The Free-Market Environmentalist Case for Cap-and-Trade[*]

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The primary purpose of this paper is to situate so-called cap-and-trade policies within free-market environmentalism (FME), but I wish to approach the topic obliquely, through the issue of global climate change. My starting point is the observation that it is a non-sequitur to say, "because I am committed to free markets, I do not believe in anthropogenic climate change." Fifty years ago, Friedrich Hayek, an FME hero, distinguished classical liberals from conservatives as being unafraid of new scientific knowledge, however inconvenient its policy implications, as their commitments to liberty are not rooted in scientific facts.[1] To be sure, libertarians as well as conservatives have good reason to be suspicious of scientists who cavalierly advocate radical social changes on the basis of their latest journal article, and that suspicion is entirely healthy. But a posture of suspicion is not the same as a theory of atmospheric physics. Ultimately, FME, *qua* FME, has nothing to say about climate change.

Speaking personally, I am convinced that the there is adequate scientific basis to begin reducing green-house gas emissions. The hot air of a few emails notwithstanding, decades of research have confirmed that human activity has already warmed the planet, and that we can expect further temperature increases from greenhouse gas emissions.

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[1] Dolan (2006), emphasizes this point in his own essay about the free-market approach to climate change. He quotes Hayek from his explanation of why he is not a "conservative," in a passage that is worth repeating.

> Personally, I find that the most objectionable feature of the conservative attitude is its propensity to reject well-substantiated new knowledge because it dislikes some of the consequences which seem to follow from it—or, to put it bluntly, it obscurantism. I will not deny that scientists as much as others are given to fads and fashions and that we have much reason to be cautious in accepting the conclusions that they draw from their latest theories. But the reason for our reluctance must themselves be rational and must be kept separate from our regret that the new theories upset our cherished beliefs. . . . By refusing to face the facts, the conservative only weakens his own position. Frequently the conclusions which rationalist presumption draws from new scientific insights do not at all follow from them. But only by actively taking part in the elaboration of the consequences of new discoveries do we learn whether or not they fit into our world picture and, if so, how. Should our moral beliefs really prove to be dependent on factual assumptions shown to be incorrect, it would hardly be moral to defend them by refusing to acknowledge facts. (Hayek 1960 p. 404, cit. Dolan 2006 pp. 447-8)

While there is still room for debate about the factors determining the extent of the increase—whether water vapor will augment temperature changes or cloud cover will ameliorate them, for example—the consensus for some warming is solid (Lindzen 2009).

But it is not my goal here to make a case about climate science. If there is disagreement on this point, let us agree to disagree. It will be enough for my purpose that we can agree that that there is no *a priori* reason why climate change might not be happening and that it might not be harmful. In that case, let us consider it as a kind of though experiment. Let us take as a premise that man-made climate change is occurring and that it is detrimental to human welfare. Then, if FME is to be a strong and robust paradigm, it should look at problems like climate change in the eye and offer an FME response.[2] I will argue that cap-and-trade is an appropriate policy and one fully consistent with FME principles.[3]

MARKET-BASED APPROACHES TO REDUCING EMISSIONS

Reducing excessive pollution is a legitimate purpose of government, but governments should do so in the least obtrusive, least heavy-handed way possible. The first generation of federal environmental policies, passed in the 1970s, turned their back on this principle. These "command-and-control" policies have injected the government unnecessarily into countless manufacturing and commercial decisions. They have also resulted in decades of wasteful environmental litigation and unnecessary burdens on the economy growing out of the inevitable unintended consequences. For example, requirements that new power plants meet tough environmental standards have prolonged the lives of older, dirtier and less efficient plants.

In contrast to these intrusive regulatory policies, free-market economists have long advocated market-based approaches to the environment. Naturally, the starting point of this approach is a deep appreciation for the efficiency of markets. Markets pro-

[2] This claim is not necessarily obvious. One could take the position instead that PERC and others advocating FME should confine themselves to those topics where they have a comparative advantage, topics such as water conservation and habitat conservation. I would argue rather that FME should have a response to such problems as climate change, even if those responses are not especially distinctive from environmental economics generally. Economists having affection for markets, there are, after all, many things about which free-market environmentalists and environmental economists generally agree.

[3] For an introduction to cap-and-trade concepts, see Kolstad (2010) and Tietenberg (2006).

vide incentives for people to work hard and to innovate. More deeply, the invisible hand of the marketplace coordinates the actions of countless individuals by using prices as the signals which convey their local and special knowledge—knowledge that no central planner could ever have, however powerful his computer.

Pollution is an exception that proves this rule because, where property rights are weak or poorly defined, prices do not convey all the relevant information about an action. They might neglect the benefits, for example, of burning natural gas in lieu of coal. But the market-based approach recognizes that if the problem is missing prices, then the solution is to create an institution where emissions carry a price and allow markets to do the rest. There are basically two ways to do this. One is to price emissions by charging fees or taxes on emissions. The second is to set a quota on allowable emissions and allow industry to trade pollution rights to each other or to environmentalists, creating a market for emissions.

Either way, these market-based approaches have three advantages over more intrusive command-and-control regulations. First, they create flexibility in *who* cuts their emissions. Industrial facilities that find it easy to reduce their emissions can save money by making extra cuts, while those that face steep abatement costs can emit more. Second, market-based approaches create flexibility in *how* the cuts are made. Plant managers, who know their own business better than anybody in Washington, are given full freedom to make the cuts however they choose. Finally, market-based approaches create incentives for entrepreneurs to devise new ways to reduce pollution more efficiently. Command-and-control policies, by contrast, merely create an incentive to comply with the specified rules. Illustrating all three advantages, the US acid-rain trading program has been a fantastic success, cutting sulfur dioxide pollution from power plants in half, at about half the cost of command-and-control regulation, while also providing more certainty for business (Carlson et al. 2002).[4]

There are two primary differences between taxes and cap-and-trade. The first is who pays the price of emissions. Either way, firms must pay the cost of reducing emissions, but the payments are different for those emissions that remain. Under emissions

[4] Unfortunately, new command-and-control regulations have all but shut down this innovative and successful trading program.

fees, firms must pay to emit. Under cap-and-trade with grandfathered (but not auctioned) permits, firms do not have to pay for their emissions under the cap. As discussed below, when viewing it through a property rights lens, we can think of this difference primarily in terms of the allocation of the initial rights to the atmosphere.

The second main difference is whether it is prices or quantities that are set in the marketplace. In the unrealistic case in which all information about costs is known, there is a simple duality between the two approaches: if a cap-and-trade program results it X units of emissions trading at a price of $Z, then an emissions tax of $Z will yield X units of emissions (See Figure 1). In the more realistic case of uncertainty about costs, the emissions tax will set the price, while allowing the market to determine the resulting quantity of emissions. The cap, it is often said, sets the quantity of emissions, and allows the market to determine the value of those emissions rights based on abatement costs.[5]

More accurately, where environmentalists can buy and retire permits, as with the US sulfur dioxide and nitrogen oxide trading programs, the Regional Greenhouse Gas Initiative, and the EU Emissions Trading Scheme, the cap sets an *upper bound* on emissions. It then allows the market to determine the price of those rights based on the value of abatement as well as the costs.

This raises the important implementation question of how to set the tax or the cap. As noted previously, environmental quality is not the only objective of interest to humans. Ideally, environmental objectives will be balanced against other objectives by equating the marginal benefits of environmental improvements with the marginal benefits of other activities that must be foregone to improve the environment. In economics jargon, the marginal benefits of environmental improvement must be compared to the marginal opportunity costs.

Thus far, I have simply restated the standard case for incentive-based environmental policy. How are we to think about the FME response to this standard paradigm in economics? A starting point might be to say that on a scale of things, free-market environmentalists would at least go so far as to say that such policies are preferable to the traditional command-and-control approach. Command-and-control approaches are typically

[5] See Weitzman (1974) for the classic comparison of price and quantity instruments.

quite invasive. Governments may impose specific technical solutions that poorly fit the context of a specific firm operating at a particular place, and offer no incentives for entrepreneurs to develop new ways to protect the environment at lower costs. Compared to such heavy-handed intervention, the use of markets—even artificially created markets—gives greater room for human freedoms and leads to more efficient outcomes.

This year being PERC's thirtieth anniversary, it is appropriate to consider what one of PERC's heroes, Milton Friedman, had to say about such policies. Friedman helped inspire PERC's founding when, in 1971, he came to Montana State University to debate the merits of federal ownership of national forests (Stroup 2007). Friedman speaks at greatest length about environmental issues in *Free to Choose*, co-authored with his wife Rose Director Friedman. The Friedmans begin their discussion by emphasizing the importance of balancing the benefits of pollution reduction with opportunity costs. They write,

> The real problem is not "eliminating pollution," but trying to establish arrangements that will yield the "right" amount of pollution: an amount such that the gain from reducing pollution a bit more just balances the sacrifice of the other good things—houses, shoes, coats, and so on—that would have to be given up in order to reduce pollution. If we go farther than that, we sacrifice more than we gain. (Friedman and Friedman 1980 p. 215)

Achieving that balance through planning alone is an impossible task, but market forces are a powerful aid. As the Friedmans explained,

> Most economists agree that a far better way to control pollution than the present method of specific regulation and supervision is to introduce market discipline by imposing effluent charges. For example, instead of requiring firms to erect specific kinds of waste disposal plants or to achieve a specified level of water quality in water discharged into a lake or river, impose a tax of a specified amount per unit of effluent discharged. That way, the firm would have an incentive to use the cheapest way to keep down the effluent. Equally important, that way there would be objective evidence of the costs of reducing pollution. If a small tax led to a large reduction, that would be a clear indication that there is little to gain from permitting the discharge. On the other hand, if even a high tax left much discharge, that would indicate the reverse, but also would provide substantial sums to compensate the losers or undo the damage. (p. 217)

Elsewhere, Friedman similarly praised the cap-and-trade approach taken in the 1990 Clean Air Act Amendments for SO_2 control [cite needed]. In either case, the government's role is limited to establishing a price on pollution, either directly or indirectly through the scarcity inherent in the cap. Following Friedman's essentially Pigouvian approach, that price or cap would be set with benefit-cost principles and feedback from the market.

Given their use of market forces and economic incentives, their greater respect for individual decision-making, and Friedman's enthusiasm for them, emissions taxes and cap-and-trade should at least be on the FMErs menu for climate change policies. But as I have presented them up this point, both policies are essentially Pigouvian, and Pigou has never been an FME hero. Emissions taxes are of course the quintessential Pigouvian solution to a neighborhood effects. Moreover, as often developed in modern textbooks, cap-and-trade seems to be simply the dual to this Pigouvian approach: a quantity is set rather than a price, but that quantity is associated with a marginal abatement cost which is equal to the tax inducing a level of abatement which is itself equivalent to the cap. However, I will argue that cap-and-trade can be interpreted in a very different light.

It may come as a surprise to some readers that Coase himself has interpreted cap-and-trade in terms of the analytical framework he constructed in the *Problem of Social Cost* (Coase 2002, Frank 2010). In the following section, I will attempt to show how cap-and-trade can be viewed as essentially Coasian.

CAP-AND-TRADE AS A COASIAN SOLUTION.

If Coase's view of environmental damages could be captured in a haiku, it might be rendered thus:

Make property rights,
reduce costs of transactions,
and let markets work.

Cap-and-trade does precisely this. In setting the cap, the government defines a clear property right: firms hold exchangeable rights to dispose of gases in the atmosphere up to the level of the cap; the government holds all additional rights to the atmosphere in public trust. Beyond that, the government simply monitors emissions levels (an enforcement of rights) and enforces contracts between private parties trading permits. Certainly, this was the view of Tom Crocker and John Dales, who first developed the idea of cap-and-trade (Crocker 1966, Dales 1968).[6]

To better see how cap-and-trade can be considered a Coasian solution to an environmental problem, consider the following scenario. Suppose property rights to the atmosphere are clearly defined, and in particular that individuals and firms have the right to use the atmosphere for disposing carbon. This being a property right, firms naturally are allowed to sell the right to emit, or to refrain from exercising it. Accordingly, environmentalists who sufficiently value reducing carbon could pay firms to compensate them for reducing their emissions. For example, if Firm A could reduce its emissions of carbon by one ton for a price of $20, and environmentalists value a one-ton reduction in carbon by $30, they could strike a bargain by which the firm would reduce its carbon emissions and the environmentalists would pay it an amount between $20 and $30, and both would be better off. This is the quintessential FME solution. If transactions costs are low, and if environmentalists did indeed value significant emissions reductions more than the costs of abating a significant amount of emissions, then we would expect to see many such transactions.

Unfortunately, as Coase constantly reminds us, transactions costs are not always low. Indeed, there are three reasons why transactions costs are likely to be high in this case. Let us consider two of these reasons at present, leaving a third for later. First, environmentalists would have to coordinate with each other and with many other firms. Coase noted that

> When large numbers of people are involved, the argument for the institutions of property rights is weakened and that for general regulations becomes stronger. The example commonly given by economists, again following Pigou, of a situation which calls for regulation is that created by smoke pollution. . . . [I]f many people are harmed and there are several sources of pollution, it is more difficult to reach a satisfactory solution

[6] On the Coasian connection in this early history of the cap-and-trade idea, see Tietenberg (2006) and Morag-Levine (2007). It should be noted that Crocker himself does not believe that cap-and-trade is the best approach for dealing with climate change. My point here is simply to show the connection to the Coasian worldview.

> through the market. When the transfer of rights has to come about as a result of market transactions carried out between large numbers of people or organizations acting jointly, the process of negotiation may be so difficult and time-consuming as to make such transfers a practical impossibility. (1959 p. 29)

Although by no means insurmountable, such negotiations would be daunting and would surely reduce the number of transactions.

Although Coase was right to emphasize the importance of this kind of transaction cost, and he has emphasized the role of centralized markets, such as the Chicago Mercantile Exchange or ICE, at overcoming them (Coase 1988). However, earlier in his career his imagination failed him when it came to seeing how such centralized markets could overcome transactions costs in trading pollution rights, with environmentalists and firms meeting and trading in an open market. This is essentially the "trade" part of cap-and-trade, and in principle it can function without the "cap" part of the appellation. Indeed, something like this is occurring on a very limited basis at the Chicago Climate Exchange (CCX), without any government prompting.[7] As with stock markets and related financial institutions, there might be some role for government oversight here, but it would certainly be minimal compared to most environmental policies.

But there is a second type of transaction cost which a marketplace alone cannot overcome.[8] This more thorny problem is that it would be hard to know just what any such purchases actually achieved in the way of reductions in emissions reductions. Suppose Firm A says that, absent any contract, it would emit 1000 tons of carbon next year, but for a certain price it would be willing to emit only 900 tons. Any environmental group would naturally be suspicious of the firm's claim. Perhaps it would only emit 900 tons next year anyway, and is simply seeking free money. In the cap-and-trade lingo, this is known as the "additionality" problem. Environmental groups would only want to make payments for reductions in carbon that are truly "additional" to what would be done anyway.

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[7] See the description at http://www.chicagoclimatex.com/content.jsf?id=821.

[8] Although I used the term "transactions cost" as a short-hand, one might argue that it is simply tautological to define as such anything that would cause the no-transactions-cost version of the Coase theorem to fail. I thank Steve Medema for making this point.

Even if this informational problem could be overcome, there may be indirect market channels undermining the purchase. Suppose the firm does reduce emissions and does so by reducing its production of electricity, or some other dirty output. This will at first create an imbalance in the electricity market as supplies fall. Prices will rise in response, and this will induce other firms to produce more electricity. If the demand for electricity is relatively unresponsive to price (what economists call "inelastic"), then this may almost entirely offset the initial purchase. Suppose instead that the firm reduces emissions, not by reducing its production of electricity, but instead by switching from coal power to wind power or some other low-carbon mode of production. Again, by lowering demand for coal this will cause coal prices to fall, and induce other firms to use more coal. Such indirect effects (known as "leakage" in cap-and-trade speak, but which economists recognize as "general equilibrium effects") make carbon purchases something like a black hole, down which any well-meaning environmentalist would eschew throwing its money.[9]

Coase understood that, in such situations, progress is made by finding creative ways to lower transactions costs, rather than trying to determine the ultimate allocation of resources (Coase 1988, 1992, 2002; Bertrand 2010a). In that spirit, consider the following cap-and-trade scheme as a way to reduce the transactions costs described above. Moreover, given that firms have a de facto right to pollute the atmosphere, this scheme will involve no change in the assignment of rights.

Suppose that under business as usual, that is, absent any regulation, any cap, or any contracts, firms would choose to emit 100 units of carbon. (Obviously, these units are arbitrary and 100 is simply chosen for convenience.) Suppose for the moment, simply to develop the thought experiment, that furthermore this emission level were known with certainty. Then the government could create a cap-and-trade program with a cap of 100 units.

At first blush, this may appear to be the ultimate act of futility. It might appear to say no more than that industry shall not emit more than it emits. Moreover, so far as all

[9] Similar issues also arise in the context of Individual Transferrable Quotas for fisheries: see Deacon and Parker (2009).

trades within the cap were between emitting firms, the equilibrium price of permits would be precisely zero. This does not seem to be much of a market.

But this first impression fails to appreciate one of the most important features of a cap-and-trade program. Namely, environmentalists (or anyone for that matter) are allowed to purchase these rights and retire them. Setting a cap, albeit a cap equal to business-as usual-emissions, overcomes the second barrier to transactions, the general equilibrium effects in a market that might un-do them. If business-as-usual emissions are 100 units of carbon, and if there is no cap, an environmental organization paying a firm to reduce its emissions one unit might find that another firm increases its emissions one unit, so that 100 tons are still emitted. The environmental organization achieves nothing for its expense. In contrast, with a cap of 100 units of carbon, the environmental organization knows that, when it buys rights to one unit, emissions will be no higher than 99 units, for no other firm will be able to obtain permits for the 100^{th} unit once it is retired.

Moreover, the tradable permit system creates units of account and a medium of exchange, thereby reducing the first kind of transaction cost. Bilateral negotiation is replaced by a centralized market. The cap-and-trade program simply reduces transactions costs, allowing mutually beneficial exchanges to proceed from the well-defined rights.

Note here that, to this point at least, no effort whatsoever is being made to identify some optimal level of emissions Q*. All that has been done is to define property rights and reduce transactions costs. If transactions costs are now low, all individuals and organizations will be able to meet in the market and contribute their local knowledge about the costs of emissions abatement and/or the value of emissions reductions. In the full sense of Hayek (1944), the market will process this diffuse knowledge and grope to a price and level of emissions that fully process these information signals. The process is illustrated in Figure 2, which illustrates transactions reducing emissions from the business as usual 100 units to some level labeled Q*. Many environmental economists would say that if transactions costs are low, the market will achieve Q*; some FME economists might prefer to say that through this process Q* is revealed. In either case, the bottom line is that an efficient market allows mutually beneficial transactions which improve the environment.

Of course, the government would still have to forecast business-as-usual emissions in order to set the cap at that level. But this task is a relatively small matter in the grand scheme of things. In the short run, next year's emissions are likely to be very similar to this year's, so forecasts are likely to be fairly accurate. More importantly, a "conservative" cap, one over-allocating emissions permits to industry, is likely to be just as effective as a cap based on an accurate forecast of business as usual. For example, in Figure 2, the government might issue 110 permits to industry rather than 100 permits. Environmentalists would simply purchase permits at a price very near zero up until the remaining rights in circulation become binding (at 100 in this illustration), at which point the price of permits would begin to increase.[10] Environmentalists would continue to purchase permits up to Q*, where their marginal value for more conservation equals the price.

In the best spirit of FME solutions, delimiting the right to the atmosphere creates new value out of tragedy of the commons. Where before there were only externalities bringing down social welfare, with the establishment of these rights there are opportunities for mutually beneficial transactions that benefit all: environmentalists can achieve their objectives in a simple and direct manner, while would-be emitters can sell their resources to higher-value users.

TIGHTENING THE CAP

To this point, we have assumed that once a cap-and-trade system is in place, transactions costs are low and the market for emissions permits works efficiently. Transactions costs for trading permits might well be low among emitting firms, so that the inter-firm allocation of emissions is efficient and a given level of emissions reductions is achieved at least cost. Unfortunately, there is still a third type of transactions cost, or barrier to efficient trading, which might prevent the above scheme from achieving an efficient level of emissions.

To purchase rights to the atmosphere from polluting firms, environmentalists would have to come together to pool their resources. But the environmental harm done by carbon, however substantial it may be in the aggregate, is spread over many mil-

[10] I thank David Haddock for making this point.

lions—perhaps billions—of people. Accordingly, people will have little incentive to take part in such a process. This dynamic is a form of the free-rider problem, in which individuals can shirk their contribution to a public resource in the hopes that others will provide it. It is a common feature of public, as opposed to private, resources. Just as diffuse interests often fail to organize in the political economy of lobbying government, so too can they fail to overcome the transactions costs needed to organize to purchase rights to the environment. As a consequence, the market will continue to allow emissions at a level higher than Q*, at something between Q* and the initial allocation of 100 permits to emitters (Stavins 1995).

Of course, Coase understood the significance of transactions costs perfectly well; indeed, his entire career can be summed up by an appreciation of their importance. In the *Problem of Social Cost*, Coase suggests that the initial allocation of rights is only a non-economic matter when transactions costs are low. In the more realistic case of higher transactions costs, the allocation of rights becomes an economic matter. "In such cases," Coase notes that

> the courts directly influence economic activity. It would therefore seem desirable that the courts should understand the economic consequences of their decisions and should . . . take these consequences into account when making their decisions. Even when it is possible to change the legal delimitation of rights through market transactions, it is obviously desirable to reduce the need for such transactions and thus reduce the employment of resources in carrying them out. (1960 p. 19)

In other words, property rights should be allocated on the basis of balancing benefits and costs. As Coase summarizes, "it is all a question of weighing up the gains that would accrue from eliminating these harmful effects against the gains that accrue from allowing them to continue" (1960 p. 26). Or, more succinctly, "the problem is to avoid the more serious harm" (1960 p. 2, 1959 p. 26).

In this case, the ideal way to allocate the permits would be to give rights only to Q* units of emissions to industry. Such an allocation would meet Coase's criterion of finding an initial allocation that maximizes social welfare. It differs somewhat from some of Coase's simplest examples, in which the allocation of rights is strictly binary. In many of his simple examples, property rights are all-or-nothing. The confectioner has the right to make noise, which disturbs the practice of his neighbor, the physician, *or* the physician has the right to quiet. Following this logic, only zero or 100 permits for emissions could be allocated to emitters initially. But it is a small matter to generalize the allocation of rights to one of degree or extent. The court could well have said the confectioner has the right to make noise up to a certain volume. Indeed, a court did do something similar in Coase's example of airport noise (*Delta Air Corp. v. Kersey, Kersey v. City of Atlanta*). There, recognizing the public's interest in aviation, the court gave the right to make noise to the airport. But it partially restrained that right by banning approaches to the airport below a specific altitude, on the grounds that the airport could avoid such approaches with the relatively low-cost fix of lengthening its runways (Coase 1960 pp. 25-6). Coase appears to apply the same reasoning to pollution when he invokes the marginal principal for pollution control (Coase 1959 p. 29).

By a series of two steps, we have opened the door to the standard cap-and-trade solution as being vintage Coasian. First, we simply make emitters' right to status-quo emissions explicit and we reduce transactions costs through the creation of permits to a standardized unit of pollution and through the institution of a central market place. Second, recognizing remaining transactions costs, we redistribute the allocation of the right so that emitters' have only Q* in Figure 2.

Two practical questions remain. The first question is what happens to the remaining permits that are not allocated to emitters (that is, 100-Q* in Figure 2)? The standard cap-and-trade proposal is for the government to reserve them as a public trust and to refrain from selling them. A variant is for the government to sell its share of the permits at a predetermined price (Pizer 2002) or perhaps at a sequence of escalating prices (Murray, Newell, and Pizer 2009). (Often called a "safety valve," this approach is essentially a hybrid of cap-and-trade and emissions fees.) But there is a third option, one which is often neglected.

This third option is to give the remaining rights to the atmosphere to a handful of environmental and/or consumer organizations. Just as such conservation organizations are free to buy emissions permits in the market when they are not initially allocated rights, when they are allocated an initial share of emissions rights they should likewise be free to *sell* their rights.[11] In this way, the government would play no role whatsoever either in setting the price of pollution or in capping the ultimate level of emissions. Environmentalists and firms would mutually determine both through their market transactions. Only in the case where transactions costs are so high as to prohibit all trading would the ultimate quantity of emissions be set at the initial allocation to emitters. Experience with emissions trading to date suggests this is extremely unlikely.

No doubt this proposal would be met with protest from environmentalists who may distrust the organizations chosen (or created) to represent them, fearing that they would sell out their environmental interests. But this objection might be overcome by limiting the environmental trusts to using any proceeds from their sales to achieve other environmental objectives. For example, they might be allowed to sell rights to emit carbon and use the proceeds to purchase rights to sulfur dioxide, or even wetlands. Such trades would be in the same spirit of a land trust, such as the Nature Conservancy, selling land donated to it for the purpose of acquiring other, more ecologically valuable lands. Environmentalists could use their expertise and their judgment to signal to the market the relative value of conservation in each of these dimensions. For the government to divest its share of the cap in this way resembles proposals for the federal government to divest itself of national forests, while perhaps maintaining an easement on the land that it be used in forestry and access granted to recreationists.

The second remaining practical issue is the determination of Q*. Again, in the presence of transactions costs, Coase (1959, 1960) would advocate allocating rights as close as possible to the users who hold the highest value. When rights to a *share* of the atmosphere are at stake, optimization involves equating the marginal values of rights to emitters with marginal values for environmentalists. This optimal balance occurs precisely at Q* indicated in Figure 2. But expressing this quantity in terms of the trade-off between costs and benefits begs the question of how these costs and benefits are to be determined a priori. Here, a dose of humility is called for. For all their sophisticated the-

[11] In the same spirit, one could imagine the government giving small shares of rights, essentially scrip, to every individual household with the right to sell them. While plausible in theory, this is likely to raise difficulties in practice.

ory and econometrics, economists cannot presume to be able to pin down the truly socially optimal level of carbon or any other pollutant.[12] But property rights must be allocated and some guidance must be provided for allocating them. *Estimates* of Q* can be made using benefit-cost analysis, and should be. I, like many others, have conducted such exercises for conventional air pollutants (Banzhaf, Burtraw, and Palmer 2004, Banzhaf and Chupp 2010) and others have done so for carbon (see e.g. Nordhaus 2008).

But it is important to emphasize that the exercise of setting the cap with the guidance of benefit-cost analysis is *not* to determine once and for all the ultimate allocation of the atmosphere. The more modest goal simply is to try to define property rights in such a way as to reduce transactions costs. When we recognize that trades can still occur between emitters and environmentalists, and that they can be made in either direction from the initial allocation, we are relieved from the burden of guessing the optimal quantity. By contrast, it is the approach of using pollution taxes or fees that must get the price "right" ex ante.

Comparisons with Other Trading Regimes

Additional insights about the potential for cap-and-trade as an FME solution to problems such as climate change can be obtained by comparing it to other trading proposals. Coase developed his well known *Problem of Social Cost* while contemplating the Federal Communications Commission's regulations of bandwidth. In his earlier article on that issue (Coase 1959), he noted that before regulation there was a period of chaos in the radio spectrum, with numerous users trampling one another in their stampede to use an open-access resource. In introducing regulation, the government essentially created a property right to use a specific bandwidth in a specific location with a certain level of power. Establishing those property rights improved the open access problem, but created a new problem of allocating them efficiently. Coase argued that these rights to the spectrum could easily be auctioned, with the government reserving some frequency for spe-

[12] Hayekians and others in the subjectivist tradition might claim that, epistemologically, one cannot even speak of the existence of some Q* to be discovered independently of market transactions. I take the view rather that it is a rational construct that can be estimated, if imperfectly, and with humble recognition of the imperfection. My perspective, similar to that of Richard Posner, seems to be consistent with Coase (1959, 1960), but Coase himself appears to have been somewhat inconsistent on this point over time. See Bertrand (2010b) for discussion.

cial public purposes such as military transmissions. I see no differences between this proposal and cap-and-trade. In both cases, open-access to the air reduces social welfare. As the "ether" has a limited capacity to transmit messages, so too the atmosphere has a limited capacity to absorb greenhouse gases. In both cases, the government establishes the property right with specific limitations (where and how powerfully to transmit, or how much carbon to emit with a permit). And in both cases, the government plays a role in establishing the market mechanism (the auction, in the case of the spectrum).

In the same way, cap-and-trade for gases is no different in its essentials from individually traded quotas (ITQs) for fisheries. Given that ITQs are widely embraced in the FME literature (e.g. Anderson and Leal 2001), it would seem that cap-and-trade should be as well. Coase has taught us that all resources are inputs with competing uses. The use of the atmosphere to dispose of carbon today competes with its use to sustain mild climate tomorrow in the same way that the use of a fish to provide protein today competes with its use to reproduce fish for tomorrow. Those operating under the cap-and-trade umbrella stand to gain from the cap regime relative to the open-access regime in the same way that those fishers operating under the ITQ stand to gain.[13] And the cap-and-trade system would call forth and process signals about each firm's opportunity costs of abatement in the same way that the ITQ processes the value of fishing rights and cost of conservation.

One important way that cap-and-trade for greenhouse gases differs from both the spectrum and fisheries is the sheer scale of the problem as well as the complexity of establishing the property rights. But these are differences of degree, not of kind. There is much to be gained as well as lost in the policy process. I consider some of these issues in the following concluding section.

THE POLITICAL ECONOMY OF CAP-AND-TRADE

I have argued that cap-and-trade is the archetypal Coasian solution to a problem such as climate change. It involves defining property rights, reducing transactions costs, and al-

[13] The only real difference between the two cases is that the number and heterogeneity of interests is much greater for the atmosphere than for a fishery. Bringing fishers together to bargain over the efficient cap on fishing (or "total allowable catch") is likely to be much easier than bringing emitters and environmentalists together to bargaining over the atmosphere. But this difference is one of degree, not kind. The difference in the potential gains are commensurate with these costs of the political process.

lowing markets to work to determine both the extent of emissions (i.e. the allocation of the atmosphere to emitters and to others) and the efficient allocation of emissions among emitters. But that first step in that process—defining property rights—to this point has been discussed only with a wave of the hand. In fact, the process of defining those rights would involve substantial political negotiation.

Coase recognized that market processes might be more costly than other alternatives. Accordingly, one might argue that the costs of defining property rights are greater than the benefits (Anderson and Hill 1983). In the case of cap-and-trade, the initial allocation of the resource is likely to be the most costly part of the process. Other costs are likely to be low: mercantile exchanges are highly efficient and, because there are at present no widespread post-combustion abatement technologies, monitoring carbon emissions can be done at the mine or well-head, making it even easier than monitoring conventional air pollutants. In contrast, with hundreds of billions of dollars of rents on the table created by cap-and-trade (Burtraw and Palmer 2008), political rent-seeking costs are likely to be large.

This critique is fair enough, but it is of course a general critique of the property rights approach rather than a specific critique of cap-and-trade for carbon. I cannot imagine *any* process of specifying property rights in a democracy that would not engender similar costs, in proportion to the potential gains. Certainly, such rent-seeking costs are present for market-based solutions for allocating other resources, such as water, and accounting for them, as well as the perceived fairness of the distribution of rights, is crucial for the success of the property rights approach (Libecap 2007).

But there is a wide gap between the claim that there will be rent-seeking costs and that those costs will swamp the gains from trading rights to the atmosphere. Direct costs of lobbying could not possibly approach such a scale. Likewise, estimated inefficiencies created by perverse incentives inherent in various allocation process (over-investment in certain technologies, for example) are small compared to the potential gains (Fischer and Fox 2007,

Some free-market thinkers have advocated carbon taxes instead, on the grounds that it is more transparent and less open to such rent seeking (e.g. Bailey 2009). While there are many virtues to this approach, taxes are just as open to political chicanery—to offsetting subsidies, consumer rebates, and the like—as caps. Moreover, the political process of debating a tax itself would call forth the same rent-seeking costs as the cap-and-trade process, or very likely more (in this case, industry opposing the sure-loss tax *plus* interests competing for the right to spend the new revenues). Essentially, we have already opened up the policy debate to these costs: the surest way to reduce them would be to establish property rights quickly rather than prolonging the agony.

Of course, a simple carbon tax might well be preferable to monstrosities like the Waxman-Markey bill, with all its rococo regulations and giveaways to green energy interests, but it is hardly fair to compare a hypothetical perfect tax with cap-and-trade bills as they have appeared in Congress. (As if it were fair to compare an Angus steak on the plate to a Kobe sausage in the factory.) I would argue that there is nothing inherent about cap-and-trade that it cannot be just as transparent as a tax.

Moreover, a cap-and-trade policy that errs toward allocation to industry, as I have proposed, would limit the changes in property rights associated with charging industry for a resource that it has always had the right to use freely. Moreover, it would create enough new wealth for industry to be better off than under the current open-access regime (Burtraw and Palmer 2008). In this respect, Thomas Crocker, John Dales, and the other pioneers of cap-and-trade may be the ultimate enviropreneurs.

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Figure 1. Duality between prices and quantities.

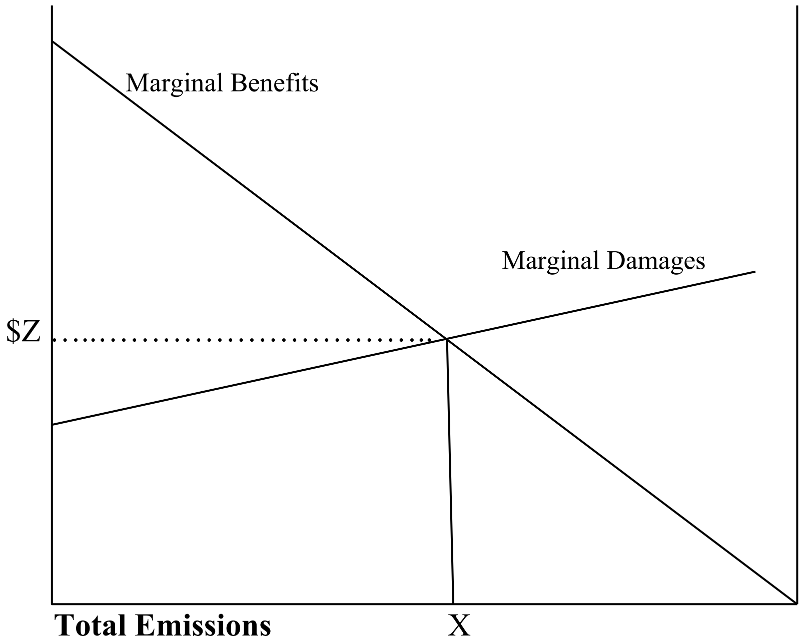

Figure 2. Trading with all Permits Initially Allocated to Emitters.