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Managing Environmental Trades: Lessons From Hollywood, Stockholm, and Houston

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Environmental Trading in Context

Pollution credit trading has been promoted by economists for years and, in the United States, is finally being considered seriously to deal with problems ranging from air and water pollution to global warming and the loss of wetlands and biodiversity.[1] Whether these market-based alternatives to direct regulation are given a chance to succeed before they are abandoned will depend, more than anything else, on the results of early trading. In principle, most people are willing to accept that environmental markets might be a good idea. However, nothing will undermine their tentative support more than an early track record of environmental trades that fail to deliver in terms of expected emission reductions or habitat protection.

Challenge of Environmental Trading

Conventional markets tend to be self-governing as buyers and sellers compete and negotiate with one another over price and quality. Environmental markets are different. They actually involve three-way trades where the economic interests of buyers (credit seekers) and sellers (credit providers) are not so much aligned against one another as against the interest of a third party, the trade regulator. This is important because the role of the trade regulator in these three-way trades is to protect the public interest. In the case of wetland mitigation trading, for example, buyers and sellers can both earn a great deal of money, i.e., share more profits from land development, if trade regulators are willing to allow commercial development of an acre of high quality mangrove swamp or salt marsh to be mitigated with a "credit" that is based on the restoration of one acre of a low-cost wetland, let's say "a two-snake mud puddle." Based on the simple acre-for-acre trade accounting standards that exist in some places, such a trade can be said to achieve "no net loss" of wetlands.[2] However, if trade regulators employ "scoring" criteria that allow too many of these trades, the decline in the quality of wetlands—the ecosystem functions and services they provide—will cause many interested parties to withdraw support for wetland mitigation trading.[3] Of course, in their efforts to protect the public interest trade regulators could establish units and rules of exchange that are so strict that they prevent any environmental credit trading from taking place, even where opportunities for environmental and monetary gains are significant.

Quality Uncertainty—A Familiar Problem?

The role of the trade regulator in protecting the integrity of environmental trading is fairly easy in the case of air emission credit trades, where the unit of exchange—a ton of pollution—is highly fungible and easy to measure.[4] The services provided by wetlands and aquatic habitats, and the problems caused by nutrient deliveries and water flows, on the other hand, depend in critical ways on their context in natural landscapes. More importantly, the values of those ecosystem services and who has access to them often depend in complicated ways on the extent of human activity in the area.[5] This puts extraordinary demands on environmen-

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1. A review of environmental trading under the Clinton Administration and how it is being expanded under the Bush Administration appears by Michael Grunwald & Eric Painin, *Bush EPA Expands Emission Trading: Clinton Program That Lets Companies Sell and Swap Pollution Credits Is Retained*, WASH. POST, Feb. 15, 2001, at A2. *See also* Water Quality Trading: Proposed Policy, 67 Fed. Reg. 34709 (May 15, 2002).
2. Concerns about the widespread use of wetland area (rather than wetland functions or services) as a measure of gains and losses from wetland mitigation trading are summarized in S.C. Brown & P.L.M. Veneman, *Effectiveness of Compensatory Wetland Mitigation in Massachusetts*, 21 WETLANDS 508 (2001); NATIONAL RESEARCH COUNCIL, COMPENSATING FOR WETLAND LOSSES UNDER THE CLEAN WATER ACT (2001).
3. The effects of wetland trading on the "value" of wetlands and the distribution of wetland values are described in James Boyd et al., *Compensation for Lost Ecosystem Services: The Need for Benefit-Based Transfer Ratios and Restoration Criteria*, 20 STAN. ENVTL. L.J. 393 (2001).
4. The success of air emission trading in the United States and the methods used to "score" air emission trades are reviewed in DALLAS BURTRAW ET AL., THE COSTS AND BENEFITS OF REDUCING ACID RAIN (Resources for the Future 1997), *available at* http://www.rff.org/proj_summaries/files/burtraw_emit_trade.htm (last visited June 15, 2002).
5. The effect of landscape context on wetland functions and values and a review of some recent "off-site" wetland trades are provided in L.A. Wainger et al., *Expanding Wetland Assessment Procedures, Landscape Indicators of Relative Wetland Value With Illustrations for Scoring Mitigation Trades*, 20 STAN. ENVTL. L.J. 413 (2001).

tal trade regulators who are acting on behalf of the public in trades that involve credit buyers and credit sellers who, ironically, have clear economic incentives to collaborate with one another against them. The unusual strategic alliance that exists between buyers and sellers in environmental credit markets, and the strategies that trade regulators must use to play their roles effectively are demonstrated in three recent headline news stories.

Lessons From Hollywood, Stockholm, and Houston

From Hollywood

A Beautiful Mind, the recent Oscar-winning Hollywood blockbuster, describes the life of John Nash, a schizophrenic mathematician who was awarded the 1994 Nobel Prize in economics for using "game theory" to explain how buyers and sellers behave in modern markets.[6] Until Nash's work, the conventional market model, perfect competition, assumed that markets consisted of many independent sellers who were "price-takers" and ignored one another. Nash showed that sellers can and do make strategic pricing decisions and that working together, as opposed to competing with one another, they can increase their profits. They accomplish this by managing the options facing buyers and their expectations. For example, if a group of independent sellers all know that a buyer would be willing to pay $5 per unit, and their production costs are around $2 per unit, they can either ignore one another and wind up competing at a price just over $2 per unit, or they can all prosper by agreeing with each other to offer the product for sale at no less than $4 per unit. Nash worked out the precise mathematical formula that defined how sellers in various market situations could gain by doing this, and it has been used ever since. After Nash, most applied economists replaced their simple notion of "perfectly competitive" markets with one based on a "Nash equilibrium" and found that it did a better job of explaining market performance.

At first glance, understanding that sellers may exhibit strategic "noncompetitive" behavior would seem to be just as important in contrived markets for environmental credits as in conventional markets for goods and services. However, to appreciate why the strategic behavior of traders is vastly more important here, it is necessary to consider one specific application of game theory that has taken place since Nash. Conveniently, the 2001 Nobel Prize in economics was awarded for this work in October 2001, the same month as the release of the movie about Nash's life introduced "game theory" to the general public.

From Stockholm

The 2001 Nobel Prize in economics was awarded to three American economists for demonstrating how "asymmetric information," namely, quality uncertainty on the part of buyers or sellers, affects modern markets.[7] The earlier work by Nash and others assumed that buyers set quality standards for the products they bought, and that sellers exercised strategic behavior primarily by working together to come up with the correct product pricing decision. The simple insight that won the award was that where buyers cannot spot quality differences, bad quality usually forces good out of the market and thereby disrupts the "Nash equilibrium." In the above illustration, for example, if buyers were incapable of spotting quality differences, the producer of an inferior product could offer it for sale at $1 per unit, forcing higher quality suppliers who produce at $2 per unit out of the market. The Nobelists point out that by the time buyers become aware of the quality difference, if they ever do, the higher quality sellers may have been driven out of the market, leaving a new market equilibrium with only low-quality products available. The initial application of this model was applied by one of them in a fascinating paper explaining differences in used car prices.[8] More rigorous and important applications were subsequently used to explain trends being observed in modern markets for products as diverse as computer chips, software, financial services, fast food, and even graduates of Ivy League schools.[9]

This application of game theory with asymmetric information, more than any other economic model, explains the "winner-take-all" conditions that are evolving in many modern markets. It also illustrates what the Nobel award winners believe is an accumulation of "perverse incentives" in these markets where quality uncertainty results in the demise of many efficient low-cost suppliers who have a genuine competitive advantage in terms of everything but advertising. Buyers who are not able to judge quality differences tend to buy only from "branded agents" with reputations for being knowledgeable and trustworthy. Sellers, in turn, invest aggressively in advertising and public relations to "brand" themselves as being knowledgeable and trustworthy. One of the most noteworthy results of research on this topic is that sellers in some cases invest more to "brand" themselves as high-quality producers than they invest to become high-quality producers. The strategic behavior of "branded" sellers may also include investing in lobbying and other activities to prevent the imposition of quality standards or rating systems which would clarify quality differences and might favor or attract more efficient or lower cost suppliers. The Nobelists expressed grave concern that the combination of asymmetric information and branding behavior threatens the integrity of modern markets, and recommended that it be addressed by improving

6. The life and work of John Nash and the early development of game theory are detailed on the website of the Bank of Sweden, Nobel Prize Committee under Prizes in Economic Sciences in Memory of Alfred Nobel, *at* http://www.nobel.se/economics/laureates.html (last visited June 15, 2002).

7. The awarding of the 2001 Nobel Prize in economics and the implications of "asymmetric information" in modern markets are summarized in Information for the Public—The 2001 Bank of Sweden Prize in Economics in Memory of Alfred Nobel, *at* http://www.nobel.se/economics/laureates/2001/public.html (last visited June 15, 2002).

8. The seminal paper on "asymmetric information" was written by one of the three 2001 Nobel award winners. It dealt with used car markets. *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q. J. OF ECON. 488-500 (1970).

9. Several publications by the 2001 Nobel award winners describe the implication of "asymmetric information" in modern markets. *See*, *e.g.*, A. Michael Spence, *Product Differentiation and Consumer Choice in Insurances Markets*, 10 J. PUB. ECON. 427-47 (1978); Joseph E. Stiglitz & Andrew Weiss, *Asymmetric Information in Credit Markets and Its Implications for Macro-Economics*, 44 OXFORD ECON. PAPERS 694 (1992).

product quality standards and encouraging them to be used by buyers and sellers.[10]

There is more uncertainty about product quality in environmental markets, e.g., gains and losses in environmental functions and services, than in used car, financial, or electronics markets. Moreover, the effects of quality uncertainty and branding behavior are vastly more important in environmental markets because of the extraordinary incentives and opportunities that buyers and sellers have to work together, either explicitly or implicitly, to exploit quality uncertainty. The award-winning applications of game theory to conventional markets focused on the strategies that informed and uninformed buyers and sellers adopt to deal with one another. In environmental markets, the more important game involves buyers and sellers strategizing together to reduce costs and avoid risks, and the trade regulator strategizing to prevent unassigned costs and risks from falling, by default, on the general public.

From Houston

A few months after the release of the movie dealing with game theory and the awarding of the Nobel Prize for research that revealed how companies take advantage of quality uncertainty, the financial collapse of Enron, America's seventh largest company, provided a practical illustration of the problem. The firm's rapid growth was based primarily on its success at branding itself as a savvy industry leader in increasingly complex markets for energy, electronics, and financial services where most investors and traders were "uninformed agents." Increasing numbers of investment and trading partners were drawn to Enron until late 2001, when it became clear that the firm was hiding its financial mistakes. Within a few months, the loss of confidence in Enron forced it into the largest bankruptcy in U.S. history.

Highly publicized congressional hearings and Securities and Exchange Commission (SEC) investigations are now underway to prevent similar financial disasters from posing what SEC leaders call "a threat to the confidence in our system of financial reporting and our capital markets."[11] The important point here is that these investigations are not focusing primarily on wrongdoing by Enron officers, but on the failure of Arthur Andersen and other third-party accounting and auditing firms who either did not understand Enron's investments and trades or had incentives to look the other way and, in any case, were not protecting the public interest. The call once again, this time from the nation's political, financial, and business leaders, rather than Nobel Prize-winning economists, is for improved accounting rules and quality standards to protect the integrity of markets, promote fair competition, and prevent "branded" bullies like Enron from forcing high-quality producers out of modern markets.

10. Charles F. Peake, *Information, Risk, and Uncertainty in Economics*, Nat'l F., Winter 2000, at 4; Matthew O. Jackson & James Peck, *Asymmetric Information in a Competitive Market Game: Reexamining the Implications of Rational Expectations*, 13 Econ. Theory 603 (1999).

11. The collapse of Enron and U.S. Senate and SEC investigations are covered routinely in the popular press. An ongoing summary of matters related to Enron is on the *Financial Times* website, *at* http://specials.ft.com/enron/FT3J5WLAFXC.html (last visited June 10, 2002). For more in-depth coverage, see http://specials.ft.com/enron/ (last visited June 10, 2002).

Implications for Environmental Markets

We can gain many insights about how to design and manage effective environmental credit trading systems by considering applications of game theory in modern markets for conventional goods and services. Particularly important are observations about how firms like Enron were able to exploit the fact that there were no clearly defined rules and units of exchange in rapidly emerging energy and natural resource markets, no established accounting standards for entering them in corporate financial ledgers, and no government regulators capable of policing trades or trade accounting. However, learning the lessons that will be most useful in environmental credit markets requires asking a few questions that most economists and financial and market experts would never find themselves asking. For example, when does it make economic sense for buyers and sellers to collude with one another to promote the development of markets with low-quality standards and to encourage high-risk trades?

Applying modern game theory in three-way environmental credit markets suggests that the answer could be "almost all the time." For example, if the cost of supplying a product in a conventional market is $7,000, and buyers are willing to pay $10,000, there are profits (economic rent) of $3,000 ($10,000 less $7,000) that will be shared by buyers and sellers based on their competitive positions and negotiating skills. In environmental credit markets, however, there is a cooperative strategy that could be more profitable for both buyers and sellers. They can invest together in lobbying and other institutional activities to force trade regulators to reduce the quality standard of an environmental credit, so that the product—for example, a wetland mitigation credit—can be produced at a cost of $4,000 instead of $7,000 per acre. The payoff from such a strategy would be a doubling of the profits that buyers and sellers can split from $3,000 per acre to $6,000 per acre. The economic payoff from investing in political action to reduce the quality standards imposed on such trades is often much higher than the economic payoff from investing in technologies to meet quality standards. The fact that most buyers and sellers of environmental credits have a shared interest in such an outcome, and can share the cost of investing in a strategy to achieve it, makes this a very attractive strategic decision for all of them.

Applications of game theory showing that buyers and sellers can be expected to pursue strategies that exploit quality uncertainty in environmental markets will receive more attention as more attempts are made to implement environmental trading programs. From this perspective, there are two aspects of these markets that deserve attention: how buyers and sellers strategize to exploit quality uncertainty and establish units and rules exchange that lower costs and shift risks away from themselves, and the strategies that environmental trade regulators employ to prevent costs and risks from being transferred to the general public. There are very few people in or out of government with enough experience in environmental science, e.g., what is being traded, and modern trading strategies, e.g., the behavior of traders, to be effective trade regulators. Those few who may have the right combination of skills will have difficulty finding enough technical, economic, political, or institutional support to do their jobs effectively. The most effective strategy for trade regulators, in this situation, will be to avoid rules

that are based on ad hoc negotiations and promote the "scoring" of environmental trades based on clearly defined criteria that are technically and legally defensible and clearly assign the risk of trade failure to buyers and sellers.[12] The term trade failure, in this case, does not refer to whether the buyers or sellers of credits or permits classify the trade as a "win-win" market outcome, but whether the trade delivers environmental gains that are equivalent to environmental losses.

Scrutinizing Environmental Trades

The questions that need to be addressed to incorporate recent discoveries about gaming behavior and asymmetric information in conventional markets into the design of environmental credit markets include:

> (1) What outcomes should be expected in markets where strategic behavior does not involve sellers colluding with one another to exploit the ignorance of buyers, but buyers and sellers colluding together to exploit the ignorance of political leaders or environmental regulators?
>
> (2) What is the effect of "early" volunteer trading by "branded agents" using unofficial trade rules on the development of "official" trade rules and the expectations and strategies of prospective buyers and sellers?
>
> (3) What are the risks to these markets when third-party trade auditors and verifiers, and even government regulators, have incentives to encourage trading in order to brand themselves as "market advocates"?
>
> (4) How can environmental trade regulators prevent bad trades from forcing out good trades, and keep an early history of bad trades from undermining public support for environmental trading before it has been given a chance to succeed?

Three Basic Rules for Promoting Environmental Trading

Based on recent lessons from Hollywood, Stockholm, and Houston, we can identify three general steps that environmental trade regulators should include in a strategy for promoting trading, avoiding problems, and protecting the public interest.

Establish Strict and Predictable Units of Exchange as Early as Possible

"Constructive ambiguity," the strategy favored by diplomats and lawyers attempting to get approval for environmental trading, is a disaster when designed into a trading system. Allowing flexible or ad hoc trade-scoring criteria, even in early "unofficial" trading, creates quality uncertainty and encourages political manipulation. At the same time, it creates "perverse incentives" that allow bad quality to force good quality out of the market. This will undermine support for environmental trading, perhaps before it has even been given a fair chance to succeed.

Establish Rules of Exchange That Assign Trade Risks to Buyers and/or Sellers

Trade risks in this case do not involve financial risks facing buyers and sellers, but the probability that environmental gains from trades will not offset losses. Traders can transfer trade risks to third parties, i.e., insurers. Unassigned trade risks fall, by default, on the general public and will eventually be noticed and cause problems.

View Each Trade as a Three-Way Noncooperative Game

Some advocates of environmental trading view early attempts to implement environmental trading as collaborative ventures in which government and industry work together to create new institutions to solve environmental problems. From a game theory perspective, however, they should be viewed as three-way competitive games where the public sector, armed only with accounting rules and threats of enforcement action, opposes self-interested buyers and sellers who have economic incentives to strategize together against the public interest. Although all sides may gain from trading, the price/quality trade offs associated with any particular trade involve potential public gains, measured in terms of environmental improvements, that are usually achieved at private costs, measured in terms of credit costs and credit prices.

This is a reasonable foundation for regulators to predict the strategic behavior of buyers and sellers in emerging environmental credit markets, and a useful basis for developing rules to manage these markets. Observations of gaming behavior in conventional markets suggest that buyers and sellers in early environmental markets will have strong incentives to take advantage of quality uncertainty, and to engage in "branding" behavior. Trade regulators will need to be aggressive about managing these tendencies to prevent an early track record of bad trades from undermining support for environmental trading before it has been given a fair chance to succeed.

12. Dennis M. King, *Anatomy of "Early" Carbon Sequestration Trading: Common Sense Can Prevent Costly and Embarrassing Mistakes*, Electronic J. of the F. for Envtl. L., Sci., Engineering & Fin., Spring 2002, *at* http://www.felsef.org/summer02.htm (last visited June 15, 2002).