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Greenhouse Gas Auctions and Taxes: Some Political Economy Considerations

Robert W. Hahn*

Introduction

In the last decade, there have been several proposals for addressing climate change, most prominently cap-and-trade programs and carbon taxes. Such programs can be implemented on a local, national, or international scale and have the potential to substantially lower the cost of reducing net greenhouse gas emissions relative to "command-and-control" regulation. Both market-based approaches attempt to achieve a cost-effective solution by encouraging firms to equate the marginal cost of abatement across different sources. In the case of a tax, a firm would typically equate its marginal control cost with the tax. In the case of cap and trade, it would equate its marginal pollution control cost with the price of an emission allowance.[1]

The cost effectiveness of these programs depends in part on whether they raise revenue for the government and how that revenue is spent. A cap-and-trade program can raise revenue by auctioning off some or all of the allowances. A tax program raises revenues directly. The arguments for using auctions and taxes, however, have not been accompanied by sober assessments of whether and how the revenues would actually be used. In fact, most of the evidence to date, discussed below, suggests that at least some of the revenues would not be spent wisely, at least from an economic perspective.

This article evaluates cap-and-trade programs that raise revenues through auctions and carbon taxes in light of political realities. It is argued that economists have been and continue to be overly optimistic in their support for auctions and taxes, and that many of the potential uses of these revenues are unlikely to result in economic benefits. More specifically, the article

*Robert Hahn is the executive director of the Reg-Markets Center at AEI and a senior visiting fellow at Oxford.
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[1] An allowance is the right to emit one metric ton of a greenhouse gas. Allowances are traded in a cap-and-trade program.

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urges governments to compare a realistic set of policy options, while recognizing that the feasibility of different types of mechanisms can change over time. Furthermore, it is suggested that the introduction of these political economy considerations may lead to a lower optimal level of pollution control than conventional economic analysis would suggest.

It is important to note that while this article identifies some potential problems with the implementation of market-based approaches, it is best viewed as a cautionary tale. Specifically, the analysis here is not meant to suggest that society should do nothing about climate change or that society should eschew market-based approaches to this problem. Rather, the article suggests that all parties involved in the debate over how best to address climate change carefully examine the strengths and weaknesses of the various instruments for controlling greenhouse gas emissions.

The rest of the article is organized as follows. The next section provides an overview of greenhouse gas auction and tax activity. This is followed in the third section by a comparison of the relative merits of auctions and taxes. The fourth section discusses the role of political economy, focusing on the government's use of revenues. The final section offers some conclusions and lessons and guidance for governments concerning the design and implementation of programs to mitigate climate change.

An Overview of Greenhouse Gas Auction and Tax Activity

To help identify some of the political and economic issues surrounding climate change policy, this section reviews past, current, and proposed auction and tax programs aimed at reducing greenhouse gas emissions.

Greenhouse Gas Auctions

Cap-and-trade programs typically involve limiting total greenhouse gas emissions by defining and distributing allowances for these emissions (Stewart and Wiener 2003). One key decision in designing a cap-and-trade regime is how to distribute allowances. The government can distribute the allowances for free; for example, to parties that are directly affected, such as businesses that are required to comply with the regulations. Another approach is to auction some or all of the allowances. The mechanism for distributing allowances (e.g., free allocation or auctions) could have significant effects on households, the economy, and the cost of the policy (Orszag 2007). Several economists, environmentalists, and politicians have promoted the auctions approach. Some economists argue that auctions are a simple mechanism for distributing allowances among firms and that auction or tax revenues can offset some of the costs of environmental policy (Burtraw 2008; Parry, Williams, and Goulder 1999). Some environmentalists argue that revenues should be used by the government to help address climate change. Some politicians have supported auctions and taxes. They may believe that it is appropriate for the government to receive revenue for distributing a scarce public resource, such as cleaner air. Moreover, these politicians may see opportunities to use the revenues from auctions to distribute benefits to certain constituencies.

With this brief introduction to the distribution of allowances, I next discuss the past and proposed auctions of allowances. Although auctions have occurred in voluntary cap-and-trade programs, I focus here on auctions in cap-and-trade programs where there is an explicit constraint on greenhouse gas emissions. More specifically, I examine the five auctions conducted under Phase I of the European Union (EU) Emissions Trading Scheme (ETS). I also discuss proposed trading schemes in the United States and other non-EU countries.

EU ETS auctions

In 2005, the EU launched Phase I of the EU ETS, the largest mandatory greenhouse gas trading scheme in the world. The EU ETS covers about half of the EU's total carbon dioxide (CO_2) emissions. In order to comply with the Kyoto Protocol, the EU approved a specific number of emission allowances for each member state based on the member state's national allocation plan (Convery and Redmond 2007).[2] One EU allowance represents the right to emit one metric ton (hereafter referred to as a "ton") of CO_2. Companies that emit less than the number of allowances they own can sell their excess allowances, while companies that have trouble keeping their emissions low can invest in energy-saving technologies or buy excess allowances.

The EU mandated that at least 95 percent of allowances be freely allocated (i.e., given directly to affected entities for free) in Phase I. The total value of the allowances distributed in Phase I was about €65–€130 billion (Convery and Redmond 2007),[3] of which only a small fraction (0.12 percent) was auctioned. In general, the EU Commission suggested that member states use auction revenues either to offset the administrative costs of the scheme or to purchase Joint Implementation (JI) and Clean Development Mechanism (CDM) credits (European Commission 2005; Victor 2007).[4] Only four countries chose to sell some of their allowances, and only three—Ireland, Hungary, and Lithuania—used at least one auction to distribute some of their allowances.[5] Appendix Table 1 summarizes the main features of these auctions.

Four common patterns emerge from the auctions carried out in Phase I of the EU ETS. First, the auctions focus exclusively on CO_2 and ignore other greenhouse gases. Second, they all use a similar mechanism for auctioning the allowances—an online, uniform price, sealed bid auction. In the case of the Hungarian and Lithuanian auctions, the "clearing price" was set by the lowest bid accepted by the auctioneer, while in the Irish auctions, the price was set by the highest rejected bid. The clearing price could not be lower than the minimum price determined by the auctioneer. Third, all three countries elected to use the auction revenue to offset administrative costs of the scheme (Hepburn et al. 2006). Fourth, the revenues were

[2]The national allocation plan outlines the total number of allowances needed for the trading period and the distribution of these allowances among individual industrial plants and electric utilities.

[3]The dramatic decline in the price of EU allowances over Phase I of the emissions trading program makes it difficult to value the permits with any level of certainty. Convery and Redmond (2007) assume a value of €10–€20 per ton of CO_2.

[4]JI and the CDM are aimed at reducing the overall cost of achieving reductions in greenhouse gases under the Kyoto Protocol. JI allows industrialized countries to finance emissions-reducing technologies in other industrialized countries and credit those reductions toward their own targets. The CDM is similar, but involves investment in reducing emissions in developing countries.

[5]The fourth country, Denmark, had planned to sell 5 percent of its allowances in open auctions, but decided to sell its permits through the brokered market when prices fell from €6.87 in December 2006 to €0.90–€2.20 in February 2007. See Klean Industries Market News, October 3, 2007, http://www.kleanindustries.com/s/PressReleases.asp?ReportID=265079&_Type=Market-News&_Title=Carbon-allowance-auctioning-EU-tries-to-find-the-right-balance (accessed September 28, 2008).

fairly modest, both with respect to what would have occurred with a 100 percent auction and in comparison to other types of auctions. For example, auctions for licenses to use specific electromagnetic frequencies for transmission, known as spectrum licenses, have exceeded $100 billion in at least one case (Klemperer 2004).[6]

Despite the common auction design, the auctions had small but important differences. For example, Hungary required participants to post the total value of their bid two days before the auction and the money was held for eight days after the auction, resulting in lower participation than in the Irish auctions (Neuhoff 2007; Kaderjak 2007). Thus, Ireland raised more revenue than Hungary despite selling fewer allowances. The difference in revenue can also be attributed to the timing of the auctions. Because there was a decline in the price of allowances over the course of Phase I, the earlier Irish auctions enjoyed a higher market price for the allowances, though design likely contributed (Betz 2007).

The use of greenhouse gas auctions is expected to increase dramatically in the future. Although no more than 10 percent of allowances can be auctioned in Phase II of the EU ETS, which began in 2008, eleven countries plan to auction at least some of their emission allowances. This brings the share of allowances distributed by auction up to 4 percent for this phase. Because member states are still in the early stages of planning Phase II auctions, it is unclear how these auctions will be designed, how much revenue they will raise, and how that revenue will be allocated. However, it seems reasonable to expect that more money will be invested in JI and CDM projects. In Phase III, slated to begin in 2013, at least two-thirds of the allowances are expected to be auctioned (European Commission 2008). It is also possible that more gases will be covered. Auction revenues in this period are therefore expected to be significantly larger relative to Phases I and II, and aside from being used to offset administrative costs and buy JI and CDM credits, at least 20 percent of revenues have been committed to climate change mitigation, adaptation efforts, and other program-reinforcing investments (European Commission 2008).

Other auction programs

Greenhouse gas emissions trading (and the use of auctions) is not restricted to the EU ETS. Trading schemes are being proposed in the United States and other parts of the world, such as Australia, New Zealand, and Japan (see Appendix Table 2). Many of these proposed trading programs are in the early stages of development and information on expected auction use is not yet available. Some, however, have already stated that they will make use of auctions.

In the United States, four cap-and-trade programs—the Northeast's Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI), the Midwestern Greenhouse Gas Reduction Accord, and California's Global Warming Solution Act of 2006—are being developed. Under the RGGI, states will auction most of their allowances, with at least 25 percent of the proceeds going to activities that will promote a "consumer benefit or strategic energy purpose" (RGGI 2005). Some states, such as New York, Vermont, Maine, Maryland, and Connecticut, plan to auction 100 percent of their allowances. If all allowances were auctioned, it would likely raise more than a billion dollars. The RGGI conducted its first auction in September 2008 and its second in December 2008, and plans to hold a third

[6]Dollar amounts used in this article are in nominal terms unless otherwise stated.

in March 2009.[7] There also appears to be widespread interest in a national cap-and-trade program in the United States. Several bills have been introduced in Congress that would regulate CO_2 on a national level through a cap-and-trade program that includes auctions.[8]

Greenhouse Gas Taxes

Despite the recent focus on auctions in a cap-and-trade system, carbon taxes still enjoy support in several countries. For example, many northern European countries, such as Denmark, Finland, Norway, and Sweden, have had a carbon tax in place since the early 1990s (see Appendix Table 3). In addition, two bills recently introduced in the U.S. Congress (H.R. 2069 and H.R. 3416) call for a national carbon tax.

As indicated in Appendix Table 3, the tax rates differ greatly among the northern European countries, with Sweden charging three times what Denmark charges. There can also be a large variation in tax rates and exemption rules within a country. For example, in Denmark, there are exemptions for gasoline (but not diesel), natural gas, and biofuels, and specially defined businesses receive 50 percent rebates on their payments. Such exemptions can give rise to economic inefficiencies by excluding some control strategies that could be cost effective.

The actual or anticipated revenues from these carbon taxes are not insignificant (see Appendix Table 3). In addition, at least some carbon taxes, such as the tax in British Columbia, Canada, are designed to be revenue neutral, meaning that some revenues will be used to reduce preexisting taxes, offsetting any revenue gain for the government. Interestingly, the one carbon tax currently in place in the United States (in the city of Boulder, CO) does not use any of the revenues to reduce taxes. One of the two proposed bills in Congress, H.R. 2069, the Save Our Climate Act of 2007, does not mention any proposed use of the revenues.

Comparing the Advantages of Auctions and Taxes

Auctions and taxes (as opposed to free allocation) are supported by economists mainly for reasons related to efficiency, defined in this article as “direct” benefits. Auctions have the potential to allocate a resource more efficiently than free allocation at the outset by ensuring that it is allocated to those who are willing to pay the most for it. In the case of taxes, a simple tax on carbon can help internalize the negative externalities associated with carbon emissions.

Auctions and taxes also have “indirect” benefits associated with revenue raising. The revenues from both auctions and taxes can be used to increase the efficiency of government—either by making the taxation system more efficient or by directing government expenditures to areas where there is a high social payoff.

The direct and indirect benefits of auctions and taxes are discussed in more detail below.

[7]The program sold 12.5 million allowances in its first auction at a price of $3.07; it sold another 31.5 million allowances at a price of $3.38 in its second. Both auctions used a sealed-bid and uniform price. See the RGGI website, http://www.rggi.org/home (accessed September 29, 2008).

[8]Bills introduced in this session to regulate CO_2 emissions that use auctions include: H.R. 6316, S. 3036, and S. 1766. See the Environmental Defense Fund, “Climate Change Bills of the 110th Congress,” available at http://www.edf.org/page.cfm?tagID=1075.

Direct Benefits of Auctions and Taxes

Auctions and taxes have the direct benefit of reducing costs of abatement by equating the marginal cost of control across sources. This is achieved by establishing a price signal for the value of emissions, which can reduce search costs for buyers and sellers and also increase trading in secondary markets. In the case of a tax, the price is set by the government. In the case of an auction, the price is set by the market or the government, depending on whether price floors or ceilings are put in place.

Examples of alternative forms of emissions control that do not use price signals are energy efficiency standards or other command-and-control regulations. There is some indication that such regulations will be an important part of climate policy in many countries.[9] In some limited cases, where the technological solution is reasonably clear, standards can be more effective than market-based instruments.[10] However, they are not particularly well suited for generating cost-effective innovation to address the problem of climate change (Tietenberg 2006; Hahn forthcoming), and are unlikely to result in major breakthroughs.

The advantage of using taxes is that they put a stable explicit price on emissions and can be less complex in design. In addition, it has been argued that taxes may be a more appropriate tool for addressing climate change under uncertainty when the marginal benefit curve is relatively flat (Weitzman 1974).

Other economists support auctions, arguing that auctions can be an efficient and transparent way to distribute allowances to those who value them most highly (Burtraw 2008). Auctions can be designed using straightforward rules, especially in the case of an auction for a single commodity, such as CO_2. In theory, the auction price of a CO_2 allowance should provide useful information about the marginal cost of reducing CO_2 emissions. This was, in practice, an important benefit of SO_2 allowance trading in the United States (Ellerman et al. 2000).[11]

In some cases, many of the efficiency gains or direct benefits of auctions can be achieved without an auction. For example, suppose that property rights are well defined and that allowances are freely allocated so that there are a reasonable number of demanders and suppliers. Furthermore, suppose that the government can effectively monitor and enforce such property rights. In such cases, it is reasonable to presume that institutions, such as exchanges and brokers, will arise to facilitate allowance trading. In the EU, there are already at least seven brokers and five exchanges for trading greenhouse gas allowances (Convery and Redmond 2007). Such institutions may perform better in conjunction with an auction held by the government. Thus, the bottom line is that while auctions can help to allocate

[9]The European Commission has proposed reducing greenhouse gas emissions by 20 percent by the year 2020, accompanied by targets of increasing the renewable share of the total energy supply to 20 percent (and that of biofuels to 10 percent), all the while boosting energy efficiency by 20 percent in the same period (European Commission 2008). In the United States, many climate bills include mandates such as energy efficiency targets.

[10]A recent UN Environment Programme study, for example, finds that building codes are more effective and less costly than market-based instruments for increasing energy efficiency in buildings (UNEP 2007).

[11]In the case of the auctions under Phase I of the EU ETS, price signals had already been established in secondary markets before the auctions took place.

allowances efficiently at the outset, they may not always be necessary (Coase 1960; Hahn and Noll 1982).

In many cases, however, auctions are likely to lead to more efficient outcomes than free allocation. They offer a system that is less complicated administratively, is cheaper, and increases the flow of information and speed of implementation. More importantly, recipients of allowances under free allocation often have a perverse incentive to maintain their level of emissions in order to continue receiving allowances. The EU countries, for example, actually discouraged cleaner production by taking allowances away from firms that were beginning to cut their emissions (Umwelt Bundes Amt 2005). Firms responded by making investment decisions that reduce the efficiency gains from emissions trading (Ahman and Holmgren 2006).

Because auctions can be more complex to design than taxes, the remainder of the discussion of direct benefits focuses on the significance of auction design. Different auction designs will sometimes yield different levels of expected revenue and efficiency (Milgrom 1989). For example, an early laboratory experiment aimed at testing the revenue generating properties of Treasury bill auctions suggests that, in selected cases, auctions in which the winning bidder pays the highest rejected bid price generate more revenue than auctions in which the bidder pays his own bid price (Miller and Plott 1982).

Other factors besides the mechanism for determining price can affect whether auctions allocate a property right efficiently. Bankruptcy, for example, could cause problems in a cap-and-trade program with auctions. Moreover, there could be problems associated with borrowing permits from the future that can be used today, if a firm that borrowed permits went bankrupt.[12] The rules need to be clear about who should bear the risk in such cases. Mechanisms, such as insurance or deposits, could be introduced to mitigate these risks.

There are many key factors that will affect the efficiency of climate change auctions. The perceived early success of climate auctions is likely to affect their design and use in the future. As constructed now, these auctions in the EU ETS and elsewhere are generally for only one or two periods or phases.[13] This uncertainty about the future may limit the incentives for firms to seek innovative ways of reducing CO_2. Even in cases where multi-year auctions have been scheduled, such as with the RGGI (Holt et al. 2007), there is uncertainty because the auctions could be supplanted by federal legislation.

Indirect Benefits of Auctions and Taxes

The main potentially significant indirect or secondary benefit of greenhouse gas auctions and taxes is that they generate revenues for the government. These revenues can be used to promote beneficial policies in three ways. The first is by substituting more efficient sources of revenue for less efficient sources of revenue, such as the payroll tax or taxes on

[12] In one case, spectrum rights were tied up for more than six years because of such a bankruptcy. NextWave Wireless Inc., a global seller of broadband and wireless products, declared bankruptcy in 1998, two years after winning the largest share of licenses in a Federal Communications Commission (FCC) spectrum auction. The FCC responded by re-auctioning the licenses, but before the FCC could deliver the licenses to the winners, a court ruled that the FCC's repossession of the licenses was illegal. The licenses were returned to NextWave and eventually sold in the secondary market (Crandall and Ingraham 2007).

[13] Ellerman (2003) finds that allocative efficiency improved in the second phase of auctions for SO_2 allowances in the United States, causing compliance costs to be less than half of what was expected.

capital. The second is to use revenues from auctions to finance government investments that yield high payoffs. So, for example, auction revenue might be used to finance research on improving health (Murphy and Topel 2003). The third is to use revenues to reduce the debt burden.

These indirect benefits can be important because the efficiency costs of environmental interventions are often high. For example, Parry, Williams, and Goulder (1999) find that the economic costs of a cap-and-trade program for CO_2 in the United States that does not include auctions will exceed the environmental benefits if the benefits from reducing CO_2 emissions are below about $24 (in 2006 dollars) per ton.[14] Current estimates of the benefits of reducing CO_2 emissions are typically below that amount. The Intergovernmental Panel on Climate Change (2007) estimates that the benefits of reducing one ton of CO_2 are about $12 (in 2006 dollars). This estimate includes the net economic costs of damages from climate change across the globe and is the average from more than 100 peer-reviewed estimates. In their study, Parry, Williams, and Goulder (1999) use a number closer to $7 (in year 2006 dollars). Values for the benefits to the United States of decreases in greenhouse gas emissions are likely to be lower.

There is a large literature on the potential benefits of "revenue recycling" (i.e., using revenues to cut taxes or fund related projects rather than to increase government spending). A core finding of this literature is that auction revenues can sometimes substantially increase efficiency if they are used to reduce other, less efficient taxes (Hahn 1989; Stavins 2003). Goulder et al. (1999) offer evidence that increases in market distortions from environmental taxes may outweigh any cost advantages of market-based instruments over technology mandates or performance standards if the revenues are not used to reduce other taxes. Other studies find that environmental taxes would reduce economic efficiency even with revenue recycling. Bovenberg and de Mooji (1994), for example, find that using environmental taxes to finance cuts in labor taxes would not result in a net efficiency gain. However, it is likely that the efficiency loss would be even greater without revenue recycling.

Efficiency gains for society from revenue recycling are expected to be in the billions of dollars. For example, according to Parry and Bento (2000), a revenue-neutral CO_2 tax of $10–$20 could create efficiency gains for society of about $20–$30 billion per year under certain modeling assumptions. The efficiency gains could vary depending on assumptions about the marginal excess burden of income taxes. Feldstein (2008) finds the marginal excess burden of income taxes to be much higher, which implies much higher gains from reducing these distortionary taxes.

While academics have extensively studied how revenues from auctions and taxes can be used to make the tax system more efficient, there has not been much research on the impact of using such revenues to retire debt or increase the efficiency of government investments. Parry (1997) generally argues that the benefit from a specific dollar amount of investment is not likely to be more than the amount of the investment itself, except when the investment is in public goods that would otherwise not be supplied by the private market. In that case, the benefit may be more or less than the invested amount, depending on how individuals value such goods. Meanwhile, using the revenue to decrease taxes could create benefits that exceed

[14] The Consumer Price Index was used to update the authors' central estimate.

the amount of the tax decrease because the benefits would filter throughout the economy by encouraging more employment and investment. Hence, the literature finds that the benefits are greatest when the revenues are used either to lower pre-existing distortionary taxes or to reduce the federal budget deficit. Parry (1997) further concludes that using revenues to reduce the federal budget deficit would also create a revenue recycling effect, except that the economic gains would accrue to future rather than present generations. This is because future generations would have to pay less interest on federal debt, resulting in fewer distortionary taxes.

The indirect benefits are larger, of course, when the tax or auction revenues are larger. Two ways of increasing expected revenue are to encourage more bidders to participate and to prevent them from colluding. A successful auction does this by paying attention to the specific market structure for the item being auctioned (Klemperer 2004). The EU ETS auctions demonstrated how specific features of auction design can either encourage or limit competition. Though both the Irish and Hungarian auctions were open to anyone holding an account with an emissions trading registry in any EU member state, the Irish auctions had higher participation, at least partly because of differences in design. The first Irish auction set a €3000 deposit requirement for bidders and allowed bidders to bid for lots of five hundred CO_2 allowances each. For the second auction, the deposit and the lot size were increased to €15000 and one thousand allowances, respectively (Holt et al. 2007). The Hungarian auctions required a higher deposit and minimum lots of one thousand allowances (Betz 2007; Kaderjak 2007). To address some of the issues from the Irish and Hungarian auctions, Holt et al. (2007) recommended that the U.S. RGGI use a minimum one thousand lot size for greenhouse gas allowances and allow all qualified bidders to participate.

Political Economy of New Government Revenue

The economics literature on auctions and taxes paints an optimistic picture of how the resulting revenue could be used to increase efficiency. However, the political economy literature is much less optimistic about this issue. This section examines what the political economy literature reveals about the likely and actual uses of new government revenues in general and those from greenhouse gas auctions and taxes in particular.

Past Experience with New Government Revenue

In general, the government does not have a history of efficient spending. For example, farm price supports, government support of schools, and government management of highways and airlines are generally regarded as inefficient (Winston 2006). Moreover, in practice, new revenues have typically not been used to lower preexisting taxes. Becker and Mulligan (2003) find that when the government obtains new general revenue, it tends to finance more spending rather than decrease taxes. This could be due to the "flypaper effect," which refers to the phenomenon of state governments spending close to 100 percent of the unrestricted grants they receive from the federal government, rather than using some of the grants to reduce taxes (Hines Jr. and Thaler 1995). Hines Jr. and Thaler attribute this effect to loss-averse taxpayers who do not see money as fungible. That is, although taxpayers would likely protest an increase in taxes, they are less likely to protest the lack of a decrease in taxes.

However, this tendency to spend all new revenue may be less likely in the case of greenhouse gas taxes (see Appendix Table 3).[15]

Experience has also shown that there may be problems with earmarking revenues, though at least this can be monitored. The main issue is whether the earmarked money is actually spent accordingly. Some research on lotteries suggests that lottery revenue, typically earmarked for some public good such as education, does not necessarily result in increased spending on the public good (Mikesell and Zorn 1986; Borg and Mason 1990). Novarro (2002) reviewed the literature on earmarking in general and concluded that only \$0.22–\$0.78 of each earmarked dollar is actually spent in the public sector for which it was designated.

Experience with Revenues from Auctions

Most proposed greenhouse gas schemes that include auctions plan to allocate some revenues for energy- or climate-related investments. A study by the Board of Energy and Environmental Systems (BEES) of the National Academy of Sciences found that energy-related investments in the United States between 1978 and 2000 have generated positive net economic and environmental returns (BEES 2001). However, projects aimed at reducing energy consumption have a mixed record (Joskow 2003). In particular, positive incentives in the form of renewable energy R&D subsidies do not reduce greenhouse gases (GHGs) as efficiently as a simple carbon tax would (Fischer and Newell 2008).[16] As for climate-related investments, research suggests that many of the CDM projects have serious problems, and may be overstating the amount of emissions reduction credits that are actually generated. In general, the CDM has offered neither cheap nor effective ways to reduce emission rates (Wara and Victor 2008).

Moreover, although these programs may please some in the environmental community, it is not clear whether they will pass a benefit–cost test, and in some cases, they may actually hurt the environment. For example, the subsidization of corn-based ethanol, which was supposed to help reduce greenhouse gas emissions, may actually increase these emissions substantially (see, e.g., Crutzen et al. 2007; Searchinger et al. 2008; and Fargione et al. 2008). De Gorter and Just (2008) find that ethanol subsidies actually increase oil and gasoline consumption.

Outlook for Use of Greenhouse Gas Auction and Tax Revenues

Why has government spending been inefficient? The answer is that the government is subject to political pressures that are different from pressures faced in the private sector (Winston 2006; Becker 1983). So, while the government can supply basic public goods, such as increases in knowledge through basic research, that have high returns, it may also implement programs and regulations that are unlikely to pass a benefit–cost test.

Based on recent history, it is likely that auction revenues, and potentially carbon tax revenues, would be used to increase the overall size of government or earmarks for a particular activity, rather than be recycled. In the case of auctions for greenhouse gases, this means

[15] Although I tend to focus more on revenues from auctions in the remainder of this section, my cautions and concerns are likely to apply to revenue from taxes as well.

[16] The authors note that research subsidies must be twice that of taxes to achieve the same cuts in emissions, and are 2.47 times as costly to administer.

that revenues may be earmarked to help defray the program's administrative expenses, as occurred in Phase I of the EU ETS. They may also be used to encourage related efforts, such as promoting energy efficiency or generating other kinds of greenhouse gas reductions. For example, Maryland's proposal for the RGGI notes that "Maryland will auction 100 percent of the allowances . . . [and] the proceeds of the auctions will enhance energy efficiency efforts, including stimulating new technology and alternative fuels" (Maryland Department of the Environment 2008). Another increasingly popular idea is to take the revenues and invest in "green" energy and job creation (Pollin et al. 2008).[17]

There is also little evidence to suggest that auction revenues will be used to reduce government debt. While some spectrum auction revenues in the United Kingdom and the United States have been allocated to reducing the federal debt, it is virtually impossible to know what the budget would have been in the absence of those revenues. For example, the chairman of the Federal Communications Commission, the agency charged with regulating spectrum use, asserted that $7 billion in revenues from a spectrum auction in March 2008 would be set aside for deficit reduction (Federal Communications Commission 2008). However, there is no way to monitor or determine how such revenues may affect the spending habits of legislators.

Looking at the proposed and implemented programs in Appendix Tables 2 and 3, some general conclusions can be drawn about the likely uses of auction and tax revenues. There is little basis for assuming that auction revenues will be used to reduce inefficient taxes or substantially increase the net benefits of government expenditures, though these possibilities cannot be ruled out. There is more evidence in Appendix Table 3 that carbon taxes may be used to reduce inefficient taxes, but this is based on a small sample with little evidence that this would be true in the United States. Indeed, historical evidence for the United States suggests that revenues are generally earmarked toward new projects (e.g., transportation-related projects, in the case of gasoline taxes) rather than recycled (Jackson 2004).

Conclusions and Lessons for Governments

This article has examined various arguments for auctions and taxes in light of political realities and has found that economists may be overly optimistic that the revenues from these instruments will be used efficiently.

Conclusions about Economic Efficiency

There are several conclusions to be drawn about the potential to spend revenues from auctions and taxes efficiently. First, efficient use of revenues is not guaranteed for either auctions or taxes. However, the review here of current auction and tax programs suggests that carbon taxes may be more likely to be used to recycle revenue. The sample, however, is too small to say that with much confidence. Perhaps because the additional revenues come from a new *tax*, using taxes rather than auction revenues to lower other taxes is viewed as more appropriate

[17]The bills in Congress that seek to establish a U.S. cap-and-trade policy for greenhouse gases suggest several ways for allocating revenues, such as protecting against and mitigating the impacts of climate change, mitigating effects on low-income consumers due to rising energy prices, supporting innovation in reducing greenhouse gases, and rewarding early reductions of greenhouse gases (see the 2007 Safe Climate Act).

by politicians or citizens, and hence is more politically feasible. More specifically, in the United States, a carbon tax would likely be passed under the Joint Committee on Taxation while cap-and-trade programs would likely fall under two environment committees. The Joint Committee may be more likely to use tax revenues to decrease other taxes because it is concerned with the overall tax structure, while the environment committees may be more likely to increase potentially inefficient spending on environmental goods (Metcalf 2007). However, U.S. proposals for a carbon tax have shied away from an explicit condition of reducing other less efficient taxes.

Thus, there is little evidence to suggest that auction or carbon tax revenues will be used to reduce other taxes that are less efficient, or that the revenues will be spent in ways that are likely to increase net benefits substantially. Based on the historical evidence, it appears likely that some auction revenues and tax revenues would be used to increase the overall size of government or be earmarked for defraying administrative expenses of the program, promoting energy efficiency or other projects that may not pass a benefit–cost test. Thus, it is not clear that revenues will be put to their highest valued uses. These inefficiencies could have important implications for how we think about case-by-case instrument choice comparisons as well as the optimal level of environmental control.

Perhaps more importantly, the political constraints on choosing a particular environmental instrument strongly suggest that a cost-effective solution to the greenhouse gas problem will *not* be achieved (even at a national level). Although this article has not examined the entire range of available instruments, they are all likely to face political constraints (Stavins, Keohane, and Revesz 1998). For example, Buchanan and Tullock (1975) discuss political constraints on both standards and taxes. Even in countries that adopt revenue-neutral carbon taxes, there are likely to be political constraints in the form of exemptions from the taxes, which will cause inefficiencies. Thus, models that assume a cost-effective solution will be achieved (i.e., most economic models) should be used with care.

In particular, when one takes into account political constraints, traditional economic models that assume that the optimal level of pollution should be selected based on the intersection of the marginal benefit and marginal cost curves may be incorrectly specified. If, for example, politics shift the achievable marginal cost curve up by some amount, then the optimal *achievable* level of environmental control would be *less* than the optimal level of control suggested by a conventional economic analysis.[18] This result would likely hold not only for the case of optimal climate change policy, but also for many environmental policies where politics constrain the choice of available policy instruments. Indeed, this result applies to a wide range of externalities where government may choose to intervene in markets in some way, including the protection of the environment, health, and safety, as well as other kinds of public goods, such as the production of basic knowledge.

In addition, it is important to remember that politics will not only affect how a system is implemented, but also whether it is implemented at all. Though revenue may be used more

[18]A more detailed analysis would want to consider a number of other factors, including hard-to-quantify benefits and costs and inefficiencies associated with adaptation. If, for example, inefficiencies associated with adaptation were greater than those associated with mitigation, the result could be that more mitigation is appropriate.

efficiently under a carbon tax, many believe that a carbon tax is less politically feasible in the United States than a cap-and-trade program involving auctions (Stavins 2007).

Lessons for Governments

Given the evidence and conclusions above, it is important that governments be realistic about what auctions and taxes can and cannot do. In particular, auctions may allocate the resource more efficiently than other alternatives such as grandfathering (allocating allowances based on historical emissions) in the short term. However, until there is a stable set of rules for reducing greenhouse gases in which a significant fraction of the world's businesses and governments participate, it is unreasonable to expect a result that approaches a cost-effective solution. Indeed, many of the systems that have been implemented over the past decade are best viewed as pilot projects or experiments in which countries and/or regions try to figure out ways to solve this daunting collective action problem of how to mitigate climate change.

Governments should keep three points in mind when designing and implementing auctions and taxes for reducing greenhouse gas emissions. First, in the case of cap-and-trade programs, it is not only the auction design that matters for efficiency, but also the more general market structure. Second, the details of the auction and tax design matter for efficiency. And third, it is important to compare realistic alternatives when assessing the likely economic benefits from greenhouse gas auctions and taxes or, more generally, from the market for limiting greenhouse gases. I discuss these three points in more detail below.

The overall design of a cap-and-trade program should address several key issues, including a clear definition of property rights (concerning allowances); a method for monitoring and enforcement; a method for changing targets over time and expanding the number of included gases; possible price floors and ceilings; and ways of extending the geographic scope of the program (Stavins 2007).

A clear definition of property rights and their transferability is probably more important than an auction in ensuring efficiency. The strategies pursued by businesses and other interested parties in auctions and allowance markets will depend on the specific auction and market rules. They will also depend critically on the nature of the property rights and expectations about how those rights may evolve in the future. Auctions are only one component of a market-based system. In the case of taxes, the taxation rules and the existence of exemptions are likely to play a large role in influencing firm behavior.

Governments interested in introducing auctions or taxes for reducing greenhouse gas emissions should take a proactive role in both design and evaluation. Other things being equal, the auction or tax should strive for simplicity and transparency. In the case of auctions, rules should be implemented to help prevent bidder collusion. In addition, to help address problems related to possible bankruptcy, governments should consider asking firms to supply some form of up-front payment or insurance in the event of default (Holt et al. 2007). In the case of carbon taxes, exemptions should be limited to help prevent distortions in behavior.

Governments may need to consider auctioning differing types and amounts of emission allowances or taxing different greenhouse gases as programs to reduce greenhouse gases are expanded. Under a tax regime, it is simple to tax an additional greenhouse gas. However, multigood auctions can also be designed with reasonably straightforward rules. Sometimes a more complicated auction may be needed to help increase the efficiency of the auction or the revenues that are raised.

As they evaluate the use of auctions and taxes, governments will need to consider how politics are likely to constrain program design and economic efficiency (Noll 2006). At this time, we have fairly limited information on what a large-scale effort aimed at substantially reducing greenhouse gases would look like. My guess is that the politics of small-scale and large-scale efforts may be very different. Given the high level of potential rents to be redistributed under a large-scale program, it is likely that interest groups will take a more active role in large-scale programs. In either case, however, we can expect well-organized interest groups, particularly those in the energy sector, to have a substantial impact on the policy that is ultimately implemented.

Moreover, just as auction and program design are likely to be constrained by politics, so too is the design of markets to limit greenhouse gas emissions (Barrett 2003). Countries must voluntarily agree to greenhouse gas reductions (Wiener 1999). Political leaders today may be willing to sign some kind of agreement limiting emissions, but they will not be able to bind future decision makers easily. That is not to say that long-term binding agreements will not emerge, but there is a very real possibility that such agreements will not work very well because of problems with free riding, monitoring, and enforcement. Furthermore, if such agreements do emerge, the process of getting there is not likely to be smooth (Lane and Montgomery 2008).

Assessing Alternative Policies

The benefits and costs of free allocation need to be carefully assessed against alternative instruments and policies. Free allocation has the political advantage that it can help buy the support of some key industries that would otherwise oppose the plan. Allocating all permits for free, however, would likely overcompensate the regulated sector, creating large windfall profits for firms, such as occurred in the first phase of the EU ETS (Hepburn et al. 2006). Bovenberg and Goulder (2001) find that roughly 10 percent of freely allocated emission allowances would compensate firms under a cap-and-trade program, while Burtraw and Palmer (2008) find that the U.S. electricity sector would require only 6 percent of total allowance value. In addition, Dinan and Rogers (2002) and Parry (2004) find that high-income individuals are likely to gain more from freely allocated allowances than low-income individuals, and free allocation would generate no revenues to address equity concerns. However, one cannot rule out the possibility that an auction or tax system that uses revenues in a highly inefficient manner could actually be *less* efficient than a market-based approach that freely allocates permits without an auction. This issue deserves more research. Moreover, the alternatives go beyond free allocation, 100 percent auctions, and a simple carbon tax. These alternatives, which might include auctioning only a fraction of the allowances or a more complicated multigas tax system, should be carefully evaluated when choosing among instruments.

Identifying realistic policy alternatives is not always straightforward. Nonetheless, it is important to try to compare how different regulatory approaches are likely to perform in practice (Latin 1985; Hahn and Stavins 1992). For example, if a market-based program discriminates against new sources of pollution, this type of constraint should be included in an assessment of the net benefits of the program.

Some Final Thoughts

While I have argued that it is important to focus on what is politically feasible when trying to design systems that are economically efficient, I also believe that ideas can expand the list of feasible options. Thirty years ago, market-based approaches for protecting the environment were little more than an intellectual curiosity. Today, some of the largest environmental regulatory schemes use market-based approaches, and they are becoming more widely accepted. Similarly, auctions have become more popular over time. The fact that some current tax systems have a goal of revenue neutrality suggests that economic research may be having an impact on policy.

Thus, we should try to design and implement systems for controlling greenhouse gases that are more economically efficient than those that have been implemented thus far. However, we should also continue to recognize that politics impose important constraints on the design of such systems, in both the short and long term.

Appendix

Appendix Table 1 Greenhouse gas auctions used in Phase I of EU Emissions Trading Scheme

Country and years	Gas	Auction amount	Amount raised	Clearing price (per tCO_2)	Auction type	Use of revenues
Ireland, 2006	CO_2	0.5M EUAs 0.75%	€13.1M (2)	€26 (1); €6.9 (2)	Uniform price, sealed bid	Offset administrative costs of scheme
Hungary, 2006–2007	CO_2	2.4M EUAs 2.5%	€9.94M (2)	€7.4 (1); €0.9 (2)	Uniform price, sealed bid	Offset administrative costs of scheme
Lithuania, 2007	CO_2	0.6M EUAs 1.5%;	€0.033M (1)	€0.06	Uniform price, sealed bid	Offset administrative costs of scheme

Sources: Press releases on the Lithuanian and Hungarian auctions from Vertis Environmental Finance, available at www.euets.com; press release on the Irish auctions from Ireland's Environmental Protection Agency, available at http://www.epa.ie/. See also Macken (2007) for more information on the Irish auctions.

Note: EU-ETS Phase 1 refers to the 2005–2007 Phase of the European Union's Emissions Trading Scheme. "Year" refers to the year in which the auction(s) occurred. In the column labeled "Auction amount," the term "EUA" refers to European Union allowances, and the percentage refers to the portion of allowances that was auctioned. In the column labeled "Amount raised," the number in parentheses refers to the number of auctions that were held. Revenues are presented in nominal terms (millions of euros).

Appendix Table 2 Proposed greenhouse gas reduction programs likely to use auctions

Country and years	Scheme and gases included	Auction percent	Earmark	Status
USA (CT, DE, MA, MD, ME, NH, NJ, NY, RI, VT), 2008–2018	Regional Greenhouse Gas Initiative (RGGI), CO_2	Varies by state; some to auction 100%	One quarter of revenue for consumer relief or strategic energy purposes	Auction held in September 2008; effective January 2009
USA (AZ, CA, MT, NM, OR, UT, WA), Canada (British Columbia, Ontario, Quebec), 2012–2020	Western Climate Initiative (WCI), all Kyoto GHGs	A minimum of 10%	None as of September 2008	Work Plan for 2009–2010, released in February 2009
USA (CA), no timeframe yet	Global Warming Solutions Act of 2006 (Assembly Bill 32), all Kyoto GHGs (linked to WCI)	Undecided	Revenues likely to be spent on aiding affected industries and households	Signed into law in 2006; Seeping Plan approved in December 2008
USA (CA, IA, IL, KS, MI, MN, WI), no timeframe yet	Midwestern Greenhouse Gas Reduction Accord, all Kyoto GHGs	Undecided	Undecided, considering. spending on climate R&D, tax cuts, aiding affected industries	Advisory Group met in May 2009
New Zealand, 2008–2013	New Zealand Emissions Trading Scheme, all Kyoto GHGs	Combination of auctions and free distribution	No details	Forestry sector in first two-year compliance period
Australia, 2010–2050	Australian Emissions Trading Scheme, all carbon gases	Undecided	Revenue neutral	Emissions trading to begin in July 2011
Japan, no start date, ends 2012	Japanese Emissions Trading Scheme (First Period), all Kyoto GHGs	To increase over time	Undecided, considering covering administrative costs, climate research funding	Interim report released in May 2008

Sources: See U.S. program websites: http://www.rggi.org/, http://www.westernclimateinitiative.org/, http://www.arb.ca.gov/cc/cc.htm, and http://www.greenhouse.gov.au/emissionstrading/index.html, respectively. For information on programs in other countries, see http://www.emissionstrading.nsw.gov.au/, http://www.mfe.govt.nz/publications/climate/framework-emissions-trading-scheme-sep07/html/page3.html, and http://www.env.go.jp/en/earth/.

Note: "All Kyoto GHGs" refers to the greenhouse gases that were explicitly mentioned in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Some preliminary proposals, such as plans by the central bank of China to begin emissions trading for all greenhouse gases, are not listed here.

Appendix Table 3 Selected carbon tax schemes, implemented and proposed

Country and years	Main tax	Annual revenue	Effect	Revenue use
Finland, 1990	\$8/ton of CO_2 (1996) \$24/ton of CO_2 (2003)	\$314M (1994)	Reduced CO_2 by 5%	Increase government budget (partly reduce labor taxes)
the Netherlands, 1990	\$16/ton of CO_2	\$850M (1995)	Reduced CO_2 by 1.5%	Increase government budget (revenue spent on environmental protection)
Norway, 1991	\$15–\$47/ton of CO_2	\$900M (1994)	Reduced CO_2 by 2%	Increase government budget (partly reduce income taxes, increase investments for energy saving and renewable energy)
Sweden, 1991	\$27–\$55/ton of CO_2	\$1700M (FY 1993–1994)	Reduced CO_2 by 20%	Revenue neutral (decrease energy tax and labor taxes)
Denmark, 1992	\$9–18/ton of CO_2	\$560M (1993)	Reduced per capita CO_2 by 15%	Reduce marginal tax rates in all income brackets
United Kingdom, 2001	Tax varies by fuel; \$0.003/kW h for gas, \$0.0087/kW h for electricity	\$505M	Reduced 16 million tons of carbon since 2001; expected to reduce carbon by 3.5 million tons annually by 2010	Revenue neutral
Canada (Quebec), 2007	Tax varies according to amount of CO_2 produced by different fuels	Anticipated \$188M	Expected to reduce GHGs by 10 million tons annually	Provincial Green Fund for reducing carbon emissions and improving public transportation
United States (Boulder, CO), 2007–2012	\$7/ton of carbon	\$1M annually	Expected to reduce carbon by 350,000 tons by 2012	Fund Boulder climate action plan to reduce energy use

Continued

Appendix Table 3 (Continued)

Country and years	Main tax	Annual revenue	Effect	Revenue use
United States (America's Energy Security Trust Fund Act), 2007	\$15/ton of CO_2	NA	No specific target	Reduce payroll tax (<2% for R&D and <1% to help affected industries)
United States (Save Our Climate Act), 2007	\$10/ton of carbon in taxable fuels, to increase by \$10/ton yearly	NA	To reduce CO_2 by 80%	Reduce taxes, increase spending on alternative fuels R&D or increase government budget
Canada (British Columbia), 2008	\$9/ton of CO_2 to rise to \$28/ton of CO_2 in 2012	\$1735M over the first 3 years	No specific target	Revenue neutral

Sources: Generally, U.S. EPA Table 57/11–12: Energy/Carbon Taxes, available at http://yosemite.epa.gov/EE/Epalib/incent.nsf/c7950cb0634d42808525634e00438a4a/032bb32faab7e7a3852564f7005e325a!OpenDocument; Organisation for Economic Co-operation and Development (OECD), 2001, *Environmentally Related Taxes in OECD Countries: Issues and Strategies,* OECD Publishing; and Carbon Tax Center's "Where Carbon is Taxed," available at http://www.carbontax.org/progress/where-carbon-is-taxed. See also the government of Finland, available at http://www.environment.fi/default.asp?node=11865&lan=en; for British Columbia, see the "Budget and Fiscal Plan 2008/09 to 2010/11"; for the 2007 America's Energy Security Trust Fund Act, see the Govtrack.us summary, available at http://www.govtrack.us/congress/bill.xpd?bill=h110–3416; for the 2007 Save the Climate Act, see the U.S. House of Representatives statement, available at http://www.house.gov/stark/news/110th/pressreleases/2007/20070426_carbontax.htm.

Note: "Year" refers to the year in which the tax was implemented or proposed. Year in parentheses refers to the year in which the tax was collected. Finland's \$24.39 current tax is derived from the official tax of €18.05, adjusted at the August 2007 exchange rate of \$1 = €0.7405. Values for Canada and the UK are adjusted using the August 2007 exchange rates of \$1 = C \$1.066 = £0.5005. Monetary values are in nominal terms and rounded to the nearest dollar or million unless otherwise stated. NA is not available. One source claimed a \$150/tCO_2 tax in Sweden, but this did not correspond to other findings. Belgium, Austria, Germany, Japan, Poland, and Costa Rica may also have small carbon or energy taxes but were not included because of insufficient information. I also do not include carbon taxes that were proposed in the past but were discontinued or never implemented, such as those in Italy, France, Switzerland, New Zealand, and the United States.

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Abstract

Many economists suggest that a cap-and-trade program and a carbon tax represent promising mechanisms for addressing climate change. A potentially attractive feature of both policies is that they have the potential to recycle revenues in an efficient manner. In the case of cap and trade, this would involve using auction revenues; in the case of a tax, it would involve using tax revenues. This article evaluates various arguments for auctions and taxes in light of political realities and finds that the enthusiasm for auctions and taxes has not been accompanied by sober assessments of whether and how the revenues would actually be used. Most of the evidence suggests that at least some of the revenues would not be spent wisely. Specifically, the article urges the government to compare a realistic set of policy options, while recognizing that the feasibility of different types of mechanisms can change over time. Furthermore, it is suggested that the introduction of political economy considerations may lead to an optimal level of pollution control that is less stringent than conventional economic analysis would suggest. (*JEL*: D44, D61, G18, H2, P16, Q5, Q54)