The Behavior of the Allowance Market:

Theory and Evidence

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Executive Summary

The most innovative feature of the 1990 Clean Air Act was the market-based approach to reduce annual sulfur dioxide emissions by 10 million tons. This approach required utilities and industrial sources to cut their total emissions in half by the year 2000. The “allowance” market places an overall cap on emissions while giving individual emission sources complete flexibility in the methods selected to achieve the desired emission reductions.

This market encourages firms that can clean up at a relatively low cost to reduce their emissions and sell surplus allowances to firms that do not have low- cost clean-up options. Compared to a technology-forcing approach in which the highest-emitting power plants are forced to scrub, the potential cost savings of a market-based approach could be as much as $1 billion annually.

A critical question is how this market will perform. This paper examines the behavior of the allowance market. The analysis suggests that prices are likely to be linked between Phase I and Phase II in a predictable manner that is broadly consistent with economic theory. Moreover, the data suggest that prices have declined over time, and that actual prices and predicted prices of allowances are converging. Finally, the analysis of distributional changes in the pattern of allowances across regions shows that the impact of recent trades has been small.

The allowance market is unlikely to achieve anywhere near all of the potential cost savings that are theoretically available. The presence of forty-eight state regulatory agencies subject to different political pressures virtually guarantees this result. To date, the level of trading is probably lower than expected based on the prediction of the leading engineering-economic models of pollution control decisions. Nonetheless, early computer simulations of the market revealed that about hail of the gains from trade could be achieved from internal transfers between utilities. This result implies that the flexibility inherent in the market could lead to substantially better results than alternative command-and-control regulation even if there were few trades between companies.

The Behavior of the Allowance Market Theory and Evidence

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I. Introduction

The most innovative feature of the 1990 Clean Air Act was the market-based approach to reduce 10 million tons of sulfur dioxide (SO_2) emissions by the year 2000. This approach required utilities and industrial sources to cut their total emissions in half by the year 2000. The "allowance" market places an overall cap on emissions while giving individual emission sources complete flexibility in the methods selected to achieve the desired emission reductions. One generating plant may use a scrubber, while another switches to a cleaner fuel and still another purchases allowances. The only requirement is that a utility or business must have allowances that cover its emissions.

The allowance market encourages firms that can clean up at a relatively low cost to reduce their emissions and sell surplus allowances to firms that do not have low-cost clean-up options. Compared to a technology-forcing approach in which the highest-emitting power plants are forced to scrub, the potential cost savings of a market-based approach could be as much as $1 billion annually. Given the magnitude of cost savings and the innovative nature of this proposal, it is quite understandable that the allowance market caught the imagination of academics, regulators, and the business community.

A critical question is how this market will perform. As several scholars have noted, the performance of this market will depend critically on the rules that are adopted by the U.S. Environmental Protection Agency (EPA) and state agencies that regulate electric utilities (Hahn and Noll, 1983; Bohi and Burtraw, 1991; and Rose

and Burns, 1991). Because utilities operate in a highly regulated environment where regulations can differ dramatically across states, the potential cost savings that can be achieved from the market are by no means assured.[1] Moreover, existing guidance from regulatory commissions is not encouraging. Bohi (1994) notes that regulators are creating rules that give utilities little, if any, economic incentive to trade. The lack of incentives could be a problem for achieving the gains associated with a market-based approach; however, some utilities have a built-in incentive to minimize their pollution control costs to compete with potential entrants.

Bohi also notes that several states provide incentives that favor other control options, such as scrubbing or clean coal technologies. The impact of having 48 different regulatory commissions devise different rules for allowance trading is unclear. All that can be said with certainty is that the potential cost savings associated with allowance trading are unlikely to be fully realized.

The purpose of this paper is to assess the behavior of the allowance market. Section 2 of the paper highlights some results from economic theory that are useful in providing a framework for evaluating the allowance market. Section 3 examines predicted and actual behavior in the allowance market and compares how the data relate to the theory. This section also provides an analysis of the geographical pattern of trades. Section 4 offers some concluding remarks on the behavior of market, the likely success of the market, and directions for future research.

II. The Market and its Theoretical Underpinnings

The objective of the acid rain program is to reduce annual SO_2 emissions by

[1] For suggestions on how to address these biases, see Bohi and Burtraw (1991) and Hahn (1991).

10 million tons below 1980 levels by the year 2000. The Act establishes a two-phase program. Phase I — January. 1, 1995 until January 1, 2000 — affects 110 of the highest emitting electric utility generating units in the United States.[2] Other plants and industrial sources not affected by the program also have the option of participating. In Phase II, beginning in 2000, the program is expanded to include most existing fossil-fired electric generating units.

The affected units are allotted tradable allowances based on their past fuel usage and statutory emission limitations. Each allowance entitles a unit to emit 1 ton of SO_2 during or after the year specified in the allowance serial number. The number of allowances a unit holds must equal or exceed total emissions at that unit at the end of the year, or the unit incurs stringent penalties. Allowances are dated by years and may be used in that year, or "banked" and used in any subsequent year. There are relatively few restrictions on trading allowances unless a trade violates a local SO_2 standard.

In addition to allowing voluntary trades, the EPA is holding yearly auctions of allowances, which began in 1993. To supply the auction with allowances, EPA withholds approximately 2.8% of the total annual allowances allocated to all units and holds them in a special reserve. In Phase I, EPA withholds 150,000 allowances each year and in Phase II, EPA withholds 200,000 allowances annually. Private allowance holders may also offer their allowances for sale at the EPA auction.

There are two parts to the EPA auction: a spot allowance auction, in which allowances are sold that can be used in that same year (but not before 1995); and an advance auction for allowances that can be used in 7 years after the transaction date.

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[2] See generally Stensvaag and Oren (1991).

The auctions are two-sided, with both bids to buy and offers to sell. After bids and offers are submitted, bids are ranked from highest to lowest on the basis of the bid price and offers are ranked from lowest to highest. The lowest offer is matched with the highest bid and the trade occurs at the bid price. EPA offers private allowances for sale only after all allowances from the special reserve have been sold.

The incentives for participants in these auctions are complicated. Because a buyer can always purchase an allowance in the private market, it has an incentive to bid less in the auction than the expected private market price. The seller would like to use a strategy that would ensure that the price received in the auction exceeds the expected price in the private market. A no-regrets strategy for the seller could be to offer units at or above the expected sales price in the private market. Each buyer and seller, however, also knows that the higher the bid price the higher the ranking, and vice versa for offers. Thus, the best strategy is not clear.

An experimental analysis of this auction by Cason and Plott (1993) suggests that the market-clearing prices from this auction are biased downward relative to a competitive auction. This finding suggests that the auction might not provide "appropriate price signals for the emerging allowance market. However, for the special case in which this market is competitive and functioning smoothly, the price in the auction would equal the price in the private market. This price would also reflect the underlying marginal control cost.

This auction was introduced partly as a mechanism for helping to provide a price signal in the private market, and partly to ensure that some potential participants in the electricity generation market would have access to allowances. Unfortunately, the design of the auction helps to ensure that it will fall in establishing a useful price signal. Instead of having the auction inform private

participants about market fundamentals, the information from the private market will serve to discipline the auction.[3] Ironically, the private market is likely to be more effective than the auction in helping to achieve a stable equilibrium.

A useful starting point for analyzing the allowance market is the economist's ideal of a perfectly competitive market. In such a market, there is a single price for allowances in a given year, which is equal to the marginal cost of controlling pollution. Thus, one measure of market performance is whether allowance prices converge rapidly to a single price.

Another result from economic theory defines the relationship between allowance prices across time. Because allowances can be stored for future use, one would expect the prices of allowances to be linked. Consider the case in which there are two time periods. In this case, the price of an allowance in period one (which is supposed to reflect the marginal cost of control) should equal or exceed the discounted price of an allowance in period 2.[4] This relationship follows directly from the ability of firms to bank allowances from the present into the future. Suppose that the marginal cost of control in period 1 were lower than the marginal cost in period 2, discounted to period 1. Then a utility with the lower marginal cost in the first period would have an incentive to reduce its emissions because it could make money by selling the allowance to someone who valued it more highly in period 2. In general, this result will lead to the conclusion that, in a competitive market, the price in any given period will equal or exceed the discounted price of an

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[3] The linkage between expected price patterns in the private market and the behavior of the auction could be examined in an experimental setting. Such experiments could provide useful information on the kinds of strategies that are likely to be pursued in future auctions. They could also provide- useful information on the linkages between different markets.

[4] The price is discounted by the opportunity cost of capital.

allowance issued for a subsequent period. The prices will also reflect the marginal costs of control in their respective periods, appropriately discounted.[5] This relationship among prices will be referred to as the "arbitrage result."

To summarize, economic theory would suggest that in an idealized competitive market, there would be a single price for an allowance at a given point in time, which would equal the marginal cost of control. Theory would also suggest that there is a well-defined relationship in terms of allowance prices over time because of the banking provision. The price of an allowance in an earlier period should be greater than or equal to the discounted price of an allowance in subsequent periods.

The preceding theory is static. It assumes that regulators do not change rules unexpectedly, that they do not introduce biases in the system that would prevent attainment of the least cost solution, and that the transaction costs associated with trading are low.[6] Nonetheless, the theory provides a useful benchmark for assessing the predicted and actual behavior of the market.

III. Data Analysis

The analysis proceeds in two parts. First, data on prices and marginal costs are

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[5] For the case of the allowance market without banking, one would expect the marginal cost in Phase I to be less than the marginal cost in Phase II because n stringent reductions are required in Phase II. If this were true, then the arbitrage result would suggest that the price of an allowance in Phase I should exactly equal the discounted price of a Phase II allowance. If technological change in this area were sufficiently rapid, however, this stronger version of the arbitrage result might not hold.

[6] Certain kinds of biases in the system and certain types of transactions costs would not change the results. See generally Hahn (1991) and Stavins (1993).

analyzed. Second, changes in the distribution of allowances are examined.

A. Prices and Costs

Two sources of price data are available — one based on forecasts and a second based on actual observations of prices in private trades and the first EPA auction in 1993.[7] Both provide useful information. One problem with the data is that the projections and reported prices are given in different years. This data has been normalized using a producer price index so that all price information presented in this paper is in 1993 dollars, unless otherwise noted.[8]

One of the fundamental economic ideas described in the previous section was the arbitrage result, which suggests that the prices of allowances in Phase I and Phase II should be linked. Based on the theory, one might expect the average price in Phase I to be equal to the discounted average price in Phase II. Ironically, this arbitrage result seems to have been ignored when making initial predictions about the time path of prices lit the allowance market. For example, EPA commissioned an analysis performed by a consulting firm prior to the passage of the Clean Air Act, which suggested that marginal costs and prices in Phase I would be several hundred dollars lower than prices in Phase II. The reason for this prediction had nothing to do with the underlying economics of the market, but was rather an artifact of the way this consulting firm had initially modeled the problem. Despite the efforts of the Council of Economic Advisers to point out that this forecast was inconsistent with the banking provisions of the allowance market, a folklore seems to have

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[7] A more in-depth analysis of the price and cost data is provided in May (1994).

[8] The producer price index for machinery and equipment was used (Council of Economic Advisers,1993; U.S. Department of Labor, 1994).

developed, which suggested that the prices and/or marginal costs in Phase II would be substantially higher than in Phase 1.[9]

Table 1 corroborates the conventional wisdom of the time. This table shows that price and marginal cost predictions prior to the auction were consistently lower in Phase I than in Phase II after adjusting for inflation. The average predicted Phase II price exceeded that for Phase I by $257. Moreover, such differences do not seem to be consistent with the arbitrage result. [10]

A second source of data is based on a survey done by Compliance Strategies Review (1993). This data provides new information on the expected relationship between Phase I and Phase II prices. In two surveys completed after the first EPA auction, respondents were asked about their expectations of allowance prices for Phase I and Phase II allowances in 1993, 1995, 1997 and 2000. Table 2 summarizes these results. The data suggest that average prices are expected to increase over time for both Phase I and Phase II allowances. Moreover, in most of the cases, the expected price of a Phase I allowance exceeds that of a Phase II allowance. This makes sense because the Phase II allowance cannot be used in Phase I. Interestingly, in the year 2000, the allowance prices for Phase I and Phase II in the August survey are roughly $50 apart, but the prices are virtually identical in the October survey.

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[9] This account is based on Mr. Hahn's personal experience while working at the Council of Economic Advisers and serving as a member of the White House drafting team for the Clean Air Act.

[10] It is possible to assess whether these forecasts are generally consistent with the arbitrage result by discounting the Phase I allowances purchased in the year 2000 back to 1995. Applying a real discount rate of 5% per year to the Phase II price numbers in Table 1, the average predicted price for Phase II exceeds that for Phase I by $138. Applying a real discount rate of 10% per year, the average predicted price for Phase II exceeds that for Phase I by$48. With a 5% discount rate,8 of 11 prices in Phase II exceed the comparable Phase I prices; with a 10% discount rate, 7 of 11 prices in Phase II exceed the comparable Phase I prices. The arbitrage result, which predicts that the discounted Phase II price would be less than or equal to the Phase I price, is not consistent with these price projections.

Table 1

Summary of SO_2 Allowance Price and Marginal Cost Projections[1]
(1993 Dollars Per Ton of SO_2)

	Phase I Low	Phase II Low	Phase I Middle	Phase II Middle	Phase I High	Phase II High
EVA/PUCO	$101	$403	-	-	$302	$807
ICF/EPA[2]	$173	$472	-	-	$197	$472
ICF/EPA RIA[2]	$103	$205	-	-	$134	$431
RDI	-	-	$309	$374	-	-
AER*X	-	-	$453	$542	-	-
EPRI	-	-	$688	-	-	-
PUC of Ohio	$421	-	$596	-	$883	-
Ohio Office of Consumer's Counsel	$415	-	-	-	$749	-
Ohio Coal Development Office	-	-	$785	$981	-	-
Allegheny Power System	-	-	$302	$807	-	-
American Electric Power	-	-	$392	$589	-	-
Sierra Club	-	-	$446	-	-	-
United Mine Workers of America	-	-	$981	-	-	-

[1] "Low," "Middle" and "High" refer to low, middle and high estimates of allowance prices or marginal costs. All projections were made before 1992.

[2] These figures are marginal cost projections, while all other values in the table are allowance price projections. Note that the ICF/EPA projections are reported for 1995 (listed here as "Phase I") and 2000 (listed here as "Phase II").

Sources: ICF Resources, Inc. (1990, 1991) and Huetteman (1994).

Table 2

Compliance Strategies Review

Emission Allowance Trading Index (EATX) Survey: Summary of Results
(1993 Dollars Per Ton of SO_2)

EATX IV – August 1993

Year	Phase I Median Price	Phase II Median Price
1993	$198	$165
1995	$213	$193
1997	$238	$205
2000	$275	$325

EATX V – October 1993

Year	Phase I Median Price	Phase II Median Price
1993	$188	$164
1995	$200	$185
1997	$217	$208
2000	$249	$248

Source: Compliance Strategies Review (1993).

There is no reason to expect a price difference in the year 2000, since these allowances enable the user to do the same thing. If one compares Table 2 with Table 1, two points are apparent. First, the price forecasts for Phase II in Table 2, which are recent, are generally lower than those contained in Table 1. Second, there is a smaller difference between predictions of Phase I and Phase II prices in Table 2, perhaps because more recent forecasters have thought more carefully about the arbitrage result and the linkage between prices across periods.

The actual price data can, of course, influence the forecasts. A summary of the data based on private trades is reported in Table 3, which uses actual prices reported in the trade press. [11] This data suggests that allowance prices in the private market have been decreasing somewhat over time.

Economic information on EPA's first auction is summarized in Table 4. The average price of allowances in the auction was $157/ton for a Phase I allowance and $136/ton for a Phase II allowance. Note that the average price for Phase I allowances exceeds that for Phase II allowances; however, the difference is only $21, which is far less than initially forecasted. A similar picture emerges for the lowest accepted bid. The lowest accepted bid was $131 in Phase I and $122 in Phase II, a difference of just $9. One must be careful in interpreting the results from the auction because of the complicated nature of the institution. Nonetheless, it appears that there is a tighter relationship between Phase I and Phase II prices in the auction than was suggested by early forecasts.

An interesting characteristic of this auction is that the range of prices is quite

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[11] This sample does not include an estimated three or four private trades that have gone unreported.

Table 3

Private Trades of SO_2 Allowances:
Phases I and II Under the Clean Air Act Amendments of 1990

PHASE I

Date	Buyer	Seller	Number of Allowances	Price Range
May 12, 1992	TVA	WP&L	10,000	$250 - $400
May 12, 1992	Duquesne	WP&L	25,000	$250 - $400
June 1992	Ohio Edison	Alcoa	25,000	$250 - $350
March 1993	AMAX Energy	LILCO	-	-
March 15, 1993	Illinois Power	Central Illinois Public Service	80,000	$170 - $197
April 1993	Illinois Power	-	125,000	-
April 1993	Illinois Power	-	90,000	-
April 1993	Illinois Power	Pacificorp	35,000	-
April 19, 1993	Illinois Power	WEPCO	75,000	-
April 1993	Illinois Power	NYSEG	20,000	-
April 1993	Illinois Power	-	50,000	-
July 1993	American Municipal Power	Big Rivers / Henderson MP&L	4,384	$205
September 1993	PSI Energy	WEPCO	37,000	$200 - $210
October 1993[1]	CP&L	Big Rivers / Henderson MP&L	150,000	-
Total Phase I			726,384	

PHASE II

Date	Buyer	Seller	Number of Allowances	Price Range
March 1993	American Lung Association	Northeast Utilities	10,000	Donated
March 1993	WEPCO	United Illuminating	25,000 - 50,000	-
April 19, 1993	WEPCO	Illinois Power	75,000	-
Total Phase II			110,000 - 135,000	

[1] This trade is actually the final result of two trades. In May 1993, Big Rivers/Henderson MP&L sold 150,000 allowances to Centre Financial Services, who in turn sold these allowances to CP&L in October 1993.

Sources: Compliance Strategies Review (1993) and Rose, Taylor and Harunuzzaman (1993).

Table 4

1993 EPA Allowance Auction: Summary of Results

	Phase I	Phase II
Average Price	$156.60	$136.19
Range of Offers	$10 - $1,900	$200 - $449
Range of Bids	$0.26 - $450	$0.01 - $310
Range of Successful Bids	$131 - $450	$122 - $310
Standard Deviation of Successful Bids	$69.36	$46.42
Allowances Withheld by EPA	50,000	100,000
Private Allowance Offers	95,010	30,500
Total Allowance Offers[1]	145,010	130,500
Total Quantity of Bids	321,354	283,406
Total Number of Bidders	106	65
Number of Successful Bids	36	30
Number of Allowances Sold	50,010[2]	100,000[2]

[1]Equals allowances withheld by EPA plus private allowance offers.

[2]The top four bidders in the Phase I auction (Carolina Power & Light Company, Kentucky Utilities Company, PSI Energy, Inc. and Illinois Power) accounted for approximately 26%, 26%, 20% and 10% of the Phase I purchases, respectively, totalling 82%. The top two bidders in the Phase II auction (Carolina Power & Light Company and Duke Power Company) accounted for approximately 72% and 25% of the Phase II purchases, respectively, totalling 97%.

Source: U.S. EPA (1993).

large. [12] The large range is partly a result of the auction mechanism and partly derives from the fact that this was the first auction. If prices stabilize in the private market, the range and standard deviation should decline over time.

A casual comparison of early price predictions with actual allowance prices suggest that the forecasts were on the high side. More recent forecasts appear to be converging to recent prices observed in private trades and the auction.

B. Distribution of Emissions

One of the concerns raised by the environmental community about allowance trading is that it could result in "hot spots" in ecologically sensitive areas or an unfair distribution of environmental quality acoss regions. For example, a representative from New York raised concerns about excessive levels of pollution falling on the Adirondacks if emission trading were allowed. This distributional issue could be very important politically and merits a serious analysis based on the data and the historical evolution of the program.

There are two important general points to keep in mind in analyzing this issue. First, the appropriate baseline from which to examine changes in emissions is the emission profile that would have existed without the passage of the 1990 Clean Air Act. The reason is that it is highly unlikely that there would have been add rain legislation in the 1990 Clean Air Act without allowance trading. During the previous decade, attempts to move add rain legislation in the Congress faltered because of difficulties in obtaining a consensus over which regions of the country should pay for the clean up. The allowance market provided a mechanism for

[12] Although the standard deviation and range of prices are large, note that just a few firms account for most of the purchases in the auction of Phase I and Phase II allowances.

reducing the cost of controlling emissions, thus making the aggressive environmental proposal put forth by the Bush Administration more palatable.

If one takes the pre-1990 Clean Air Act as the relevant baseline, then the changes in the emission pattern due to trading are likely to be trivial compared to the reductions that are achieved by the Act. Thus, environmental concerns are likely to have been misdirected, a point ably articulated by Goffman (1993), who is a leading environmentalist and key contributor to the development of the allowance market.

A second key point to note is that the total volume of Phase I trades to date has been relatively small compared to the total stock of allowances in Phase I, thus suggesting that trades to date will probably not have a major impact on the distribution of emissions. [13] The total volume of known trades for Phase I is 776,000 allowances, with 50,000 allowances sold in the auction. This represents about 2.7% of the 28.5 million allowances that are available during Phase 1. [14] The total volume of trades for Phase II ranges from 210,000 to 235,000 tons, of which 100,000 have been sold in the auction. [15] These trades make up just over 2% of the annual allowance allocation for Phase II.

The actual changes in distributional patterns resulting from private trades

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[13] This, of course, does not rule out the possibility that there will be significant transfers of allowances and emissions a space and time in the future. Moreover, a all volume of trades could result in a localized "hot spot," but this appears not to have been the case thus far.

[14] A narrow definition of Phase I allowances is used here, which applies to all Phase I utilities.

[15] Phase II trade between United illuminating and WEPCO calls for the annual exchange of 5,000 allowances for five to ten years. The exact time frame for this trade has not been disclosed. Thus, the total volume of this trade could range from 25,000 tons to 50,000 tons.

and the auction are presented by EPA region in Table 5. This table catalogues Phase I trades for which there are identifiable users of allowances and allocates them by state. In many cases, it was simply not possible to allocate trades to specific states or regions. For example, Illinois Power made several private purchases in 1993 from undisclosed sellers. The data shown in the table cover 95% of the allowances traded in the auction and about 60% of allowances from private trades where quantities are reported.

The primary conclusion to be drawn from the table is that the distributional impact of trading, both privately and through the auction, has been quite small. Regions 1 and 2 (which include most of the northeastern states), as well as Region 7, all show a net outflow of allowances. Of these three regions, Region 2 has realized the greatest outflow as a percentage of its initial allocation, totaling 2.5%.[16] The South and the Midwest, which are grouped into Regions 3, 4 and 5, have experienced a net inflow of allowances, although for all three regions the distributional change has not exceeded .25%.

IV. Conclusions and Suggestions for Future Research

This paper has analyzed the available data on allowance trading and has attempted to link those findings to basic economic theory. The analysis suggests that prices are likely to be linked between Phase I and Phase II in a predictable manner that is broadly consistent with economic theory. Moreover, the data suggest that prices have declined over time, and that actual prices and predicted prices of allowances are converging. Finally, the analysis of distributional changes in the

[16] This shows that even relative to the new baseline, the concerns about New York receiving additional pollution are not borne out by the data.

Table 5

Effect of Spot Auction and Private Trades on the Distribution of Phase I Allowances[1]

EPA Region[2]	Initial Distribution	Effect of Spot Auction[3]	Effect of Private Trades[4]	New Distribution	Percent Change in Distribution
1	160,950	-282	0	160,668	-0.18
2	858,800	-1,506	-20,000	837,294	-2.50
3	5,857,750	-10,275	25,000	5,872,475	0.25
4	8,324,800	12,936	5,616	8,343,352	0.22
5	11,307,550	-46	24,384	11,331,888	0.22
6	-	-	-	-	-
7	1,994,250	-3,498	0	1,990,752	-0.18
8	-	-	-	-	-
9	-	-	-	-	-
10	0	0	-35,000	-35,000	-[5]
Other[6]	-	2,672	-	2,672	-
Total	28,504,100	0	0	28,504,100	0.00

[1]Numbers may not add due to rounding.

[2]Region 1: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont; Region 2: New Jersey, New York, Puerto Rico and Virgin Islands; Region 3: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia and West Virginia; Region 4: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee; Region 5: Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin; Region 6: Arkansas, Louisiana, New Mexico, Oklahoma and Texas; Region 7: Iowa, Kansas, Missouri and Nebraska; Region 8: Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming; Region 9: Arizona, California, Hawaii, Nevada, American Samoa and Guam; and Region 10: Alaska, Idaho, Oregon and Washington.

[3]A "+" denotes a net import of allowances, while a "-" denotes a net export.

[4]This calculation is based on 14 Phase I trades; however, due to missing data, four of these trades are excluded.

[5]This percentage is undefined, as the initial allocation in Region 10 is 0.

[6]"Other" category includes the following: 2,682 allowances (where the buyer purchased less than 100 allowances, or there is uncertainty regarding the buyer's state or firm type) minus 10 allowances (for American Electric Power Service's purchase of 10 allowances in the private portion of the spot auction).

Sources: U.S. EPA (1993, 1994), Compliance Strategies Review (1993), and Rose, Taylor and Harunuzzaman (1993).

pattern of allowances across regions shows that the impact of recent trades has been small.

Whether the market will behave in a reasonably efficient manner is a more difficult question. To date, the level of trading is probably lower than expected based on the prediction of the leading engineering-economic models of pollution control decisions.[17] Nonetheless, early computer simulations of the market revealed that about half of the gains from trade could be achieved from internal transfers between utilities, which would not show up as trades (ICP, 1989). This result implies that the flexibility inherent in the market could lead to substantially better results than alternative command-and-control regulation even if there were few trades between companies. At the same time, the allowance market is unlikely to achieve anywhere near all of the potential cost savings that are theoretically available.[18] The presence of forty-eight state regulatory agencies subject to different political pressures virtually guarantees this result.

Economists are likely to labor long and hard deriving estimates of the cost savings associated with the allowance market. These labors are essential to gaining an understanding of whether the market served its purpose; however, such work may not be critical to the future application of market-based approaches for

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[17] In part, the low level of trading may be caused by the absence of guidance from state regulatory agencies. Relatively few states have promulgated rules or guidelines for trading, even though utilities and businesses need to be planning their compliance strategies now. According to an EPA official, only seven states have issued rules, orders or guidelines that address $S0_2$ allowance transactions (Solomon, 1994).

[18] The absence of rules creates uncertainty for potential participants in the allowance market, and probably encourages utilities to prefer strategies that do not involve trading with other companies in Phase I. One distinct possibility is that firms find it in their interest to trade or bank among units they own, rather than trade with other firms. This result is particularly likely if regulatory agencies do not allow utilities to retain some of the gains from trading allowances with other utilities.

environmental protection because it may not be closely linked to how key interest groups perceive the success of this market.

The views of the environmental community and the actual participants in the market are likely to be the critical factors in determining whether this market is seen as a "success." If environmentalists believe that the pattern of emissions resulting from this market resulted in serious problems, or that there were serious enforcement problems associated with the market, then future market proposals will be less likely to survive the rigors of the political process. Similarly, if utilities and industrial emission sources find that the market does not really give them the flexibility that was promised — either because transaction costs of trading are high, it is not in the financial interest of utilities to trade, or the government keeps changing the rules — the enthusiasm for applying this innovative regulatory approach to future problems is likely to diminish as well. Fortunately, there are forces at work in the academic community, the environmental community, the business community and the regulatory community whose aim is to make this market a real and perceived success. We are guardedly optimistic they will prevail.

In the meantime, academics should continue to examine the behavior of the allowance market. Key factors that should be addressed include the cost savings resulting from the market, the distribution of economic gains from trading, and the changes in the distribution of emissions. The stakes are quite large here. Economists have moved from the point where their ideas were shunned to the point where they are actually being used in the policy process. It behooves us to evaluate this process so we can learn from this experience and improve upon it in future applications.

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