The Future(s) of Pollution Control: The Case of the Acid Rain Program

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Abstract: *This study examines the potential success of the futures contract in SO_2 Emissions Allowances. Factors affecting the success of the futures contract are presented including the uncertainties of air pollution and public utility regulation, emission control technology, electricity demand, and electric utility needs for an allowance price discovery mechanism for long-range compliance planning under risk. If SO_2 futures market is successful, there is some potential for expanding futures trading to other pollutants. Since SO_2 is uniquely suited to a national market, duplication of SO_2 futures for other pollutants may be difficult.*

Key Words and Phrases: *Clean Air Act (CAA) Amendments of 1990, Electric utilities, Tradable permits, Emission Allowance (EA), Acid Rain Program (ARP), Futures contract, Sulfur dioxide (SO_2).*

The 1990 Amendments to the Acid Rain Program (ARP) of the Clean Air Act (CAA) created the first national market in pollution rights. This market was established in conjunction with federally mandated reductions in allowable sulfur dioxide (SO_2) emissions. By the year 2000, total allowable SO_2 emissions will be capped by the Environmental Protection Agency (EPA) to one-half of 1980 emission levels. The EPA will allocate most of the emissions allowances (EAs) while holding a reserve for auction and direct sale. Electric utilities and others will trade EAs that have been allocated by the EPA or purchased in the direct sales and auctions. The Chicago Board of Trade (CBOT) has been designated by the EPA to administer the annual auction and direct sales of EAs. CBOT has also been approved by the Commodity Futures Trading Commission to conduct a futures and futures-options market for SO_2 allowances. Even though utilities will not be required to obtain emission permits until 1995, the first phase of the ARP, initial auctions of limited numbers of EAs have already taken place.

One of the difficulties in establishing a futures market for any commodity is specifying the commodity to be traded (Black). Pollution rights[1] or EAs are different from other commodities in a number of ways. The value of these rights does not emerge from a market in which people place a positive or currency value on the commodity. Instead, markets are based on the negative value of air pollution. Government pollution restrictions increase the value of pollution rights and provide the basis for cash and futures markets in SO_2 rights. With cash markets being instituted almost simultaneously with the introduction of a futures contract, there is little historical public record of prices and volumes on which to base expectations about price and liquidity. In addition, the primary suppliers and demanders of pollution rights are not profit-maximizing firms or utility-maximizing consumers but electric utilities whose economic returns and business activities are regulated by fifty separate state public utility regulatory commissions.

Tradable pollution rights have characteristics similar to those of other commodities for which futures contracts have been established. Futures contracts are created to manage price risk. In the case of SO_2 emissions, price uncertainty results from the stochastic production processes, unpredictable consumer demand (as with agricultural and mineral commodities), and unpredictable policies (as with currency exchange rates). This point is not readily apparent but is a key ingredient to any evaluation of a SO_2 futures contract. As the new CAA Amendments are instituted, they directly affect the attractiveness of self-generated power and the price of electric power and, hence, the operation of many agribusiness activities. Thus, it is important to analyze the implications of this major institutional innovation in incentive-based pollution control. Results of this research can be easily applied as a model for studying other pollution controls of direct concern to agriculture such as water pollution, land use and chemical regulation policy.

The objectives of this study are to provide a theoretical perspective on a market innovation in trading pollution rights and to specifically assess the economic justification and feasibility of a futures contract in SO_2 emissions rights. First, the SO_2 trading program is described in the context of overall air pollution control policy and special features of the cash market are described. Next, the conditions associated with establishing a futures contract are discussed and related to the special features and problems of the EA trading program with conclusions about the chances of success for a futures contract in SO_2 emission rights. Finally, a hedging example is presented.

Air Pollution Regulation and the Acid Rain Program

Sulfur dioxide is produced by electric generating stations, smelters, petroleum refineries and industrial boilers. An estimated 66 percent of the 1988 total of 22.5 million tons of SO_2 pollution was produced by electric utilities (Weisel and Kelly). High concentrations of SO_2 can increase the incidence and exacerbate the symptoms of heart and respiratory diseases and can also be toxic to plants, impair visibility and cause damage to metals, textiles and painted surfaces. Acid rain refers to the increased acidity of precipitation resulting from elevated sulfur and nitrogen oxide levels in the atmosphere. Higher levels of sulfuric and nitric acids in rain have resulted in increased acidification of lakes and streams, particularly in the Midwest, Northeast and Canada, and negatively affect many forms of aquatic life. Acid rain has also been implicated in forest decline in Europe and the United States, although with much less scientific consensus about the seriousness of the effects.

Sulfur dioxide has been regulated since 1970 as a criteria pollutant under the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act. The SO_2 standards of 0.03 ppm annual average and 0.14 ppm maximum twenty-four hour concentration were set almost entirely as public health criteria, with little regard to compliance costs and defined in terms of ambient concentrations in specific ground locations (Tietenberg). Unlike the localized health effects driving the NAAQS standards, acid rain is a regional problem and reductions from any contributing source will have beneficial effects throughout a relatively large airshed. In fact, efforts to control SO_2 pollution in the 1970s attempted to reduce local concentrations by increasing smokestack heights and using intermittent control systems (Melnick). While both of these methods could effectively reduce ambient concentrations, neither reduced, and possibly even exacerbated, the high-altitude presence of the chemical compounds leading to acidic precipitation.

The basic structure of regulation for sulfur dioxide and air pollution in general has been described as command-and-control (CAC), reflecting the lack of options and flexibility given to sources attempting compliance. CAC regulation required compliance through use of a particular technology to control air pollution, leading to much greater expenditures than necessary to achieve ambient goals. By not allowing compliance flexibility, existing regulations did little to encourage utilities to reduce emissions through conservation or investment in new power generating technologies or investment in research and development for pollution control technologies. In addition, CAC regulation left little financial incentive for utilities to clean up beyond minimum legal requirements. Existing electric generating units were regulated much less severely than new units, which were forced to meet a standard of 1.2 lbs. SO_2/million BTUs generated (Ackerman and Hassler). Many new utilities chose to meet this by switching to low-sulfur coal, but the incentive to use low-sulfur coal was removed by the 1977 CAA Amendments which required all new units to install flu-gas scrubbers.

These shortcomings were noted and criticized for all NAAQS criteria pollutants, but particularly for SO_2 (Ackerman and Hassler). A system based on tradable property rights has been the most frequent suggestion for overcoming these shortcomings (Tietenberg). Under this system, firms would be given permits assigning a right to pollute a set amount with the option to trade these permits to change their legal entitlements to pollute. Firms would be free to choose their compliance methods given their permit holdings. Because total pollution is set by the regulatory agency through the number of permits allocated, total pollution would not exceed the amount desired. Trading based on individual firms' profit maximization schemes would ensure that the firms most able to control pollution cheaply would find it in their interest to do so. In addition, firms that achieved further clean-up through innovation would be rewarded as additional permits would be freed for sale. Tradable permits allow analysis at the margin. Polluting firms will abate until the marginal cost of abatement equals the price of the permits. Theoretically, the firm will purchase permits if the price of the additional permits is less than the cost of further abatement.

Tradable property rights systems were used in very limited and incomplete ways to meet the NAAQS standards (Hahn). A national system was not feasible as long as meeting localized NAAQS standards was the goal. However, the ARP passed as part of the 1990 CAA made the goal national. The 1990 CAA called for an annual reduction of 10 million tons of sulfur dioxide emissions below 1980 levels by the year 2000. The 110 power plants with the greatest SO_2 emissions are required to reduce emissions by 3.7 million tons per year beginning in 1995. In addition, these facilities and an additional 700 power units are required to reduce their emissions by another 6.9 million tons per year beginning in 2000, resulting in utility emissions of no more than 8.9 million tons per year (Weisel and Kelly).

Each utility receives initial allowances based on a formula using historical emissions during the years 1985 through 1987 (EPA). Each allowance is for one ton of SO_2 emissions. Utilities can trade their allowances as long as they pollute no more than the quantity of allowances they hold at the end of the year. Excess allowances can be held for use or sale in a later year. New utilities must purchase rights in order to begin operations. In order to prevent existing utilities from refusing to sell allowances to prevent potential competition, 2.8 percent of allocated allowances are reserved for sale at auction. Sales revenue from the auctions is returned to the utilities (EPA).

The EA trading strategy is an added choice variable in a firm's strategy. Compared to the CAC approach in which compliance methods were dictated, the flexibility allowed through the ARP adds to the number of operating decisions a utility is forced to consider. The regulated utilities will strive for savings from trading in the EA market to offset some of the compliance costs by carefully considering all the uncertainties of operation. Firms deciding how to control SO_2 emissions must make lumpy and long-term decisions about control and production technologies: conversion to low-sulfur coal or to alternative fuels like natural gas, investment in scrubbers, and investment in nascent clean-coal technologies and conservation. These decisions must be made in light of uncertainties about future electricity demand and production from small-scale producers. Further, the course of regulation by both environmental authorities and public utility commissions will have a direct impact on the scope for trading, and the price of, SO_2 allowances. The futures market provides a risk management tool allowing hedging and more efficient choices of compliance strategies.

Futures Markets and Emissions Allowances

Both Telser and Black give explanations for the success and existence of futures markets. Telser makes a persuasive argument that organized futures markets exist simply because the benefits derived from them exceed their cost. He also makes the point that futures markets facilitate trade among strangers (Telser, p. 1).

> It is the demand for a fungible financial instrument traded in a liquid market that is necessary for the creation of a futures market. The benefits, weighed against the costs, determine whether the net gain is large enough to warrant organized futures markets (Telser, p. 9).

The costs in the form of transaction costs are small compared to the benefits of hedging in the futures market. Gains from favorable price moves are limited by hedging, but that is the price of being risk averse. What must be determined is whether sufficient risk exists to warrant hedging using futures contracts.

Black relates success to commodity and contract characteristics. The commodity components include durability and storability, homogeneous units, frequent and wide price fluctuations, large supply and demand, a competitive cash market, low delivery costs, and a breakdown of forward contracting. While each one of these criteria has been violated by the success of some futures contract, these components form a useful framework for discussion.

Durability and Storability. Durability and storability of SO_2 EAs is guaranteed by the EPA. The allowances can be banked for future use and may be used in perpetuity, or until the program is changed or dismantled. Traders may be matched through the CBOT; however, these transactions must be communicated to the EPA's Allowance Tracking System (ATS) by designated representatives of each party (EPA; Sandor).

Homogeneity. A homogeneous product is associated with a standard of quality and an exact unit of measure so buyers know exactly for what commodity they are contracting. This standardization is important in allowing traders to concentrate on trading and price negotiation (Sandor). The Clean Air Act creates a homogeneous product, although it is an artificial commodity, through the allowance defined as the right to emit one ton of SO_2 per year. The commodity's existence is assured by emissions monitoring equipment required by the EPA.

Price Variability. Differing attitudes among consumers and producers in the market about demand and/or supply conditions create the price variations that make risk reduction through futures contracting attractive. It is price variability that is often cited as a determinant of whether a commodity is suitable for a futures contract (Telser, p. 18).

Price variability depends on the elasticity and stability of the supply and demand schedules. The more elastic and stable are these schedules, the lower is the price variability. Inelastic supply and a large income elasticity generate more price variability (Telser).[2] While the amount offered for sale in any given time period will respond somewhat to price, the total potential supply of allowances is fixed under the terms of the regulatory program. This limits the response of the market to price changes and should tend toward inelastic supply, causing the price variability that creates the demand for the hedging services provided by a futures contract.

Compliance choices for meeting SO_2 reductions requirements have been increased by the passage of the 1990 CAA Amendments. Utilities will meet their SO_2 emissions obligations with pollution abatement equipment, some combination of alternative fuels such as natural gas, lower-sulfur coals, and coal blending, new generating equipment, conservation management, purchasing and selling power, and allowance holdings. Pollution control equipment has a degree of price uncertainty—the cost of equipment is dropping and its efficiency is rising because of increased demand for equipment and research and development spurred by the CAA Amendments. Competition among scrubber manufacturers as well as fuel suppliers is driving down the price of compliance options (Weisel and Kelly). The cost of fuel-switching depends not only on the performance of converted capital equipment, but on the relative price of low-sulfur and high-sulfur coal. Firms that manufacture and install control equipment and fuel suppliers will wish to retain the option of using allowances to guarantee compliance as part of their contracts with utilities. All of these factors will tend to increase the unpredictability of the permit needs of both utilities and third parties and, thus, increase price variability in the market.

Utility companies concerned with least-cost planning will have to make compliance decisions in an environment of uncertain future demand for electricity. Speculations on future load growth will have a very significant effect on investment decisions and the flexibility utilities want to maintain allowing them to adjust to unexpected regulatory, technical and climatic changes. Demand will vary as the nature of consumer technologies change and investments are made in conservation. Increasing amounts of electricity may be supplied by small-scale producers and co-generation facilities exempt from SO_2 restrictions.[3] Year-to-year demand for any utility will also vary with weather conditions. For example, a pattern such as the hot summer of 1993 in the southeastern United States will increase demand for southeastern utilities and raise their demand for allowances relative to electric utilities in the West.

Annual demand growth for electricity has been predicted as 2 percent, which is historically slower than in the past because of more efficient electrical processes and movement of manufacturing away from energy intensive industries (Campbell and Harris). As population grows and more activities and processes become electrified, demand will increase. Conservation practices and more efficient processes will decrease demand with an uncertain net effect. Even with this uncertain net effect, total SO_2 permits are fixed after the year 2000 as demand continues to grow. All of the above sources of uncertainty will tend to produce the kind of price variability that would give a futures market a valuable role as a price discovery mechanism and a risk management tool.

Supply and Demand. The potential for large supply and demand for allowances will certainly exist. The mandate of the 1990 CAA Amendments is to reduce SO_2 emissions to 8.9 million tons in the year 2000. This will be the supply of allowances in that year. Thus, supply will be small relative to the emissions level of 1993. This will increase the value of allowances as compliance strategies are implemented. The value of this market ranges from $1.8 billion to $4.0 billion based on the prices of the initial CBOT EA auction in March, 1993, which ranged from $122/ton to $450/ton (*Atlanta Constitution*). In the spot auction of permits for the year 1995, 47 percent of the EAs sold for $151 to $170. Utilities purchased 95 percent of the EAs, brokerage firms purchased 5 percent, with public interest groups, private investors and others each purchasing less than 1 percent (EPA, 1993). In the advance auction of year 2000 permits, 46 percent of the EAs sold for $141 to $160 (EPA, 1993).

Cash Market. A crucial factor for the success of a futures market is the success of the cash market. This cash market can be public or private, regulated or unregulated, national or international, but above all it must be active. There must be buyers and sellers that prefer the opposite asset (either money or commodity) to the asset they currently possess and be willing and able to make frequent transactions to exchange these assets. A cash market characterized by infrequent transactions will not generate the combination of price variability and liquidity necessary to make a futures contract an efficient means of reducing price uncertainty. Both volume and price variability will tend to increase with the total size of the market.

The driving force behind the cash market is the variation in demand for EAs by utilities as part of their compliance strategies. Trades will, in theory, be driven by the difference in marginal control costs among utilities that will drive high-cost controllers to buy, and low-cost controllers to sell, allowances. The willingness of utilities to participate in this market as a part of compliance strategies is a precondition for the allowance trading system to realize its potential as a cost-effective way of meeting overall SO_2 targets. The EPA will allocate permits by a set amount that will not vary due to changes in circumstance.[4] This means utilities will almost certainly have to vary their permit holdings in response to changes in electricity demand and divergences between expected and actual performance of their emissions control strategies.

Delivery Costs and Forward Contracting. Low delivery costs are guaranteed by the nature of the SO_2 trading program. The actual allowances are recorded electronically on the ATS when designated representatives communicate transactions. Failure of forward contracting is an issue to be determined by the relative benefits and costs of futures and forward contracting. On the surface, the behavior of the utilities toward futures contracting is unknown. Logic suggests these companies will not continue using the high cost alternative.

Nature of EA Market, Cash and Futures

There is widespread agreement that allowances will be bought and sold as part of an individual utility's compliance strategy. What is not yet clear is the nature of the cash market for allowances. Will exchanges take place bilaterally or through a central exchange like the CBOT? There are 265 separate generating units involved in Phase I and 2,200 units in Phase II of the Acid Rain Program. However, many of these units are at the same plant and belong to the same utility or utility holding company and exchanges between these stations will almost certainly not take place through an exchange. There is already a precedent for bilateral inter-utility trades

(Allen). Alternatively, CBOT will provide a central marketplace, bring buyers and sellers together, allow utilities to adjust allowance inventories quickly and eliminate the costs of finding parties with which to trade. Confidence in the market will be enhanced by the CBOT's proven integrity. Even if trades are conducted bilaterally or through private brokerage houses, a futures contract traded through a central exchange like the CBOT can still be successful.

Heiderscheit concludes that the need to write complex contracts in which both volumes and prices are contingent on factors such as sludge disposal costs, failure of emissions monitoring equipment, and demand levels will ensure that bilateral trades arranged by specialized brokers will be the norm. If each exchange is governed by such a contract, trades will always be bilateral and transactions costs will remain high. This scenario is unlikely for two reasons.

First, an active and open cash market is more likely to exist when price discovery is an important function as in the case of the EA market. Utilities are making large investments in a variety of emission control strategies. The equilibrium price of allowances will depend on the nature of the choices made by each utility and on the unforeseen problems that arise as these strategies are implemented. A central marketplace allows for quick changes in holdings with minimal transaction costs. Especially during Phase I, utilities will strive for compliance options that are flexible enough to be modified quickly as additional information becomes available and market conditions change for fuels, technologies and electricity demand (Palmisano and Brooks). This is evidenced by an Industrial Information Service survey showing that 70 percent of Phase I utilities plan to switch to low-sulfur coal in the first phase instead of investing in long-term options (Weisel and Kelly, p. 110). As the second major cutback date occurs and utilities gain more information about their compliance status in 2000, a price discovery mechanism will again be paramount to informed decisions about adaptive compliance actions. Utilities will be making longer-term operating decisions.

The intertemporal nature of the price discovery problem makes a futures contract all the more important. Because futures contracts are standardized, the cash (spot) markets can easily use the futures market as their primary price discovery mechanism. The public and third party nature of futures markets also tends to assure confidence in the prices generated.

Another reason complex contracts and bilateral trades will not characterize the emissions market is the nature of the commodity. The risks utilities face in response to uncertainty about future conditions are manifested in the price of meeting obligations under the ARP given unforeseen circumstances. This risk is essentially the same as the price risk of using allowances. Because of the liquidity of the market, such risk can be managed more efficiently by reducing price risk through futures contracting than through complex cash forward contracts that are expensive to write and enforce. Further, third parties will demand allowances as part of their provision of services to manage this risk for utilities. Owners of high-sulfur coal resources have expressed interest in packaging coal with allowances to ensure their customers achieve compliance at a guaranteed cost. These owners will be best served by access to a cash market that gives them the ability to buy and sell allowances in response to changing conditions they and their customers face. Consulting firms that guarantee compliance through installation and operation of abatement equipment are well aware of the frequency of breakdowns and periods of substandard performance of such equipment. They will wish to retain the option of using allowances to guarantee compliance as part of their contract with utilities. Their ability to write contracts guaranteeing compliance will be greatly facilitated by the existence of a liquid market with low transactions costs rather than bilateral exchanges with complex contingencies and attendant high contracting costs. The complexity and uncertainty of compliance strategies can expand the number of traders in the cash market by bringing buyers and sellers in addition to the utilities into the market.

Utilities can disentangle noncompliance risks they face from various factors and make adjustments in the cash market. If they feel the need to hedge that risk they can then use forward contracting or a futures contract. Working has said, "Hedgers prefer a 'poor' hedge that is cheap to a more nearly perfect hedge that is relatively expensive" (Black, p. 23).

Competitive markets are also a prerequisite for a functioning futures market. Traders must be confident that future price cannot be manipulated by buyers or sellers with sufficient market power to influence the market to their advantage. Constraints on the free functioning of the market that determines the price of allowances do exist which will cause the equilibrium price to diverge from the efficient price predicted by economic theory. The efficient price would minimize the overall cost of SO_2 emissions control by equalizing marginal abatement costs for all utilities. While market imperfections and irregularities may, in fact, prevent this efficient price, they will not lead to a situation in which price can be manipulated to anyone's advantage. Rather, they will tend to be reflected in increased price variability which will make a futures contract more valuable to market participants and thus increase the likelihood of such a contract's success.

Trades will take place even if the full potential of the market for minimizing costs is not realized. A successful futures contract does not require that abatement costs be minimized, only that trades take place and uncertainty exists about the price of exchange over time.

Electric utilities are not unconstrained profit-maximizing corporations. They exist under the regulation of state utility commissions whose rules for pricing and cost recovery govern the utilities' operating decisions and profitability. Bohi and Burtraw (1991, 1992) have examined ways that regulation of utilities affect the incentives to buy and sell allowances. The rules for sharing with ratepayers the costs of capital investments, the revenues from selling EAs, and the costs of purchasing EAs will distort the supply and demand schedules for EAs and may increase overall costs of the ARP.

According to Bohi and Burtraw (1991, 1992), if utilities earn a negative net rate of return, they will minimize capital investments. In this case, all options should be treated the same in terms of cost recovery. If utilities earn a positive net rate of return, they will not minimize capital. Therefore, regulations should favor the least-cost options. Depreciation of assets can also affect compliance incentives. If capital is depreciated and EAs are not, utilities may be biased toward capital abatement. Capital gains are yet another area affecting compliance decisions. If a capital gain is allowed from the sale of EAs and all gains have to be passed on to ratepayers, the incentive to sell excess EAs will be removed. Finally, the methods of cost recovery for compliance strategies may affect trading. If investment costs can be recovered, but other options such as switching to cleaner burning fuels or purchasing EAs are expensed, utilities may prefer capital abatement. The regulatory treatment of utility operations will affect how utilities perceive compliance options since the relative costs of the options depend upon treatment in investment cost recovery. Bohi and Burtraw (1991, 1992) provide a convincing case that these barriers can reduce the potential savings presented by the EA trading program.

Given that rules for treating allowances vary from state to state and may be subject to change, it is plausible the uncertainty created by differential treatment might actually help a futures market in two ways. First, these rules enhance the need for a price discovery mechanism by weakening the information inherent in any utility's marginal control cost. Second, uncertainty about future changes in state utility regulation should increase the range of uncertainty over the future price of emissions and thereby increase the need for risk management tools like futures and options.

Another factor that technically could violate the competitive market prerequisite and thus have a negative influence on the efficiency properties of the allowance trading program is uncertainty about the future of the federal regulatory program and its enforcement. Utilities must still meet the local NAAQS standard for SO_2 emissions. If this constraint is binding then there will be no point in holding permits in excess of the maximum levels that allow local standards to be met. Federal environmental regulations have changed many times over the past two decades in response to political pressure and changes in economic and environmental conditions. Any changes in the total number of allowances or the possibility of special exemptions for utilities for which compliance proves too costly would change the value of allowances in the market. Speculation about the likelihood of this happening, in turn, should affect the mix of components in individual utility compliance strategies and introduce another source of uncertainty into expectations about the future price of allowances.[5] As with uncertainty about rate regulation, this uncertainty may decrease the ability of the allowance program to efficiently control SO_2 emissions but should increase the demand for a futures contract as a hedging and price discovery tool.

The record of weak enforcement and low penalties for noncompliance in environmental regulation might be expected to lower the value of allowances (Malik). In the case of SO_2 emissions, however, we find it likely this will not be a severe problem. First, the sources are relatively few in number and are highly visible and accessible to enforcement personnel. Second, the 1990 CAA Amendments require the installation of Continuous Emissions Reporting Systems, so measurement is unlikely to be difficult. Lastly, penalties for noncompliance are mandated under the amendments themselves, and are structured so noncompliance is unlikely ever to be economically rational when discovered.[6] These factors, combined with the public awareness of the trading program and pressure on the part of utilities that have purchased allowances, will tend to ensure that compliance is not a major problem.

It is possible environmental groups may purchase allowances and retire them—that is, withhold them from utilities in order to reduce total emissions below the requirements of the CAA Amendments. Most previous research has held this will not be a significant force in the market because of the size of the financial resources required to make a difference in the price and availability of allowances. To the extent such a demand does become important, it would drive up the cash price. Any uncertainty about such a factor should again increase the chances of success of a futures contract.

Even though the least-cost potential of the ARP may not be reached, the characteristics of the EA trading program make it conducive to a successful futures contract. The uncertainties utilities must face in adopting compliance strategies help ensure the conditions needed for success will be met.

A Hedging Example

Contract characteristics must be conducive to attracting hedgers and speculators while preventing manipulation. Contract specifications must closely resemble cash trading (Powers). This pertains to delivery, standard grades, and contract size.

The suggested specifications for a SO_2 contract are for a contract unit of twenty-five one-ton SO_2 emission allowances with a minimum price fluctuation of $1 per allowance. Delivery months to be traded include the current month and the next eleven months plus quarterly listings in the March, June, September and December cycle for up to three years from the current month.

Trading futures contracts for SO_2 will be the low-cost method of managing an inventory of emission allowances. The alternatives are spot and forward markets. Because of the many operating uncertainties, the futures market offers hedging opportunities. A utility may predict unusually extreme weather or may expect a new technology to come on line or a new unit to be opened. These cases will most likely require adjustments of holdings.

Consider the following scenario: suppose utility A anticipates a demand for 1,000 allowances (forty contracts) in December in order to comply with year end total emissions. It is June. Utility A will buy forty December SO_2 contracts at today's price (say $150/ton). The total value of this contract is $150,000 (1,000 × $150) but Utility A would deposit between $10,000 to $20,000 to control this contract. Utility A has locked in a price of approximately $150/ton for its purchase price. If Utility A holds the futures position until December, then it will sell its contracts at the current price (say $200/ton). Furthermore, assume the spot market for allowances is trading at $200/ton on the same day in December. Utility A will buy 1,000 allowances in the spot market for $200,000 (1,000 × $200) and receive $50,000 in gains from the futures market.[7] This will result in a net price of $150/ton, which equates to its June price of $150/ton. That is the mechanics of a simple trade scenario. But the relevance revolves around leverage. To lock in the December price in June required utility A to invest approximately $15,000. It could have purchased the allowances in June for $150,000 and foregone the use of $135,000. Alternatively, utility A could have simply waited until December and bought the allowances for $200,000 (or the price of allowances could have decreased to $100/ton). Finally, utility A could have negotiated a forward contract for 1,000 allowances in the forward market and risked a price change.

A futures contract is a complex financial instrument. Although hedging is an extremely important function, the view is incomplete that sees futures contracts and markets as primarily hedging instruments through which price risk is transferred and price discovery occurs. Rather, futures contracts are financial debt instruments with high degrees of leverage. Their third party (clearinghouse) nature assures performance and makes familiarity with opposite traders irrelevant. This further lowers transaction costs.

Conclusion

The Acid Rain Program is an important and exciting experiment in cost-effective pollution control. Long-term strategies for compliance on the part of electric utilities require ways of managing risk associated with the cost and effectiveness of various control options. The SO_2 allowance trading program offers an ideal means of providing this flexibility. Important preconditions for a successful futures market have been discussed. Stochastic variation in price will prove to be a particularly strong impetus to widespread futures trading. A futures market will reduce the transactions costs of hedging and provide an important means of price discovery.

Researchers and industry analysts have identified a number of reasons the Acid Rain Program might fall short of its full potential to minimize the costs of meeting environmental quality targets. This examination indicates the majority of these factors inhibiting efficiency will not prevent a successful futures contract in SO_2 allowances. Indeed, it has been argued there is some reason to believe several of these factors could actually enhance the demand for a futures contract by creating uncertainty in the institutional and market-based factors affecting individual utility demand and supply of allowances over time. As long as there is an active cash market for emissions traded in a standard contract, a futures contract can be successful.

If the market is successful, there is some scope for expanding this trading into rights for other pollutants, particularly on a watershed- or air-basin-wide level. However, sulfur dioxide is almost uniquely suited to a national market, so even if successful it may be difficult to duplicate.

Notes

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1. Language restrictions aside, the 1990 CAA specifically states emission allowances are not legally a property right. Sec. 403(f) of P.L. 101-549

(the Act) states: "An allowance under this title is a limited authorization to emit sulfur dioxide in accordance with the provisions of this title. Such allowance does not constitute a property right. Nothing in this title or in any other provision of law shall be construed to limit the authority of the United States to terminate or limit such authorization...."

2. However, income elasticity of demand is not a directly relevant concept here. We are, instead, concerned with factors particular to the electric power industry that can generate demand instability.

3. Phase II of the Acid Rain Program will regulate existing utilities with an output capacity of 25 megawatts or greater and new facilities with a capacity under 25 megawatts using fuel with a sulfur content of at least 0.05 percent (EPA).

4. Bonus allowances and extensions of compliance deadlines for investment in certain abatement technologies may reduce demand and lower the face value of EAs.

5. See note 4.

6. The penalty is $2,000 per ton of excess emission *plus* a requirement to reduce emissions below allowance levels in the following year by the amount of the violation (EPA).

7. In this example, estimated basis (cash - futures) in June is zero as is the actual basis in December. This would not necessarily be the case.

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