Using Emissions Trading to Regulate U.S. Greenhouse Gas Emissions: An Overview of Policy Design and Implementation Issues

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Abstract

In Kyoto in 1997, the US government agreed that between 2008 and 2012 it would limit average annual emissions of greenhouse gases (GHGs) to seven percent below 1990 levels. As participants in the climate policy debate consider various means by which limits on US GHG emissions might be undertaken in the wake of the Kyoto agreement, there is considerable interest but also some confusion about how a GHG trading program could be organized and operated in practice. In this paper we address several aspects of policy design for a US system, such as who and what is covered by regulation, the organization of the trading system, how carbon permits are allocated, and how a system could be initiated and changed over time. The paper synthesizes existing analyses and adds new insights concerning uncertainty, intertemporal consistency, market institutions, and interactions with the tax system. Our fundamental conclusion is that a domestic "cap-and-trade" system with homogeneous permits applied to control flows of fossil fuels "upstream" in the energy system (along with selective inclusion of other gases and CO_2 "sinks"), with permits auctioned periodically by the government, has the most appeal of different trading systems on efficiency and distributional grounds, though it may suffer politically because of its close resemblance to a carbon tax. We identify auction mechanisms that appear to be feasible and efficient for carbon permit allocation. We further argue that while the private sector should bear the "external" risk of changes in total permit availability as a consequence of modifications in international agreements, and that an auctioned upstream program provides more protection against the "internal" risk of efficiency-reducing opportunism by government regulators than other trading mechanisms.

Key Words: climate change, emissions trading, environmental policy design

JEL Classification Nos.: Q25, Q28

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USING EMISSIONS TRADING TO REGULATE U.S. GREENHOUSE GAS EMISSIONS: AN OVERVIEW OF POLICY DESIGN AND IMPLEMENTATION ISSUES[†]

Carolyn Fischer, Suzi Kerr, and Michael Toman[‡]

INTRODUCTION

In Kyoto in 1997, the US government agreed that between 2008 and 2012 it would limit average annual emissions of green house gases (GHGs) to seven percent below 1990 levels. Participants in the climate policy debate are expressing considerable and growing interest in the use of an "emissions trading" policy to achieve these limits. Through the trading of emissions permits, society as a whole benefits from having environmental goals achieved at lower cost than command-and-control.[1] Over time, GHG controls implemented by permit trading will induce investments in the development and diffusion of new technologies (such as renewables and enhanced energy efficiency) for reducing GHG emissions. Several recent experiments with emissions trading to control other pollutants, notably the phaseout of lead in gasoline and the ongoing reduction of SO_2 emissions from electric utilities under Title IV of the US Clean Air Act, suggest that an emissions trading policy is very promising (Hahn and Hester 1989, Burtraw 1996, Kerr and Maré 1997, Stavins forthcoming). However, there is still considerable debate and some confusion about how a GHG emissions trading program would be organized and operated in practice.

In this paper we address a number of questions that must be considered in designing and implementing a domestic GHG trading system in the US. These include who and what is covered by regulation (what sources and gases); the commodity to be traded and the trading system; how rights to emission permits are defined; how the system is to be initiated and

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[1] The relative advantages of emissions trading as a quantity-based instrument and carbon taxes as a direct price-based instrument is an important question (Pizer 1997). In this paper we limit our attention to quantity-based trading policies.

changed over time; how to deal with different kinds of uncertainties; and the interactions of permit trading with the tax system. While some of these questions have been discussed in previous studies, our paper draws these issues together and adds new insights concerning uncertainty, intertemporal consistency, market institutions, and interactions with the tax system. Our focus is exclusively on domestic policy; we do not consider how emissions trading or other GHG control policies should function in an international context. Throughout we consider the overall cost-effectiveness of alternative approaches (including administrative costs), their distributional implications, and political economy considerations.
Our fundamental conclusions are:

(i) The basic system should be an "upstream," "cap-and-trade" program with auctioned, bankable permits.

(ii) The rules for altering permit allocations should create the proper incentives for the private sector to respond to risk while also limiting opportunistic government behavior.

(iii) If permit are issued gratis, they should be taxed on their market value.

(iv) The revenue from the permit auctions should be used to offset existing tax distortions and to provide carefully targeted assistance to those most adversely affected.

DESIGN OF A GHG TRADING SYSTEM[2]

Direct regulation of all or even most GHG emissions is all but impossible in practice: looking only at CO_2 emissions from fossil fuel use, the most important GHG, there are literally scores of millions of sources. In addition, highly precise methods for directly measuring CO_2 emissions are economically practical only for large boilers that can be equipped with continuous emission monitors. One alternative is to control fossil fuel inputs to the economy. Fortunately, the CO_2 emitted from fossil fuel is essentially perfectly correlated with the carbon content of the fuel. Therefore, a reasonably accurate measure of emissions can be obtained by keeping track of quantities of fossil fuel used together with their carbon content. For example, it would be possible to control natural gas entering interstate pipelines, crude oil (domestic and imported) entering refineries, and coal sales from mines or processing plants. Such a system would require oversight of fewer than 2000 actors (Cramton and Kerr 1998, Hargrave 1998).[3]

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[2] A substantial literature is emerging on this issue (Smith et al. 1992, Hahn and Stavins 1995, Swisher et al. 1997, Swift et al. 1997, Hargrave 1998, Festa 1998). A related literature also has emerged in connection with international GHG policies (Tietenberg and Victor 1994, Fisher et al. 1996, Stewart et al. 1996).

[3] A variety of adjustments would need to be made. The basic system would not capture the relatively small amount of energy used in producing and initially transporting the fossil fuels to the regulatory control points. A rough adjustment might be made for that energy by requiring permits in excess of the actual carbon content of the fuel. It would be necessary also to adjust for non-combustion uses of fossil fuel inputs (such as chemical

One might also consider various hybrids that combine regulation of downstream CO_2 emissions from large boilers (as in the US SO_2 program) with upstream regulation of other fossil fuel flows. This approach requires more complex record keeping and enforcement and has greater risks of sources "leaking" from the system. More importantly, given reasonably competitive product and factor markets (including progress toward a competitive restructuring of the US electric utility industry), a downstream approach will have the same ultimate effects on fossil fuel and other prices as an upstream program. This corollary of the basic proposition that the ultimate incidence of a tax is independent of where it is applied is frequently misunderstood by proponents of downstream-based GHG emissions trading. The main substantive argument for a hybrid approach instead appears to be the ability to allocate emission permits to various energy users; we return to this point below.

A "cap-and-trade" program involves issuing a quantity of homogeneous permits (i.e., not sector or GHG specific) equal to the total level of emissions the Protocol allows. Individuals are free to buy and sell permits subject to whatever bookkeeping requirements are needed for assuring compliance. The "commodity" traded is the opportunity to emit a unit of GHG (measured in terms of carbon content released) once, rather than defining the commodity as a stream of GHG emissions over time. This approach, which is used already to regulate US utilities' SO_2 emissions, provides maximum flexibility and liquidity in the permit market. "Transaction costs"--the costs of identifying trading partners and effectuating trades--can be very low, and "derivative" transactions such as forward, futures, and options contracts can develop. Other human-induced greenhouse gas emissions (such as methane from coal mines and landfills, or HFCs now used in lieu of CFCs in air conditioners) could be added to the cap-and-trade system (based on calculations of their relative contributions to global warming), depending on the capacity to measure or infer emission balances. Sources, sinks, and gases not included directly, because of difficulties in tracking aggregate balances, could be incorporated in ancillary project-specific efforts to create credits that could be "imported" into the core program.[4]

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feedstocks, taking into account that some of the carbon in these materials eventually may escape to the environment as wastes are burned). Biomass energy supplies could be included by requiring biomass supplies to be permitted for their carbon content but then providing credits for the carbon sequestered in the growing of the feedstock. Similar crediting provisions would be needed for other deliberate carbon-sequestration activities, notably reforestation.

4 In addition, some arguments have been made for including producers of energy-using capital equipment in a trading system (for example, by requiring vehicle manufacturers to hold permits equal to the expected lifetime emissions of their vehicles). However, this approach controls only the performance of new equipment, has no effect on the utilization of equipment, and creates a bias that encourages uneconomic life extension of older, less efficient equipment. It also can lead to double regulation of emissions from energy using capital equipment. Over the long term, price signals provided by a fuels-based program will effectively guide both equipment purchase and utilization decisions. It is certainly possible that market failures associated with energy-using equipment (information unavailability, institutional barriers to transmission of effective price signals, and the like; see for example Jaffe and Stavins 1994) need to be addressed to improve the efficiency of capital purchase decisions. But these problems are best attacked directly where they occur.

Each permit can be used after a given date. For example, permits for the first budget period would be dated 2008, those for the second period, 2013. Permits could be used or banked for future use. Banking is a key feature of an efficient trading system, since it allows for efficient arbitrage of marginal costs when these are rising over time as emission targets tighten or energy demand grows. Regulators also could issue or sell permits ahead of their "use after" dates, and emitters and fuel suppliers could engage in forward contracting to assemble portfolios of permits. In particular, it may be useful to initiate provision or sale of permits for the initial commitment period (2008-2012) somewhat beforehand, so as to allow price information to develop and to build confidence in the trading and monitoring institutions themselves. Experience with the US SO_2 program suggests that confidence is enhanced by establishing in advance how trading will work, and how results will be monitored.

A key question is how any pre-2008 reductions of GHG emissions or fossil fuel use would "count" in terms of compliance with subsequent regulatory limits. Any such crediting depends on the establishment of credible, internationally recognized baselines for assessing the early reductions. The overall cost of compliance could be reduced if low-cost early reductions were banked for use when the compliance period commences, increasing the total level of emissions permitted during the commitment period but holding constant (or even reducing) atmospheric concentrations of GHGs (Kopp et al. 1998). However, this approach is not currently an option under the Kyoto provisions.[5] Another proposal would give permits usable after 2008 to those who undertake early reductions. However, other than the social value provided by early experimentation with emission control, this strategy amounts to government encouragement of uneconomic rent-seeking. Additional costs would be incurred early with no reduction in future compliance requirements, just a redistribution of the rents generated by those requirements.

Once a capacity for measuring or reliably estimating individual actors' CO_2 emissions or fossil fuel sales is established (a feasible but not trivial task), it is necessary only to keep track of covered sources' permits relative to fuel flows or emissions. There would be no need to keep track of specific transactions in the trading registry, other than the creation of project-specific non-CO_2 emission credits imported into the core cap-and-trade program. Any shortfall between required and actual permits would be deterred by stiff financial penalties and a requirement to cover the shortfall. Permits would be fully fungible within the five year commitment period, but each year firms would be required to show they hold permits equal to or greater than their emissions. This annual reporting would avoid the risk of large carbon debts when firms go bankrupt, and could provide useful information to the permit market.

[5] Right now bankable early reductions are possible only through actions by industrialized "Annex I" countries to reduce emissions in developing countries through the "Clean Development Mechanism." Banking industrialized countries' own early reductions would require changes to the Kyoto Protocol. One concern of environmentalists with early reduction banking is that it would implicitly undercut the emission reduction targets of the Protocol, which were predicated on the expectation of interim reductions. This is one reason why the baseline established for measuring early reductions is so important.

HOW CARBON PERMITS ARE ALLOCATED[6]

Before any trading program could commence, the permits would first have to be allocated. The government could simply require prospective permit holders (and anyone else who wished to) to bid for permits in an auction. An active secondary market could and (unless foolishly prohibited by government) would evolve that would allow sources to adjust their permit holdings to changes in circumstances between auctions. Auctions could be held periodically (e.g., quarterly). The government could auction more permits than are expected to be used within the period, to allow "borrowing".

A great deal of research and a reasonable amount of practical experience is available for designing such an institution (see Cramton and Kerr 1998). One option with strong potential for efficiency is a sealed-bid auction with a uniform price rule. Buyers would submit bids, the auctioneer would find the price that clears the market, and those who bid at least as much as the clearing price would receive permits at that price. Uniform pricing encourages participation by small bidders, since it is strategically simple. The usual concern with market power in uniform price auctions does not arise in this competitive market. Ascending auctions are more complex approaches that can yield some efficiency improvements over sealed bids, an advantage which must be balanced against their complexity.[7] The repeated bidding process in an ascending auction reveals information about participants' valuations of permits, which improves the bidders' own valuation estimates and hence the efficiency of the final permit allocation.

An auction would raise considerable revenue for the government.[8] This revenue could be used to mitigate the adverse effects of GHG control for certain groups of businesses or workers, to help finance innovation in technologies for GHG reduction (such as new energy sources or carbon storage technologies), for adaptation to climate change, or to benefit taxpayers as a whole through reductions in other taxes. As we discuss further below, this last approach has the potential to substantially reduce the net cost of GHG control, assuming the tax cuts are broad-based and efficiency-increasing.

The alternative to an auction is some form of gratis allocation. Such an allocation could occur in a number of ways. One often-discussed strategy is a form of "grandfathering,"

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[6] We use the term "carbon permits" here because it is common parlance, but a broader and more accurate term would be "GHG permits" to reflect the existence of GHGs besides CO_2.

[7] An illustration of such an approach is the "ascending clock auction." The "clock" indicates the current price. In successive rounds, bidders submit the quantity they are willing to buy at the price shown on the clock and are not allowed to increase their bids as the price rises. If the total quantity bid exceeds the quantity available the clock price is increased. The bidding continues until the quantity bid is less than the quantity available. The permits are then allocated at the immediately prior price (with rules for distributing them to those who reduced their quantity in the last round of bidding).

[8] To illustrate, US emissions of carbon from fossil fuel burning in 1990 were calculated to be 1374 million tonnes. Reducing this by seven percent by 2008 would imply emissions of about 1280 tons. (The US is obliged only to reduce all GHGs by an average of seven percent by 2008-2012.) If the price of a GHG permit were $50/tonne of carbon emission, then 1280 million tonnes of permits in the US would be worth $64 billion per annum.)

whereby regulated emission sources or fuel suppliers are given permits in proportion to their historical emissions or fossil fuel sales. Another approach is to divide up permits in proportion to market output shares, which could be updated over time (for example, in a "rolling average"), though this approach would act as an efficiency-reducing subsidy on output (Fischer 1998).

Gratis allocation provides a tool for distributing the scarcity rents created by limits on fossil fuel use or GHG emissions. It reduces the resistance of those who would in an auction have to pay for all their carbon or emission permits. However, the beneficiaries from a political decision to allocate permits to certain parties may not correspond to those who ultimately face the most adverse economic effects from imposition of the program. As already noted, the ultimate price and allocative effects will be the same with any permit allocation or with a permit auction. This means that, for example, employees that are unable to easily change jobs in response to lower labor demand in specific sectors such as coal, or households that cannot easily reduce energy demand in response to higher energy prices will suffer such effects under any system. On the other hand, with gratis allocation the rents will flow to the shareholders of the favored firms. Gratis allocation also deprives the economy of the opportunity for revenue-neutral reductions in existing distortionary taxes, and it may reduce somewhat the incentive for technical innovation (since, if an innovator anticipates cost savings due to permit price reductions, these savings will be smaller with a gratis allocation).[9]

For all of these reasons, we strongly prefer auctioning (see also Cramton and Kerr 1998 for further discussion). Because it may be problematic politically, it would be possible to start with a mixture of gratis allocation and auctions and gradually phase out the gratis allocation. In light of the argument in the previous section, the allocation should be of upstream fossil fuel carbon permits, *not* emission permits. Gratis allocation of these permits to downstream actors would then be bought back by upstream actors which directly face regulation(e.g., refineries), making the flows of rents fairly transparent. Rent transfers also could be achieved in more direct and more transparent ways than through the gratis allocation of permits—in particular, through transfers of revenues from a permit auction to whatever groups of shareholders or consumers are deemed worthy of receiving them.[10]

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[9] Grandfathering is sometimes criticized as being biased against new sources, which must pay for their emissions permits while existing sources obtain theirs for free. However, unless there are deeper competition problems, existing firms will have neither the motivation nor the capacity to discriminate against new entrants. For their part, entrants can and should come into an industry if and only if they are more efficient than incumbents, taking into account the opportunity cost of GHG permits. It is possible that small new sources could be disadvantaged because of imperfect capital markets that limit their access to finance. But this problem is best rectified by addressing the sources of any capital market distortions. As noted in the text, gratis allocations other than grandfathering (such as an approach based on market share) also create inefficiencies, so they are a poor choice for reducing any entry barriers that do exist.

[10] To avoid unnecessary inefficiency, these payments would have to be structured so as not to become output or consumption subsidies.

INTERTEMPORAL FLEXIBILITY AND UNCERTAINTY

As noted previously, banking of unused permits is important for improved efficiency when regulatory targets are such that marginal control cost is rising over time faster than the relevant rate of interest. By the same token, long-term borrowing against future allocations to meet nearer-term targets will be attractive if the price of permits otherwise is expected to rise more slowly than the rate of return on other assets, indicating a disproportionate short-term burden of controlling GHG emissions relative to the longer term. This could occur because the composition of energy-using capital is more flexible in the longer term than in the shorter term, and because tougher short-term requirements provide relatively less opportunity to embed technical improvements over time.

Modeling studies suggest that emitters can stabilize atmospheric concentrations of GHGs at far lower cost (well over 50 percent savings), with little or no adverse climate change implications in the short-to-medium term, if emitters can maintain significantly higher emissions in the next couple of decades than are allowed under the Kyoto Protocol. During these decades they would begin to install higher-efficiency capital that will allow much lower emissions subsequently (Richels and Edmonds 1995; Manne and Richels 1996, 1997). These models provide an economic argument for permit borrowing (or long-term allocation of permits without restriction on advance use). Critics of these analyses have argued that postponement of short-term emissions reductions, by lowering energy prices below what would have occurred with tighter standards, also will retard some induced innovation and learning-by-doing that is assumed by proponents to be available in the future (Grubb 1997, Ha-Duong et al. 1997). Reaping the cost savings pointed to by advocates of borrowing thus might require increased government commitments to R&D.[11]

Critics of borrowing also have raised more fundamental questions related to time consistency. What is to stop emitters from rapidly depleting their endowments of permits in anticipation that current regulators will not be willing to impose sanctions? If future regulatory actions to enforce repayment of borrowed permits are not seen as credible, then needed investments in R&D also will not be undertaken. In addition, what would prevent future regulators, who will themselves have incentives to defer control costs, from not going along with the higher control cost burdens that a current decision to defer abatement would place on them? This problem might be countervailed if new, significantly lower-cost ways to limit GHG emissions are discovered and diffused, perhaps with government support, so that postponement is less attractive; or if permits are sold well in advance (but cannot be used in advance), giving private holders an incentive to resist subsequent efforts by the government to add permits to the system and create capital losses on banked holdings.

Because the potential cost savings from providing increased intertemporal flexibility are so great, it is important to continue to investigate ways that such flexibility might be

[11] A more complex question, which we do not address here, is what level of public and private R&D actually is desirable, and the extent to which a desirable level will be undertaken when a policy like emissions trading is imposed.

credibly implemented in practice. The government also could attempt to approximate the results of intertemporal borrowing by announcing a sequence of tighter emission limits over time. However, there is still a credibility problem related to whether the government will follow through on a commitment to tighten emissions limits, and this uncertainty will deter R&D. At the same time, the higher cost of stricter near-term emission controls deters compliance from the outset.

A GHG trading program also must deal with various uncertainties over time. "External" factors reflect changes in aggregate national GHG emissions ceilings due to such international influences as changes over time in the perceptions of the risks of climate change, and the ongoing process of negotiation of global emissions targets and national obligations under the Framework Convention. For example, a discovery that climate change is more threatening than it seems today could cause national GHG budgets to be reduced to phase down emissions more quickly. "Internal" uncertainties reflect the government's own political or revenue-based motivations for changing the allocation of permits. The time inconsistency problem is one major source of uncertainty. Other sources arise even if the Kyoto targets are met. One is reallocations of gratis quota among sectors, for example reductions in downstream sectoral quotas when a sector has shown particular capacity to reduce costs. Another is unannounced movements from gratis allocations to auctioned allocations to increase government revenue.

These uncertainties call for responses that are to some extent at cross purposes. Putting the external risk on the private sector creates uncertainties in their investment planning. However, these risks are unavoidable and emitters, not the government, are in the best position to bear them through a portfolio of investments in existing and new technologies that provide flexibility if quotas fall (and options to emit more if they should happen to rise).[12] On the other hand, internal risks unnecessarily increase investment uncertainty, and they can undercut the incentives for permit market participants to undertake desirable investments in lowering the cost of emissions control. By their nature, hybrid upstream/downstream programs with gratis allocation seem more prone to internal risks than an upstream auctioned approach, since the government has more control over the initial allocations of permits. Policy needs to spell out carefully the circumstances under which emissions allocations can be altered, in order to limit opportunistic regulatory behavior, while recognizing the sovereignty of the government over GHG emissions and its need to respond to ongoing international discussions on GHG reductions.

PERMIT TRADING AND THE TAX SYSTEM

Any permit system has to operate within the context of the existing tax system. Each system will have an effect on the efficiency of the other, raising important design issues for GHG trading. Of particular concern is the tax treatment of banked permits over time, as

[12] Banked allowances should be sacrosanct; without this assurance, a valuable means for improving the efficiency of emissions control over time will be lost.

general inefficiencies in the taxation of capital income raise some specific issues for intertemporal emissions abatement choices.

Permits are potential assets as well as inputs to production. This dual nature poses a challenge in choosing proper tax treatments and achieving efficiency in the permit market. When market conditions favor banking of permits (that is, when abatement costs are expected to rise sufficiently in the future to warrant holding permits for later use), the taxation of capital gains can introduce distortions in permit markets. One distortion is a "lock-in" effect that stimulates excessive banking of permits. Given the choice of (a) selling a permit and paying tax on capital gains accrued to date, then investing the sale proceeds, and (b) holding the permit in expectation of further capital gains, which will only be taxed when the permit finally is sold, existing permit holders will tend to defer permit sales that might otherwise be economically efficient.

The tax system also creates a kind of reverse lock-in: allowance purchase costs cannot be deducted as inputs until use, which deters purchase of allowances in advance. However, because of the first lock-in effect, the deferral of deductibility is crucial in order to deter inefficient tax avoidance. Without this rule, taxes could be saved by purchasing and immediately deducting allowance costs, and deducting interest in funds borrowed to finance the purchase, while only paying tax on the accrued return when the asset is sold. Still, the same kind of tax arbitrage can occur when permit buyers purchase and fully deduct higher-cost permits while holding permits with a lower cost basis for accrual of gains. This particular scenario can be avoided by a type of FIFO (first-in, first-out) rule.

Inefficiencies arise when permits face different effective tax rates across different individuals. For example, an owner of a permit would require a lower rate of return to holding permits to offset the lock-in effect and sell today rather than hold the asset. But with different cost bases, different owners will require different premia to overcome the particular lock-in they face and sell today. On the other hand, for a buyer to be willing to purchase and hold a permit, she would require a higher rate of return, since she cannot deduct the cost until later. No permit price path can simultaneously make all these actors indifferent to buying, selling, and holding.

Gratis allocation creates more of a bias toward excessive permit banking, the first lock-in effect. This will tend to inefficiently "tilt" the permit price path downward: permits today will be more expensive, and the greater volume of banked permits will lower future price expectations. The excessive tilting of the price path in turn will shift abatement activities inefficiently toward the present. On the other hand, with auctioned permits the bias is against holding, since the deduction must be deferred. In this case, to have banking the price path must inefficiently tilt up; correspondingly, some abatement will be inefficiently deferred.

Ultimately, reducing these distortions would require broader reform of capital gains taxation (Auerbach 1992). Simply eliminating the taxation of capital gains on permits would not eliminate the problems; as long as permits are deductible, gains must be taxed. Otherwise, two permit users could swap permits, with each deducting the full value and neither being taxed on the proceeds. Exempting permits from taxation completely would treat firms symmetrically and get rid of this incentive to "churn." However, differences in income tax brackets among individuals and corporations mean that different investors still will face different tradeoffs between permits and other assets, and distortions will remain. If permits were tax-exempt then people with high marginal tax rates would invest in them, driving down the rate of return to the low after-tax rate of return these individuals would reap on other assets; consequently, the lower rate of return would cause excessive amounts of early abatement effort. Furthermore, exempting permits from taxation would tend to narrow the tax base, leaving other forms of income-generating activities to shoulder more of the distortionary tax burden.

How substantial are distortions to abatement decisions, as well as the potential loss of tax revenues through arbitrage activity, from these features of the tax system? Recent evidence in the literature on capital gains taxation suggests that when people choose to realize capital gains is not that sensitive to tax rates over the long term, implying a relatively small lock-in effect (Gravelle 1991, Burman and Randolph 1994, Zodrow 1995). However, gratis permits pose a larger potential lock-in effect than most assets: since the cost basis for gratis permits is zero, they in effect instantaneously accrue the market value. The incentive to defer gains by holding onto permits is not only the postponement of taxes on the price increases, but also the postponement of taxes on the initial permit price itself. Short of auctioning permits, this problem could be mitigated by taxing the recipient on the market value of the allocation, thereby allowing the initial basis to be the market rate and not zero. Firms would then deduct that market value for the permits they use, so at tax time they would effectively only be liable for gains tax on the gratis permits they did not use.

In addition to specific interactions with the tax code, a permit system can interact with the tax system through the generation of auction revenue. Since leisure goes untaxed, any tax on consumption goods or income lowers the effective real wage and distorts the labor supply decision. Consequently, any environmental policy which raises the cost of carbon-intensive goods exacerbates the pre-existing distortions in the labor market. This type of tax interaction is best mitigated by collecting permit rents through auctions and using the revenues to lower distorting labor taxes (Goulder 1995, Parry 1995, Parry et al. 1997). Coupling an auctioned permit system with broad-based income tax reform not only minimizes additional labor market inefficiencies but also lessens tax distortions to the permit system itself.

CONCLUDING REMARKS

Our conclusions that the permit system should be upstream, auctioned, and that auction revenue should be recycled are still controversial. However, if one assumes a longer-term national commitment to potentially costly GHG emissions control there is both a fair amount of time for regulatory institutions to evolve and gain public acceptance, and a pressing need to choose the best institutions possible. Without such a commitment, which is currently lacking in the political arena, any discussion of regulatory options is somewhat beside the point. Only time will tell if our proposal gains currency in the 10 years between now and the start of binding commitments under the Kyoto Protocol. Many important practical questions need to be addressed before a GHG trading system in the United States can be constructed and implemented. However, the deployment of a relatively efficient and transparent system seems within our grasp, especially once key issues related to who benefits from the revenues created by such a system are resolved. A well-developed domestic trading system in turn would provide a good foundation for taking advantage of the potential opportunities afforded by GHG trading on an international scale.

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