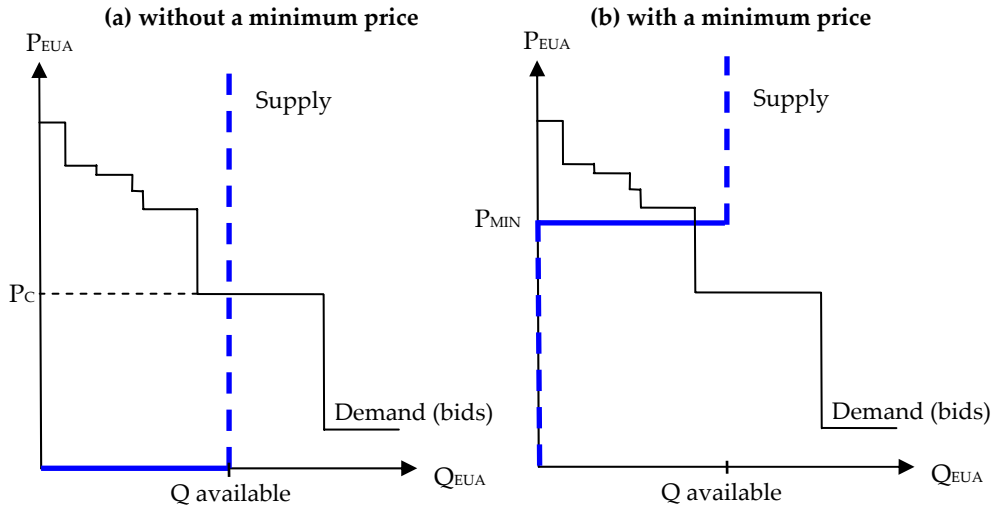
There are many possible formats for auctions of EU ETS allowances which can be divided into two broad types. These are *ascending-bid* auctions, in which bidders have the opportunity to raise their bids during the auction, and *sealed-bid* auctions in which bidders submit only their final offers. The preferred choice of format depends on the circumstances. For example, ascending-bid auctions may be easier to understand for inexperienced bidders and have been recommended for auctions of UK greenhouse gas emissions reductions in 2002 (Klemperer, 2004 p.135) and the New Entrants Reserve (NER) in Phase I of the EU ETS in the UK (DTI, 2005).[24] However, in the case of EU ETS allowances, as long as Member States do not unnecessarily restrict competition in auctions (e.g. by allowing only one sector to participate in any given auction), there are many potential bidders and sealed-bid auctions should perform well.

In a sealed-bid auction, participating bidders submit confidential bids in the form of demand schedules, which specify how many permits a bidder would be willing to buy at any given price. These bids are added together to form an aggregate demand curve and a market clearing price is determined as the point at which aggregate demand equals supply. Winning bids are identified as those above the clearing price. Figure 1(a) provides an illustration of a sealed-bid auction, where P_C denotes the market clearing price. In section 4.2 below, we discuss the idea of Member States agreeing a reserve price for auctioned allowances. Figure 1(b) shows an example where this reserve price, P_{MIN}, binds. In the case shown, P_{MIN} is higher than the clearing price, so not all the allowances are sold at auction.

[23] Eligibility and participation issues are considered in section 3.2 below.

[24] The 2002 auction of emissions reductions was a reverse auction in which bidders competed to sell reductions to the government. Concerns about encouraging entry led to the use of a descending-bid auction format (the mirror image of ascending bids in a standard auction). The fact that this was the first ever auction for greenhouse gas reductions and the relatively small scale of the market meant that small bidders could have been deterred by the costs of having to formulate a strategy in a sealed-bid auction. (The small scale of the auction meant that having a non-competitive bid facility of the kind that would mitigate these concerns would be impractical.) The government was keen to promote entry both to increase competition in the auction itself and to ensure a liquid secondary market (Klemperer et al., forthcoming).

Figure 1: Market clearing price



Two variants of the sealed bid auction are the discriminatory and uniform-price formats commonly used to issue government securities. The two formats differ in the payments that winning bidders must make. In a uniform-price auction, every winning bidder pays the market clearing price. In a discriminatory auction, every winning bidder pays its own bid for the units it wins. For example a bidder who bids for 20 permits at €30 each and a further 10 units at €20 each pays a total of €800 if all the bids are above the market clearing price.[25]

Because both formats are now well established, Member States and potential bidders would be — or could easily become — familiar with the rules of either auction. Using these familiar formats would also address concerns about auctions being untested or over-complicated. Both discriminatory and uniform-price formats would be feasible and low-cost for Member States.[26]

There are two important considerations relevant to the choice between uniform and discriminatory formats. First, it is often argued that it is simpler for bidders to formulate bidding strategies in a uniform price auction, promoting participation and competition. In a discriminatory auction, small or inexperienced bidders may find it difficult to

[25] An alternative type of sealed-bid auction is the *Vickrey* auction, where a winning bidder's payments equal the bids of the losers who would have won in the absence of his participation. The winner thus pays the opportunity cost of his bid. Vickrey auctions are of great interest to academic auction theorists and have been shown to have desirable theoretical properties (Ausubel and Cramton, 1998). However Vickrey auctions are much harder for participants and the public to understand, and as long as bidders have very little market power uniform-price auctions produce similar results.

[26] This is not to say that alternatives should not be considered, or that either option is necessarily the preferred auction format for every Member State. However the low costs of such formats (e.g. compared with ascending bids) and the fact that Member States can draw on the experiences of securities markets suggest that discriminatory and uniform-price auctions should be thoroughly examined.

anticipate the market clearing price and may be deterred from bidding for fear of making costly mistakes.[27] This might arise if secondary and futures markets are illiquid and there is a great deal of uncertainty over prices.[28] In the case of EU ETS allowances, one would expect greater uncertainty towards the beginning of a trading period (e.g. in the year 2008 for the 2008-12 period) when fewer allowance trades will have occurred.

If low participation by smaller bidders is a concern, non-competitive bids could be permitted. A bidder who submits a non-competitive bid is guaranteed to win the desired units in the auction. In a uniform-price auction, the price is simply the market clearing price, while under discriminatory pricing the non-competitive price is an average of the conventional winning bids. Bidders can therefore limit risk by submitting non-competitive bids, particularly in discriminatory auctions.[29]

Second, the revenue raised may differ between pricing formats. Without reflection, one might expect uniform-price auctions to raise less revenue than discriminatory auctions, where bidders pay their bid. However, this ignores the fact that bidders will adopt different bidding strategies under different auction formats. In a discriminatory auction, bidders have a strong incentive to shade (i.e. lower) all of their bids in order to avoid paying much more than they need to for each unit. In a uniform-price auction, bidders will only shade their bids if they think that this may influence the market clearing price. As such, it is not clear *ex ante* which auction will produce higher revenues or more efficient allocations.[30]

Nevertheless, there is some evidence from securities auctions that uniform-pricing raises *more* revenue and produces less concentrated allocations (e.g. Archibald and Malvey, 1998), and it was partly on the basis of this evidence that the US Treasury switched to a uniform-price format in 1998. Furthermore, the UK Department of Trade and Industry expressed a preference for uniform over discriminatory pricing in Phase I NER auctions (DTI, 2005).

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[27] One possible problem is the "winner's curse". The value of winning a tradable allowance is similar for bidders because they will all face the same resale price on the secondary market. In this kind of "common value" auction, the bidders estimate what this price will be and bid accordingly. However the most likely to win is also the most likely to have overestimated the price, and bidders need to shade their bids to account for this.

[28] In the United Kingdom, index-linked securities (gilts) are sold in a uniform-price auction, while conventional gilts are sold using discriminatory pricing. The Debt Management Office explicitly attributes this decision to the greater uncertainty surrounding prices of index-linked gilts and the illiquidity of secondary markets.

[29] If non-competitive bids are permitted in securities auctions they typically comprise a small proportion (about 10-20%) of the issue.

[30] There is also the possibility of 'demand reduction' in uniform-price auctions (Ausubel and Cramton, 2002).

In summary, as long as entry by bidders is not artificially restricted, EU ETS auctions are likely to be very competitive and efficient. There are several possible auction formats, but the most likely candidates are the sealed-bid uniform-price and discriminatory auctions, used in sales of government securities. The limited evidence that we have slightly favours uniform-pricing, especially as bidders appear to find uniform-price auctions more straightforward. If participation is a concern, then non-competitive bids may be used.

3.2 Eligibility and Participation

The most important objectives of auction design are to promote competition and to encourage entry. Consequently auctions for EU ETS allowances should ensure the widest possible participation by bidders from all sectors. Artificially restricting participation to national buyers or specific sectors is likely to impair revenues and the efficient allocation of allowances.

Nevertheless, only one of the four governments that auctioned in Phase I opened the auction to all EU bidders. Given that allowances are readily tradable, national or sectoral bidders will only benefit from restrictions on participation if auction prices are significantly lower than those in the secondary market. Despite the arbitrage possibility, prices at auction may be lower than on the secondary market if poor auction design facilitates non-competitive or collusive behaviour by bidders. The net result would be a reduction in revenue and an implicit subsidy for bidders.[31]

Increasing the number of eligible bidders is desirable because it is likely to lead to greater competition and higher auction revenues. However, even if they are eligible, small bidders are unlikely to participate directly in auctions because of the transaction costs involved in formulating and submitting bids. Moreover the institutions responsible for conducting the auctions face costs in dealing with each bidder (e.g. in ensuring compliance with capital requirements or securities regulations).

One option is to allow current dealers on the ETS secondary market to become "primary dealers" who can bid on their own accounts or on behalf of clients. Because these dealers would participate more regularly than individual buyers some transaction costs could be avoided. Small buyers might even be encouraged to participate via a dealer when they would not be willing or able to do so directly.

In order to prevent either primary dealers or their clients from manipulating the auction price, limits could be set on the size of any individual bidder's share of the allowances

[31] This is then equivalent to partial grandfathering, and the various arguments discussed in Section 2 above are applicable. If such subsidies are justified in some manner, there would be better ways of delivering them than by distorting the auction design.

allocated in an auction. Manipulations of the secondary market (such as 'short squeezes') will probably not be a major consideration as the proportion of allowances sold at auction will be relatively small.[32]

3.3 Allocation of free allowances

Obviously, auctioning allowances in Phase II reduces the allowances that are available for free allocation. Governments must determine how the remaining free allocations are distributed between sectors. An obvious and simple approach is to reduce the allocation to all sectors by 10% (or the proportion chosen for auction). Nevertheless, given the differential pass-through of costs between sectors, discussed in section 2.2 above, it may be considered politically appropriate to compensate for undesirable distributional consequences by adjusting the allocation between sectors. For instance, sectors with higher rates of cost pass-through might receive a smaller share of free allocation, while others would receive a more generous allocation.

3.4 Auction periodicity

The principles

How often should auctions be performed? At one extreme, the entire allocation could be sold at the beginning of the five-year period. Large infrequent auctions would minimize administrative and transaction costs and might also promote competitive bidding between bidders for whom this is the only chance to buy allowances at auction. However, we believe more regular auctions are advisable, for a number of reasons.

Smaller and more frequent auctions are likely to encourage participation by smaller bidders. For example, firms who wish to purchase at auction rather than on the secondary market may not have a large enough line of credit to purchase five years worth of permits in advance. This is a substantial asset to hold on the balance sheet and one-off auctions might deter small bidders without "deep pockets". These bidders would still trade on the secondary market, but the auctions themselves would be less competitive.

By providing a steady injection of liquidity more frequent auctions would limit the impact of any individual auction on market prices. Periodic auctions might also enhance price stability and the management of uncertainty, as discussed below in Section 4. Although market interactions are unlikely to be problematic for Phase II, where only 10% of allowances can be auctioned, the impact on the market is likely to become more

[32] US treasury auctions restrict bidders to 35% of supply in any auction but these rules have occasionally been circumvented. In 1991 Salomon Brothers admitted to submitting fraudulent bids in the names of their clients in order to squeeze short sellers in the "when-issued" market.

important if and as a greater proportion of allowances are auctioned over time.[33] Furthermore smaller auctions reduce or eliminate any residual (and probably unjustified) concern that participants with market power would buy large fractions of the allowances and subsequently extract oligopoly rents on the secondary market. Multiple auctions would allow other players to adjust their bids in later auctions in response to any initial strategic purchasing by large players.

Auction frequency with 25 countries.

Finally, periodicity also depends upon whether Member States coordinate their auctions. If Member States run their auctions independently, then staggering their timing would ensure a gradual release of liquidity. For instance, if all 25 Member States run quarterly auctions, there would be two allowance auctions every week, which seems too frequent. Even annual national auctions could result in an auction somewhere in Europe every two weeks. At the opposite extreme, Member States could collaborate and coordinate the timing of their auctions, considered briefly below.

The ideal trade-off between ensuring a competitive auction with low transactions costs and providing steady liquidity is difficult to judge before we have gained more experience with allowance auctions. If auctions were to be based on experience with electricity markets, then a frequent uniform price auction (e.g. weekly), would allow small participants to directly acquire the allowances they need to cover their emissions in the auction.[34] High frequency would ensure that bidders pay a price close to the price on the secondary market at the time of emission, thus limiting risk exposure. In electricity markets this approach has been successfully implemented with low transaction costs (various pool type market designs).

If, on the other hand, EU ETS auctions were to be more guided by the experience of Treasury bill auctions, then less frequent auctions (e.g. 1-3 times a year) would be envisaged. A simple uniform price format might be employed, but less frequent auctions would also allow the use of a wider range of auction formats. Of course, a more complex auction format, requiring more careful preparation of the bid, would increase the costs for small players to directly participate in the auction. Very small players are therefore likely to obtain their allowances from intermediaries, who would provide risk hedging and other services, arguably at a cost reflected in lower auction revenue. This approach also has the benefit of supporting liquidity in CO_2 spot markets.

Finally, note that Member States could consider auctioning in advance; auctions for 2008-12 allowances, for example, could and probably should be held before 2008 to help the market form price expectations.

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[33] Auctioning permits all at once would increase liquidity in the secondary market. However since only 10% of allowances will be sold at auction this is unlikely to be a major concern.

[34] A discriminatory price auction with non-competitive bids could also be used.

3.5 Auction competition and coordination

In principle there is no reason why Member States should not hold auctions entirely independently of each other. The question of how actions in one country might affect others would then need to be considered; in effect, governments themselves might become active "market players", judging the timing and volume of auctions in relation to market projections, including expectations about the auction decisions of other Member States – a kind of "auction competition". It is not clear how desirable it would be for the legal authorities responsible for forming the market to then become active players in it, and whether this might lead to conflicts of interest. How numerous auctions might interact with the auction method is another issue to be considered - especially if some of the auctions are very small, enabling large players to influence the outcome.

For these and other reasons, Member States might consider "pooling" auctions under the same rules. In particular Member States with fewer allowances to sell might decide to hold joint auctions and to divide the revenue according to their share of supply. Coordinating the timing of auctions might also aid price stabilisation.

The ultimate manifestation of this would be for all countries that hold auctions to pool together, in EU-level auctions. It is unlikely that Member States would give up revenues, but that is a separate issue; there would be nothing to prevent central EU institutions managing the auctions and returning revenues to Member States. De-linking decisions on auctions in this way from the revenues generated would avoid any potential conflict of interest. And to have some element of EU-level auctions may be inescapable for some of the more "active uses" of auctioning, to which we now turn.

4. Active auctioning: hedging, pricing and border adjustments

Section 2 above set out the main debates around auctioning, concluding that these offer strong arguments for a degree of auctioning, probably increasing over time. Section 3 indicated that there are no significant operational problems in conducting such auctions. In our view, however, these are not necessarily the only interesting and important benefits of auctioning. In addition to the distributional and incentive properties, there may be other important practical roles for auctions in the context of the EU ETS that have as yet been inadequately considered, and we now turn to examine these issues.

4.1 Management attention

Economic analysis tends to assume that firms maximise profits. This assumption drives the result, noted in section 2.2 above, that cost increases passed through to consumers should depend on the marginal cost increase – driven by the carbon price – not directly by the method of allocating allowances. In practice, although an assumption of narrow profit-maximisation is not egregiously wrong, it is an idealisation that obviously does

not fully capture reality. The behaviour of people and firms embody considerable inertia and they often use heuristics and 'rules of thumb'.[35] One relevant example from the energy sector emerges from the experience with financial transmission rights in the North East of the US. There it was found that the free allocation of transmission rights dampened the industry response to price signals. To increase responsiveness subsequently, all transmission rights were auctioned and revenues returned to initial owners of the rights.

If the allowances given to firms cover the bulk of their emissions, there is no risk exposure and few cash flows. In these conditions, the EU ETS may well be handled by environmental compliance departments, particularly in smaller companies, rather than moving up to affect investment, operational and strategic decision making. Indeed the design of the EU ETS and its focus on facilities itself reflects its origins in EU environmental regulation, with emphasis upon compliance. In these conditions, the current arrangement largely allows companies to carry on emitting as they would have in the absence of the scheme. Worse, it may foster a psychology that firms must put their main emphasis upon lobbying for all the allowances they project to be needed, rather than on considering or implementing their real opportunities for abatement, particularly in sectors characterised by smaller firms or lower energy intensity.

Thus, the effectiveness of the trading system might be substantially improved by mechanisms which prompt an active response from management. Two options would appear to grab management attention, namely cutbacks in allocation and auctioning. Allowance cutbacks are also emerging as a way of addressing the profits accruing to the power sector.[36] Given lobbying, market uncertainty and price volatility, as well as the macroeconomic dimensions considered in section 2, auctioning might well be seen as the preferred method. Auctioning could help to get the desired response to the regulation, as the increased financial flows may shift management attention to include allowance costs when optimising production decisions.[37]

4.2 Auctioning and price stability in Phase II

Since the EU ETS market opened in January 2005, prices have been quite unstable: they rose more than expected, had a couple of periods of volatility in the range €20-30/tCO_2, crashed in Spring 2006 as real data on verified emissions for 2005 were released, and at the time of writing are oscillating wildly as governments debate options for shoring up

[35] As documented and analysed more fully in the growing literature on behavioural economics. For specific examples see Gigerenzer and Goldstein (1996) and Gigerenzer (2003). Of course, the use of heuristics per se is not *necessarily* inconsistent with profit maximisation.

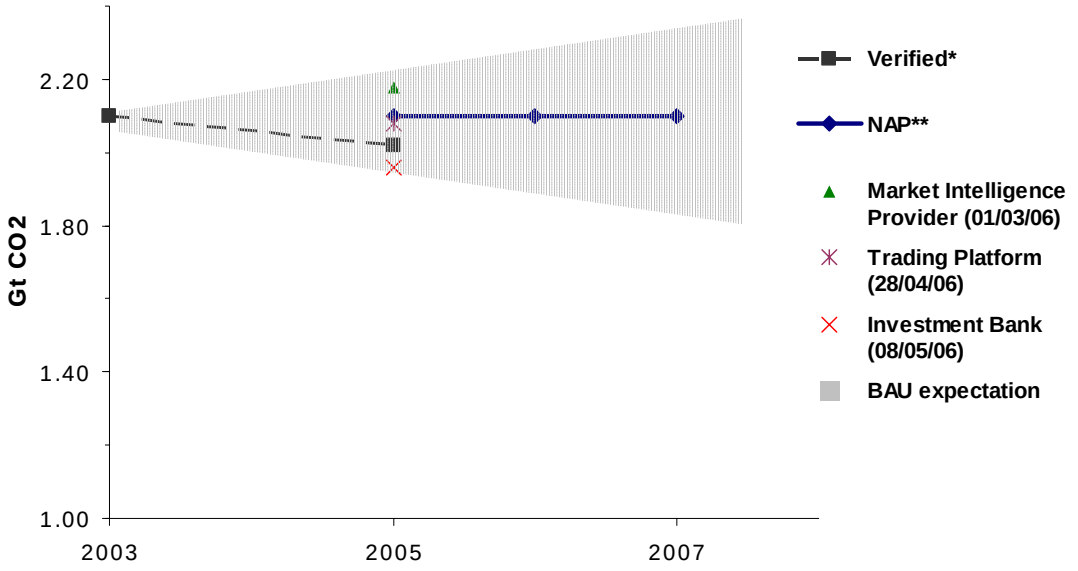
[36] Allowance cutbacks to power generators would reduce total allowances, increasing the allowance price. In contrast, auctioning would not have this effect. As such, downstream sectors should clearly prefer auctioning to an equivalent allocation cutback.

[37] Auctions might also raise shareholder awareness of carbon costs, and alert them to the possibility of savings through abatement, resulting in greater pressure on managers to reduce emissions.

the price. The fundamental cause is that the projections upon which allocations were based embodied far greater uncertainty than was acknowledged, and the cutbacks were well *within* the range of the uncertainty.

This is illustrated dramatically by Figure 2, which compares verified emissions (for 21 of the 25 countries covered by the EU ETS)[38] — the declining line from 2003-5 — with actual allocations for 2005-7, and estimates made in the run-up to the data release. Allocations exceeded emissions by close to 100MtCO_2; the gap could easily have been even bigger.[39] Yet, *even as late as Spring 2006*, there were retrospective estimates from a leading provider of market intelligence that turned out to be completely wrong. The uncertainty in the original projections upon which NAPs had been based was, of course, far wider still. This gives some indication of the uncertainty inherent in predicting emissions and abatement responses — and hence, of prices and costs.

Figure 2. Uncertainty on emissions from installations covered by the EU ETS



Uncertainty in future allowance prices leads to delay in investment decisions. By waiting, a company gains more knowledge about future CO_2 prices, and thereby makes better decisions. Furthermore, in the presence of price uncertainty, risk aversion is also likely to reduce investment.[40] The risk of low CO_2 prices, or even a price crash due to allocations based on high emission forecasts, represents a significant hurdle for

[38] It is assumed that Poland, the main unknown, has an 18% excess allocation, similar to Hungary and Czech Republic.

[39] Big gas price increases during 2004-2005 led to a switch back to coal in power generation, increasing emissions. This indeed was the principal factor behind the initial increase in CO2 prices. Had gas prices stayed low, emissions from the dominant power sector would have been lower and the gap between emissions and allocations probably even larger.

[40] These are classic results of real option theory. See Baldursson and von der Fehr (2004) for a more sophisticated discussion of the impact of risk aversion.

investment in low-carbon investments. Obviously, companies are prepared to bear risks, but they generally prefer to take risks in their core business, where this can create strategic opportunities.[41]

Clearly, policies which can provide a greater degree of price stability in the EU ETS would be valuable.[42] One approach is to impose a price ceiling and a price floor on the market,[43] and auctioning could play an important role in facilitating this.

An absolute, unbreakable price ceiling could only established if an appropriate government institution agreed to provide an unlimited supply of permits to the EU ETS at a fixed price, which would be difficult to align with the commitment of European Member States to their cap under Kyoto.[44] With only 10% of the allowances available to auction in Phase II, there is no practical way in which auctions could set an 'unbreakable' price ceiling, but auctioning could reduce the risk of price spikes if some allowances were held in reserve and only released on to the market in the event that price went above some pre-determined level for a certain duration. A limited auction capacity of this nature would, however, have to address potentially serious problems of gaming the system.[45]

Auctions probably offer a more ready and 'game proof' approach to supporting, though not dictating, a price floor.[46] Governments could agree that part of the allowances held back for auction would be sold above a reserve price (eg. €15/t CO_2.). Given the limited volume (because of the 10% maximum under the Directive), this could not *guarantee* a particular price floor, but it could make a useful contribution to price stability. There are two main cases to consider.

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[41] Furthermore, asymmetries in risk hedging and allocation have an impact. Utilities in the power sector (with a more conservative risk profile and relatively restrictive allocations) have needed to buy from other sectors, which were under no pressure to sell surplus allowances. This sellers' market arguably inflated prices. Auctions on a regular basis (e.g. biannually) would improve directly and indirectly the liquidity of the market by reducing this type of problem.

[42] The ability to bank allowances from Phase II into subsequent periods in theory can contribute to price stability; in practice, given the fundamental uncertainty about the nature of post 2012 commitments at present, this may remain a marginal consideration for much of Phase II (we return to the topic in the following section).

[43] In the limit, if the ceiling and the floor are equal then obviously the allowance price would be fixed, and what was 'quantity instrument' would now effectively become a 'price instrument'.

[44] On price capping, see, eg, Pizer (1997, 2002), Aldy, Orszag and Stiglitz (2001), McKibbin and Wilcoxen (2002), and Jacoby and Ellerman (2004). The EU directive prohibits ex-post adjustment of national allocation plans, hence national governments could not sell additional allowances after the submission of these plans.

[45] For example, market players might artificially create a price spike to prompt the release of allowances into the market. The experience with speculative attacks on currency and exchange rate controls provides some important lessons.

[46] An absolute price floor in the EU ETS could be established if a government institution agreed to *purchase* an unlimited number of permits at a fixed price. If sellers are guaranteed this floor price by selling to the government, the market price will not fall below the floor. Treasuries, however, are typically reluctant to sign up to such financial liabilities.

(a) Tight market. If external supply of JI and CDM credits is limited or constrained (perhaps by additionality criteria), and if abatement is also limited or expensive, the participating sectors may want to purchase all of the auctioned allowances. In this case the reserve price in the auction, P_{MIN}, translates to a price floor for ETS. Figure 3 illustrates this idea. In figure 3(a), without auctions, the EUA price P* is determined by the point at which the demand curve crosses Q_{Kyoto}. In figure 3(b), 10% of the allowances are removed from circulation, and auctioned back at or above the reserve price, P_{MIN}. A proportion of the auctioned allowances remains unsold, and the EU ETS price now equals P_{MIN}.

(b) Loose market. Second, if supply of JI and CDM credits increases significantly or large emission reductions are achieved in the ETS sector, then the allowance price could drop below the reserve price of the auction, as illustrated in Figure 4. The auction reserve price still increases the EU ETS price from P* to P_A* (compare figures 4(a) and 4(b)), because the withdrawal of 10% of the allowances from the market ensures that the price is higher then it would have been otherwise.

*Figure 3: Auctions when JI/CDM supply is **not** important*

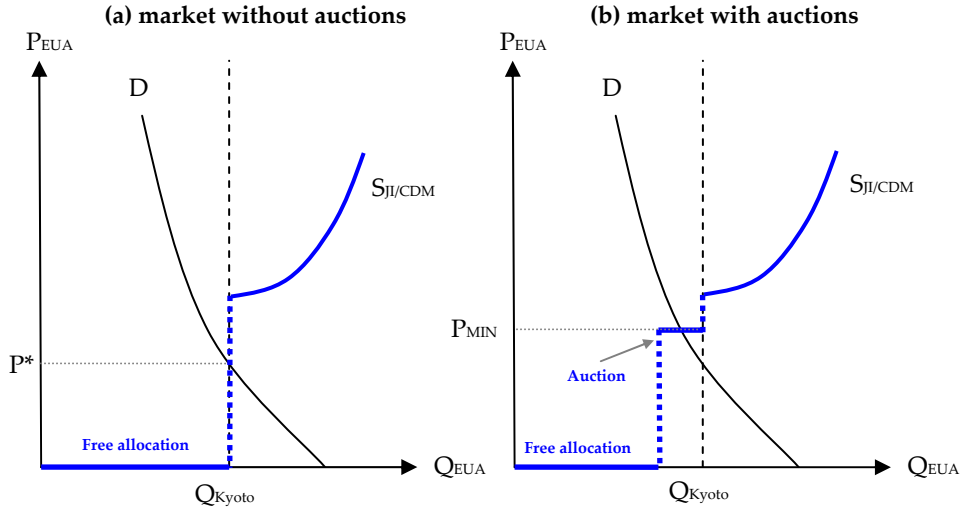
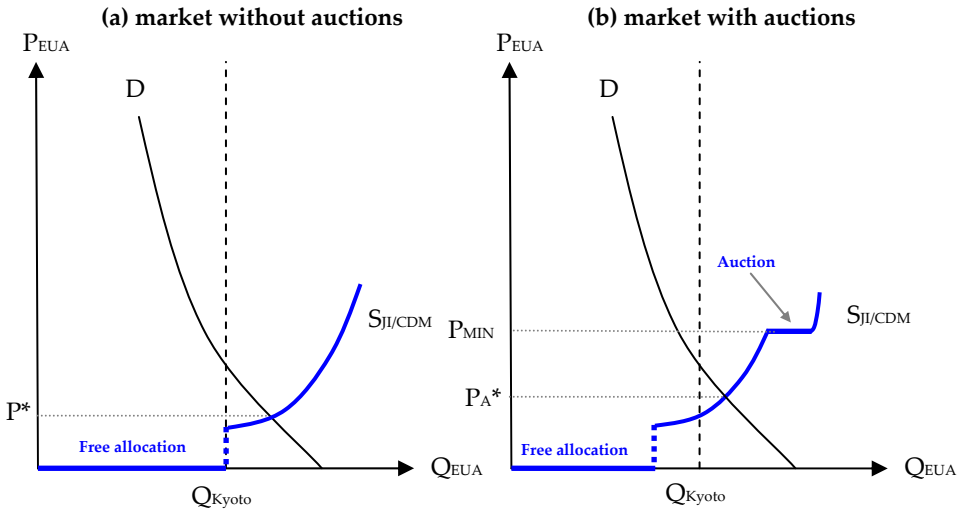


Figure 4: Auctions when JI/CDM supply is important



Setting an auction reserve price would only have no impact in two unlikely situations. First, with very weak emission targets (or extremely cheap abatement) the allowance price might drop to zero, even if only 90% of the allowances are available.[47] No company would purchase at auction, and the price would remain at zero. This theoretical possibility, however, seems highly unlikely.

Second, if ETS prices are already well above the reserve price, P_{MIN}, then the reserve price is irrelevant — the allowances will be sold at a clearing price above P_{MIN}. Nevertheless, even in this situation, auctions provide indirect beneficial effects, including greater price stability ex ante, and hence increased investment in low carbon technologies.

Using a reserve price auctions to increase price stability is a simple mechanism that could improve the performance of the scheme, but it would require commitment and coordination between Member States. This is an area in which "auction competition" might be problematic, since, under certain conditions, each Member State might have an incentive to fractionally undercut the others in its "reserve price". It may be advisable for Member States to place some fraction of their auctionable allowances in a common pool, to be auctioned at the EU-level auctioning under the agreed price terms; revenues would then be returned to the Member State in direct proportion to their share of the auction pool. A binding commitment would be required to ensure that governments did not withdraw allowances from the common pool and undercut it in the event of a soft market — something which would shatter the confidence of private sector investors.

[47] This would be reflected in figure 3 by the demand curve shifting down to cut the axis in the free allocation area.

Extending these ideas, auctions could be used to enhance price stability by supporting a "price cushion" of the sort illustrated in Figure 4. The design for capacity markets for electricity generation in various states of the North East of the US indicates that it may be possible. Applying this approach to the CO_2 context suggests that governments could commit to a supply curve for additional CO_2 allowances where, for example, the first lot of allowances from the auction budget might be sold at a minimum price of €20/tCO_2, with increasing fraction of allowances sold at gradually increasing minimum prices. This allowance supply elasticity will complement the demand elasticity created by different abatement options and thus contributes to a reduction of CO_2 allowance price volatility. The implementation of such a scheme in a multi-period, multi-country auction would, however, require careful consideration. Initial price stabilisation might reduce the incentive of market participants to hedge their decisions, potentially exposing them to even higher risk in the case that all available allowances are auctioned and prices become more peaky.

In sum, the foregoing analysis suggests that within the current EU directive, auctions might play a useful role in serving to support a cushion for prices, reducing volatility and increasing investment security.

4.3 The feasibility of long-term price signals

The economics literature sets out a strong case that, in the context of a problem like climate change, fixing prices is more efficient than capping quantities.[48] The essential argument concerns the relative sensitivities of the benefits of mitigation, and the costs of control under uncertainty. If the marginal costs imposed by a given quantity constraint are very sensitive to the level of constraint (steep marginal cost schedule), but the marginal benefits of abatement relatively insensitive to the amount (a flat marginal damage schedule),[49] then price-oriented controls are more efficient.[50] Pizer (2002) finds that a price-oriented approach for near-term CO_2 controls could yield enormous net social benefits. In contrast, an equivalent absolute emissions cap is far less attractive — if the cap turns out to be wrong, the economic costs could rise sharply and offset the environmental benefits.

[48] Weitzman (1974) and Roberts and Spence (1976) provide the canonical theory. Pizer (2002) and Hoel and Karp, (2001, 2002) apply the theory to climate change, accounting for the fact that greenhouse gases are a "stock pollutant", not a "flow pollutant"..

[49] Note that assuming a flat marginal benefits curve does not imply that damages from climate change are small. It simply implies that damage from climate impacts do not *change* rapidly as a function of additional emissions. Assuming a flat marginal damage curve is probably accurate over a short period (e.g. 5 years), because climate damages are a function of the *stock* of greenhouse gases in the atmosphere, rather than the flow of emissions. This assumption is less appropriate over longer timeframes, and Hoel and Karp (2002) show that capping quantities becomes more attractive as the relevant policy time horizon is increased.

[50] See Hepburn (2006) for a simple presentation and review of the "prices vs. quantities" literature with an application to policy questions in health, transport, defence and the environment.

In practice, there are several reasons why pure price instruments are still rarely applied to environmental problems.[51] Given the political realities, the best feasible approach may be to design emissions trading systems to address price uncertainties. In a multi-period system like the EU ETS, allowing banking and borrowing creates several interesting possibilities, discussed by Newell, Pizer and Zhang (2005). For instance, parties might agree that the stringency of targets in the next period automatically depends upon the revealed price in the current period, with the relationship defined by the agreed target price.[52]

Auctions offer some additional approaches to providing a basis for a clear, long-term carbon price signal. First, mechanisms discussed above could be used to created a long-term "price floor". This could be implemented by auctioning all allowances with a reserve price equal to the price floor, coupled with a government commitment to repurchase allowances at the price floor. If credible, a price floor would increase investor confidence in the profitability of low-carbon technology investments.

Second, Helm and Hepburn (2005) propose that the revenue from auctions could be recycled to industry in a technologically-neutral way that provides long-term carbon price certainty. They outline a scheme in which national governments would sign "carbon contracts", under which the government would pay the private sector a fixed price (to be determined by another auction) for the supply of emission reductions over a long-time horizon, such as 20-30 years. A key feature of the scheme is that the "carbon contract" auction would be technology neutral, so that the government would be able to avoid the fraught process of 'picking winners'. Winning a carbon contract would provide low-carbon innovators with a reliable forward revenue stream which could be employed to secure project finance.[53] Note that the use of carbon contracts would not prevent governments from subsequently implementing more stringent climate policy, if appropriate.[54]

Auctioning EU ETS allowances would provide the Treasury with the public funds to pay for carbon contracts.[55] This would be politically appealing — spending auction

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[51] As noted above, taxes combine several politically difficult problems in one, and their history (as with the European carbon tax proposals of the early 1990s) is patchy and limited. Newell, Pizer and Zhang (2005) note some of the problems from a theoretical perspective. At the international level, the difficulties that would faced in trying to establish a harmonised, long-term, credible global carbon tax are obvious.

[52] Newell, Pizer and Zhang (2005) develop the mathematics of these approaches in detail.

[53] This could lead to the development of a more sophisticated forward market for long-term allowances, in which low-carbon innovators could hedge against future low prices by taking a short position (i.e. agreeing to provide reductions).

[54] Additional policies would not erode the credibility of the contract, which is so crucial in climate policy (Helm, Hepburn and Mash, 2003), because the price set in the long-term carbon contract is fixed and would not be affected by changes in the stringency of other climate policies.

[55] Alternative financing structures are possible. For instance, the government could require the emission reductions to be fungible with the EU ETS, such that the liability under the carbon contracts can be offset by

revenues on long-term carbon contracts would represent genuine revenue recycling to industry in a manner that enhances the environmental effectiveness of the EU ETS,[56] and also provides a much-needed long-term price signal.

4.4 The feasibility of border-tax adjustments

A final dimension of auctioning is its relationship to competitiveness through the use of border tax adjustments. It is difficult for energy intensive sectors to pass through the (opportunity) costs of CO_2 allowances to product prices if these prices are set in international markets. Persistent price differences might, therefore, drive new investors to regions not covered by stringent emission trading schemes, as discussed more fully in Grubb et al., this Issue.

If the effective CO_2 price differs between regions post 2012, investment in energy-intensive industries is likely to gravitate towards regions with lower CO_2 prices. Clearly, stringent CO_2 policy is only possible, in the mid term, if it does not undermine the competitiveness of a region or country. To protect competitiveness, energy-intensive sectors might be excluded from the ETS, but this would weaken the overall scheme. Alternatively, the allocation methodology of free allowances could be redesigned to reduce the impact of CO_2 prices on product prices. But this would distort investment and operation incentives and severely restrict substitution effects to less carbon intensive products, seriously undermining the effectiveness of the ETS in deliver CO2 emission reductions.

Border tax adjustment ('BTA') may be a preferable solution to facilitate the longer term extension of CO_2 policies in the absence of global agreement (Biermann and Brohm 2003). To make BTA compatible with WTO principles, tariffs must be set at the average costs of CO_2 allowances, excluding opportunity costs. Average costs are only significant with auctions, and thus a move to auctions is required to facilitate BTA. Ismer and Neuhoff (2004) suggest the following approach to address frequently voiced concerns about WTO compatibility (Esty 1994). Suppose a company producing one widget, with best available technology, emits X tons of CO_2 and consumers Y MWh of electricity in

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selling the allowances onto the EU ETS. Alternatively, the transmission systems operator could purchase the emission reductions under the carbon contacts, so that if any liability materialises it can be passed through to customers via transmission charges.

[56] To get a rough sense of the potential improvement in environmental effectiveness offered by recycling auction revenues into long-term carbon contracts, consider the following highly imperfect back-of-the-envelope calculation. If 50% of a member state's emissions are covered by the EU ETS, then auctioning 10% of Phase II allowances is equivalent to auctioning 5% of the applicable Kyoto limit. Now suppose the prices paid in the auction are similar to the prices the government pays for emission reductions delivered under the carbon contract. If the carbon contracts required delivery for 2008-2012, the government would thereby achieve an additional 5% reduction in emissions. Of course, the point of a long-term carbon contract is to extend beyond 2012, so they would deliver less than a 5% reduction over the first commitment period, but would also deliver emissions reductions after 2012. The net present value of the emissions reductions delivered should be within an order of magnitude of a 5% reduction in the first commitment period.

the process. Emission trading increases costs of this company by X times the allowance price and Y times the price increase of electricity due to emission trading. An auditing body will determine the factors X and Y for the best available technology of the relevant product groups, thus minimising administrative efforts (Zhang 1998). The auditing body would consult with industry, ensuring a balanced result between the differing interests of domestic and foreign industry. Any exporter out of the area covered by the emission-trading scheme will now be reimbursed for these costs. Older or less efficient plants will also be compensated at the level of the best available technology. On the flip side, a tariff at the level of these costs is levied on imports. This reinstates a level playing field for companies irrespective of the domestic CO_2 policy.

The joint implementation of stringent CO_2 trading with this type of border tax adjustment will leave companies in foreign countries weakly better off than the absence of any scheme, while domestic companies are weakly worse off. The joint implementation thus addresses concerns resulting from analysis of independent implementation of border tax adjustment (Charnovitz 2004). The joint scheme achieves the objective of facilitating unilateral internalisation of CO_2 costs, as simulated for the cement sector (Demailly and Quirion, 2006), without discriminating against foreign producers.

However, WTO regulations mean that companies could only be compensated for the *real* costs they incur as a result of the regulation — not for the marginal costs or opportunity costs that follow from free allocation. Thus, companies could only be compensated up the level of actual, average costs incurred, whereas the competitiveness issue is more to do with the impact of marginal costs of prices, at least when firms seek to maximise profits. Auctioning helps to bring average cost impacts in line with the marginal costs, and thus would enable a greater level of border tax adjustment more aligned with any actual price differentials. To implement effective BTA, a prerequisite for WTO-compatibility is auctioning.

5. Conclusion

The traditional arguments for and against auctioning, reviewed in section 2, support two widely-known conclusions, namely that (i) auctions are almost certainly in the public interest, but (ii) political economy considerations have to date presented serious obstacles to the implementation of auctioning within the EU ETS on any significant scale. The winds may be changing, however, and more recent signs are that governments are keen to find approaches to resolve these political challenges.

If auctions are employed in Phase II, section 3 of this paper provides some broad guidance on how this might occur. Sealed-bid auctions are likely to be appropriate, and both discriminatory and uniform-price payment rules are feasible. Auctions could be conducted at relatively frequent intervals (every six months or so) over the 2008-2012

commitment period. Market power is not expected to be a significant problem as long as Member States do not impose artificial restrictions on entry.

Perhaps the most interesting possibilities for auctions, though, go beyond the usual benefits of static and dynamic efficiency. Section 4 discussed the potential for auctions (and the resulting revenues) to provide several new benefits, including (i) an increase the environmental effectiveness by focussing management attention on carbon; (ii) an amelioration of competitiveness considerations, either by direct support or by legitimising border-tax adjustments; (iii) a clearer long-term price signal, through recycling the revenues into carbon contracts; and (iv) an improvement to price stability if Member States agree to coordinate auctions by including an auction price floor.

One can only speculate whether these additional considerations will increase the political support for greater use of auctioning in Phase II. Certainly, as targets become more demanding, efficiency becomes more and more important and the appeal of auctioning will correspondingly increase. The creative deployment of auctions to increase efficiency, stabilise prices, and help to address competitiveness issues would be feasible, and could yield big social benefits.

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