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Tradable Permits in Principle and Practice

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I. Introduction

A. Background

One of the most prominent approaches for coping with the problem of rationing access to the commons involves the use of tradable permits. Applications of this approach have spread to many different types of resources and many different countries. A recent survey found nine applications in air pollution control, seventy-five applications in fisheries, three applications in managing water resources, five applications in controlling water pollution, and five applications in land use control.[1] And that survey failed to include many current applications, including those that have sprung up in response to the Kyoto Protocol.

The Kyoto Protocol authorizes three cooperative implementation mechanisms that involve tradable permits: emission trading, joint implementation, and the Clean Development Mechanism. These programs have, in turn, spawned others. The European Parliament passed a bill capping European industry's carbon dioxide output and letting firms trade the allowed emissions. Beginning in January 2005,

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* This paper draws upon previous studies completed for the National Research Council in the United States, *see* Thomas H. Tietenberg, *The Tradable Permits Approach to Protecting the Commons: What Have We Learned?*, *in* THE DRAMA OF THE COMMONS 197 (Elinor Ostrom et al., eds., 2002); and the Organization for Economic Cooperation and Development in Paris, *see* ORG. FOR ECON. COOPERATION & DEV., TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM (2004); as well as an earlier paper on climate change published in the *Oxford Review of Economic Policy* and a second paper focusing on *ex post* evaluation currently in production to be published in a collection of essays on market-based instruments edited by Jody Freeman and Charles Kolstad and published by Oxford University Press. *See* Thomas H. Tietenberg, *The Tradable Permits Approach to Protecting the Commons: Lessons for Climate Change*, 19 OXFORD REV. ECON. POL'Y 400 (2003).

1. ORG. FOR ECON. COOPERATION & DEV. (OECD), IMPLEMENTING DOMESTIC TRADABLE PERMITS FOR ENVIRONMENTAL PROTECTION (1999).

many plants in the oil refining, smelting, steel, cement, ceramics, glass, and paper sectors have required special permits to emit carbon dioxide (CO_2). Individual countries such as the United Kingdom[2] and Denmark[3] have created their own national trading programs. Corporations are even involved. British Petroleum (BP), an energy company, has established company-wide goals and a trading program to help individual units within the company to meet those goals. Despite the fact that the United States has not signed the Kyoto Protocol, American companies, states and municipalities have accepted voluntary caps on CO_2 and methane emissions and are using trading to facilitate meeting those goals. A new institution, the Chicago Climate Exchange,[4] has been set up to facilitate these trades. The unprecedented scope of these programs breaks new ground in terms of geographic coverage, the number of participants, and the types of polluting gases covered.

B. *Overview*

In this essay, I review the experiences of the three main applications of tradable permit systems—air pollution control, water supply and fisheries management—as well as some unique programs such as the U.S. program to mitigate the loss of wetlands,[5] the Netherlands' water pollution control program to limit damage from manure spreading,[6] and the U.S. program to allocate grazing rights on federal land.[7] The purpose of this review is to exploit the large variation in implementation experiences to isolate the lessons about the design and applicability of tradable permit systems that can be gleaned from this rich variety of applications.

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2. David Harrison Jr., *Ex Post Evaluation of the RECLAIM Emissions Trading Programmes for the Los Angeles Air Basin*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 45 (OECD ed., 2004).

3. Sigurd Lauge Pederson, Experience Gained with CO_2 Cap and Trade in Denmark, Address at the Proceedings of the Org. for Econ. Cooperation & Dev. Workshop on *Ex post* Evaluation of Tradable Permits: Methodological and Policy Issues (Jan. 21-22, 2003).

4. For more information on this institution, *see* http://www.chicagoclimatex.com/.

5. Leonard Shabman, *Compensation for the Impacts of Wetland Fill: The US Experience with Credit Sales*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 155 (OECD ed., 2004).

6. Ada Wossink, *The Dutch Nutrient Quota System: Past Experience and Lessons for the Future*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 99 (OECD ed., 2004).

7. LEIGH RAYMOND, RESOURCES FOR THE FUTURE, PRIVATE RIGHTS IN PUBLIC RESOURCES: EQUITY AND PROPERTY ALLOCATION IN MARKET-BASED ENVIRONMENTAL POLICY (2003). For a previous survey that also examines tradable permit systems across resource settings, *see* Bonnie G. Colby, *Cap and Trade Challenges: A Tale of Three Markets*, 76 LAND ECON. 638 (2000).

At the most general level, the major conclusion of this review is that context does matter. The various resources being controlled by tradable permits have different characteristics and those characteristics affect program evaluation, design, and effectiveness.

The review proceeds in several steps. First, we examine the substantive results from *ex post* evaluation studies using three specific criteria: implementation feasibility, environmental effectiveness, and economic effectiveness. This section lays the groundwork not only for isolating what seems to work and what does not, but also for isolating the implications of these results for how design characteristics affect success. Finally, in the last section, we draw together the lessons that can be extracted from this review.

II. A Review of Ex Post Evaluations of Tradable Permit Systems

This assessment of the outcomes of these systems focuses on three major categories of effects. The first is implementation feasibility. A proposed policy regime cannot perform its function if it cannot be implemented or if its main protective mechanisms are so weakened by the implementation process that it is rendered ineffective. What matters to policy makers is not how a policy regime works in principle, but how it works in practice. The second category seeks to answer the degree to which environmental protection was offered, not only to the targeted resource, but also to other resources that might have been affected either positively or negatively by its implementation. Finally, the third category questions what the economic effects are on those who either directly or indirectly use the resource?

A. Implementation Feasibility

Until recently, the historic record on tradable permits seemed to indicate that resorting to a tradable permits approach usually only occurred after other, more familiar, approaches had been tried and failed. In essence, the adjustment costs of implementing a new system, with which policy administrators have little personal experience, are typically perceived as so large that they can only be justified when the benefits have risen sufficiently to justify the transition.[8]

This review finds some support for that view, particularly in the earlier years of tradable permits. Most fisheries that have turned to these policies have done so only after a host of alternative input and output controls have failed to stem the destructive pressure being placed upon

8. GARY D. LIBECAP, CONTRACTING FOR PROPERTY RIGHTS (1990).

the fishery.[9] A similar story can be told for air pollution control. The offset air pollution control policy, introduced in the U.S. during the 1970s, owes its birth to an inability to find any other policy to reconcile the desire to allow economic growth with the desire to improve the quality of the air.[10]

It is also clear from the historical record that not every attempt to introduce a tradable permit approach has been successful. In air pollution control, attempts to establish transferable permit approaches have failed in Poland[11] and Germany.[12] The initial attempts to introduce a SO_2 trading system also failed in the United Kingdom,[13] although recent attempts to establish a CO_2 program have succeeded. However, programs in water pollution control have generally not been very successful.[14]

On the other hand it does appear that the introduction of new tradable permit programs becomes easier with familiarity. In the U.S., following the very successful lead phase out program, new supporters appeared and made it possible to pass the sulfur allowance program. The introduction of the various flexibility mechanisms into the Kyoto Protocol was facilitated by the successful experience with the U.S. sulfur allowance program, among others. The recent introduction of tradable permits systems in several European countries and the EU itself was precipitated by the opportunities provided by the Kyoto Protocol.

It also seems quite clear that, to date at least, using a free distribution approach to the initial allocation has been a necessary ingredient in building the political support necessary to implement the approach.[15] Existing users frequently have the power to block implementation while potential future users do not. This process has made it politically expedient to allocate a substantial part of the

9. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

10. Thomas H. Tietenberg, *Introduction*, *in* EMISSIONS TRADING PROGRAMS VOLUME I: IMPLEMENTATION AND EVOLUTION xi-xxvii (Thomas H. Tietenberg ed., 2001).

11. Tomasz Zylicz, *Obstacles to Implementing Tradable Pollution Permits: the Case of Poland*, *in* IMPLEMENTING DOMESTIC TRADABLE PERMITS FOR ENVIRONMENTAL PROTECTION 147 (OECD ed., 1999).

12. Bernd Scharer, *Tradable Emission Permits in German Clean Air Policy: Considerations on the Efficiency of Environmental Policy Instruments*, *in* POLLUTION FOR SALE: EMISSIONS TRADING AND JOINT IMPLEMENTATION 141 (Steve Sorrel & Jim Skea eds., 1999).

13. Steve Sorrell, *Why Sulfur Trading Failed in the UK*, *in* POLLUTION FOR SALE: EMISSIONS TRADING AND JOINT IMPLEMENTATION 170 (Steve Sorrel & Jim Skea eds., 1999).

14. Robert W. Hahn & Gordon L. Hester, *Marketable Permits: Lessons from Theory and Practice*, 16 ECOLOGY L.Q. 361 (1989).

15. RAYMOND, *supra* note 7.

economic rent that these resources offer to existing users as the price of securing their support. While this strategy reduces the adjustment costs to existing users, it generally raises them for new users.

One tendency that seems to arise in some new applications of this concept is placing severe restrictions on its operation as a way to quell administrative fears about undesirable, unforeseen outcomes. As Shabman points out, this is precisely the case with the U.S. wetlands credit program.[16] In some cases, including the wetland program, these restrictions are so severe that they cripple the program, thereby preventing its ultimate evolution to a smoothly operating system. Although initial restrictions can severely diminish the early accomplishments of the program, with increased familiarity, they tend to disappear over time.

B. Environmental Effects

One common belief about tradable permit programs is that their environmental effects are determined purely by the imposition of the aggregate limit, an act that is considered to lie outside the system. Hence, it is believed, the main purpose of the system is to protect the economic value of the resource, not the resource itself.

That is an oversimplification for several reasons. First, whether it is politically possible to set an aggregate limit at all may be a function of the intended policy. Second, both the magnitude of that limit and its evolution over time may be related to the policy. Third, the choice of policy regime may affect the level of monitoring and enforcement, and noncompliance can undermine the achievements of the limit. Fourth, the policy may trigger environmental effects that are not covered by the limit.

1. The Stringency of the Limit

In general, the evidence seems to suggest that by lowering compliance costs, tradable permit programs facilitate the setting of more stringent caps. In air trading programs, the lower costs offered by trading were used in initial negotiations to secure more stringent pollution control targets (e.g. acid rain programs, lead phase out programs and RECLAIM[17] or earlier deadlines. The air quality effects from more stringent limits were reinforced by the use of adjusted offset ratios for trades in nonattainment areas. (Offset rations were required to be greater than 1.0, implying a portion of each acquisition would go

16. Shabman, *supra* note 5.
17. Regional Clean Air Incentives Market.

towards improved air quality.) In addition, environmental groups have been allowed to purchase and retire allowances (e.g. acid rain program). Retired allowances represent pollution that is authorized, but not emitted.

In fisheries, the institution of individual transferable quotas (ITQs) has occasionally resulted in lower (more protective) total allowable catches (TACs). In the Netherlands, for example, the plaice quota was cut in half over time (and prices rose to cushion the income shock).[18]

2. Meeting and Enforcing the Limit

In theory, the flexibility offered by tradable permit programs makes it easier to reach the limit, suggesting the possibility that the limit may be met more often under tradable permits systems than under previous systems. In most fisheries, this expectation seems to have been borne out. For example, while exceeding the TAC was common before the imposition of an ITQ system in the Alaskan Halibut and Sablefish fisheries, the frequency of incidences dropped significantly after the introduction of the ITQ.[19]

Regardless of how well any tradable permit system is designed, noncompliance can prevent the attainment of its economic, social, and environmental objectives.[20] Although it is true that any management regime faces monitoring and enforcement issues, tradable permit regimes raise some special issues. One of the most desirable aspects of tradable permits for resource users is the ability to raise income levels for participants. However, this is a two-edged sword because it also raises incentives for noncompliance. In the absence of an effective enforcement system, higher profitability could promote illegal activity. Insufficient monitoring and enforcement could also result in failure to keep a tradable permit system within its environmental limit.[21]

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18. W.P. Davidse, *Lessons from Twenty Years of Experience with Property Rights in the Dutch fishery*, *in* THE DEFINITION AND ALLOCATION OF USE RIGHTS IN EUROPEAN FISHERIES: PROCEEDINGS OF THE SECOND WORKSHOP HELD IN BREST, FRANCE, 5-7 May 1999 at 153 (Ctr. For the Econ. & Mgmt. of Aquatic Res. ed., 1999).

19. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

20. Noncompliance not only makes it more difficult to reach stated goals, it sometimes makes it more difficult to know whether the goals are being met. In fisheries, for example, stock assessments sometimes depend on the size and composition of the catch. If the composition of the landed harvest is unrepresentative of the actual harvest due to illegal discards, this can bias the stock assessment and the total allowable catch that depends upon it. Not only would true mortality rates be much higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards). This is known in fisheries as "data fouling."

21. Prior to 1988, the expected positive effects of ITQs did not materialize in the Dutch cutter fisheries due to inadequate enforcement. Fleet capacity increased further,

One increasingly important aspect associated with transferable permit systems involves the ability to raise revenue for both enforcement and administration. In many permit systems, enforcement costs are now routinely financed from the enhanced profitability promoted by the tradable permit system. Not only has the recovery of monitoring and enforcement costs from users become standard practice in some fisheries (New Zealand, for example), but funding for at least some monitoring and enforcement activity out of rents generated by fisheries has already been included as a provision in the most recent amendments to the U.S. Magnuson-Stevens Act. This concept is beginning to affect air pollution control as well. In the sulfur allowance program, for example, the environmental community demanded (and received) a requirement that continuous emission monitoring be installed and financed by every covered utility. Coupling this with the rather stringent penalty system has meant 100% compliance. In the Danish system,[22] which does not rely on continuous emission monitoring, electricity producers pay an administration fee of 0.079 Danish kroners per ton of CO_2 allowance to the Danish Energy Agency to cover the administration costs. These costs include the verification of CO_2 emissions, the distribution of allowances, registry operation, monitoring of trading, and development of the scheme.

A successful enforcement program also requires a carefully constructed set of sanctions for noncompliance. In the sulfur allowance program, generally considered the most successful tradable permit program, those found in noncompliance must not only pay a substantial financial penalty for noncompliance, but they also must forfeit a sufficient number of future allowances to compensate for the overage. Any egregious violations can lead to forfeiture of the right to participate in the program.

3. Direct Effects on the Resource

Air pollution programs have typically had a very positive effect on reducing emissions. The U.S. programs to phase out lead[23] and to reduce ozone-depleting gases[24] were designed to eliminate, not merely reduce,

the race for fish continued, and the quotas had to be supplemented by input controls such as a limit on days at sea. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

22. Pederson, *supra* note 3.

23. Barry D. Nussbaum, *Phasing Down Lead in Gasoline in the U.S.: Mandates, Incentives, Trading and Banking*, *in* CLIMATE CHANGE: DESIGNING A TRADEABLE PERMIT SYSTEM 21 (OECD ed., 1992).

24. Robert W. Hahn & Al M. McGartland, *The Political Economy of Instrument*

pollutants. Both the U.S. program to control sulfur[25] and RECLAIM[26] involve substantial reductions in emissions over time.

What have been the effects on biomass in fisheries? The evidence on the overall effect on the fishery has been mixed. In the Chilean squat lobster fishery, the exploitable biomass rebounded from a low of about 15,500 tons (prior to ITQs) to a 1998 level between 80,000-100,000 tons.[27] The herring fishery in Iceland experienced a similar rebound.[28]

How typical are these examples? One review of thirty-seven ITQ or IQ fisheries found that twenty-four experienced at least some temporary declines in stocks after instituting the programs. These declines were largely attributed to a combination of inadequate information on which to set conservative TACs and illegal fishing activity resulting from ineffective enforcement. Interestingly, twenty of the twenty-four fisheries experiencing declines had superimposed additional command-and-control regulations such as closed areas, size/selectivity regulations, trip limits, and vessel restrictions in addition to the tradable permits system.[29] These additional regulations were also ineffective in protecting the resource; apparently, the problems plaguing ITQs plague more traditional approaches as well.

4. Effects on Other Resources

The resource controlled by the permit program is frequently not the only resource affected. In water applications, one significant problem has been the protection of nonconsumptive uses of water.[30] In the U.S., some states only protect private entitlements to water if water is diverted from the stream and consumed. The entitlements for water remaining in the stream, although necessary to promote recreational uses, could be

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Choice: An Examination of the U. S. Role in Implementing the Montreal Protocol, 83 NW. U. L. REV. 592 (1989).

25. Dallas Burtraw & Erin T. Mansur, *Environmental Effects of SO_2 Trading and Banking*, 33 ENVTL. SCI. & TECH. 3489 (1999).

26. Harrison, *supra* note 2.

27. Patricia Bernal & Bernardo Aliaga, *ITQ's in Chilean fisheries*, *in* THE DEFINITION AND ALLOCATION OF USE RIGHTS IN EUROPEAN FISHERIES: PROCEEDINGS OF THE SECOND WORKSHOP HELD IN BREST, FRANCE, 5-7 May 1999 (Ctr. For the Econ. & Mgmt. of Aquatic Res. ed., 1999).

28. Birgir Runolfsson, *ITQs in Icelandic Fisheries: a Rights-based Approach to Fisheries Management*, *in* THE DEFINITION AND ALLOCATION OF USE RIGHTS IN EUROPEAN FISHERIES: PROCEEDINGS OF THE SECOND WORKSHOP HELD IN BREST, FRANCE, 5-7 May 1999 at 164 (Ctr. For the Econ. & Mgmt. of Aquatic Res. ed., 1999).

29. OECD, TOWARDS SUSTAINABLE FISHERIES: ECONOMIC ASPECTS OF THE MANAGEMENT OF LIVING MARINE RESOURCES (1997).

30. Michael D. Young, *Learning from the Market: Ex post Water Entitlement and Allocation Trading Assessment Experience in Australia*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 135 (OECD ed., 2004).

confiscated by authorities. "Unused" rights do not meet the definition of a beneficial use. Recent changes in policy and some legal determinations have afforded more protections to these environmental uses of water.

According to Shabman, the wetlands permitting program has failed to stem the degradation of wetlands, and therefore, the degradation of all ecosystems dependent on those wetlands.[31] His review suggests that the ecological functions, especially for wildlife and habitat, of avoided wetlands and on-site wetlands offsets have become compromised by polluted runoff and adverse changes in hydrologic regimes. In some cases, ecological failure resulted from poor construction techniques. In other cases, a promised offsetting restoration project may not have been undertaken at all. In general, the failure to prevent these compromises to the program can apparently be traced back to limited agency enforcement resources.

Leakage provides another possible source of external effects. Leakage occurs when pressure on the regulated resource is diverted to an unregulated, or lesser regulated resource as when fishermen move their boats to another fishery or polluters move their polluting factory to a country with lower environmental standards.

In some cases, leakage can intensify the positive effects of a program, as is the case when the control of greenhouse gases results in substantial reductions of other air pollutants associated with the combustion of fossil fuels.[32] In others, however, the effects on other resources can be quite detrimental.

In fisheries, the possibility for detrimental effects on nontargeted species is particularly large. Two examples of these effects are bycatch and habitat destruction. Bycatch, the harvesting of nontargeted species (perhaps due to the nonspecificity of the harvesting gear) is a problem in many fisheries, regardless of the means of control. Harvested fish for which no quota is held are likely to be discarded before reaching shore. For many species, these discards die rather than recover. No clear pattern about how the introduction of ITQs affects bycatch emerges from the literature. Two reviews found that bycatch may either increase or decrease in ITQ fisheries depending on the fishery.[33]

Habitat damage occurs when fishing gear causes damage to the seabed or geological formations that provide habitat for species dwelling

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31. Shabman, *supra* note 5.

32. Paul Ekins, *The Secondary Benefits of CO_2 Abatement: How Much Emission Reduction do they Justify?*, 16 ECOLOGICAL ECON. 13 (1996).

33. OECD, TOWARDS SUSTAINABLE FISHERIES: ECONOMIC ASPECTS OF THE MANAGEMENT OF LIVING MARINE RESOURCES (1997); NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

on or near the ocean floor. Tradable permits could, in principle, increase or decrease the amount of habitat damage by affecting both the type of gear used and the timing and location of its use. Evidence whether tradable permits intensifies or limits this problem is also extremely limited.[34]

C. Economic Effects

While the evidence on environmental consequences is mixed (especially for fisheries), the evidence on economic consequences is clearer. In the presence of adequate enforcement, tradable permits do appear to increase the value of the resource (in the case of water and fisheries) or lower the cost of compliance (in the case of emissions reduction).

Considerable savings in meeting air pollution control targets have been found.[35] For water, the increase in value brought about by transferring the resources from lower valued to higher valued uses has typically been quite large.[36] In fisheries, a substantial income increase not only results from more appropriately scaled capital investments (resulting from the reduction in overcapitalization), but also from the fact that ITQs frequently make it possible to sell a more valuable product at higher prices (fresh fish rather than frozen fish).[37] One review of twenty-two fisheries found that the introduction of ITQs increased wealth in all twenty-two.[38]

In both water and air pollution, the regulatory transition following the introduction of transferable permits was not from an open-access resource to tradable permits, but rather from a less flexible control regime to a more flexible one. The transition has apparently been accomplished with few adverse employment consequences, though sufficient data for a comprehensive evaluation on that particular issue do not exist.[39]

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34. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

35. A. Denny Ellerman, *The U.S. SO_2 Cap-and-Trade Programme*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 71 (OECD ed., 2004); Harrison, *supra* note 2; Hahn & Hester, *supra* note 14; Thomas H. Tietenberg, *Economic Instruments for Environmental Regulation*, 6 OXFORD REV. ECON. POL'Y 17 (1990).

36. Young, *supra* note 30; K. William Easter et al., *Water Markets: Transactions Costs and Institutional Options*, *in* MARKETS FOR WATER: POTENTIAL AND PERFORMANCE 1 (K. William Easter et al., eds., 1998).

37. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

38. OECD, TOWARDS SUSTAINABLE FISHERIES: ECONOMIC ASPECTS OF THE MANAGEMENT OF LIVING MARINE RESOURCES (1997).

39. Eli Berman & Linda T. Bui, *Environmental Regulation and Labor Demand:*

The employment consequences for fisheries have been more severe. In fisheries, the introduction of ITQs has usually been accompanied by a considerable reduction in the amount of fishing effort. Normally, this means not only fewer boats, but also less employment. The evidence also suggests, however, that the workers who remain in the industry work more hours during the year and earn more money.[40]

The introduction of ITQs in fisheries has also had implications for crew, processors, and communities. Traditionally in many fisheries, crew have been co-venturers in the fishing enterprise, sharing in both the risk and reward. In some cases, the shift to ITQs has shifted the risk and ultimately shifted the compensation system from a profit sharing to a wage system. Though this has not generally lowered incomes, it has changed the culture of fishing.[41]

Secondary industries can be affected by the introduction of tradable permits in a number of ways. Consider, for example, the effects on fish processors. First, the processing sector is typically as overcapitalized as the harvesting sector. Since the introduction of ITQs typically extends the fishing season and spreads out the processing needs of the industry, less processing capacity is needed. In addition, the more leisurely pace of harvesting reduces the bargaining power of processors versus fishers. In some remote areas such as Alaska, a considerable amount of this processing capital may lose value due to its immobility.[42]

Communities can be, and in some cases have been, adversely affected when quota held by local resource users is transferred to resource users who operate out of other communities. As described below in the design lessons section of the paper, techniques developed to mitigate these effects, however, seem to have been at least moderately successful.[43]

Generally, market power has not been a significant issue in most permit markets despite some tendencies toward the concentration of

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Evidence from the South Coast Air Basin, 79 J. PUB. ECON. 265 (2001); Eban Goodstein, *Jobs and the Environment—an Overview*, 20 ENVTL. MGMT. 313 (1996).

40. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

41. Bonnie J. McCay et al., *Labor and the Labor Process in a Limited Entry Fishery*, 6 MARINE RESOURCE ECON. 311 (1989); Bonnie J. McCay & Carolyn F. Creed, *Social Structure and Debates on Fisheries Management in the Mid-Atlantic Surf Clam Fishery*, 13 OCEAN & SHORELINE MGMT. 199 (1990).

42. Scott C. Matulich et al., *Toward a More Complete Model of Individual Transferable Fishing Quotas: Implications of Incorporating the Processing Sector*, 31 J. ENVTL. ECON. & MGMT. 112 (1996); Scott C. Matulich & Murat Sever, *Reconsidering the Initial Allocation of ITQs: the Search for a Pareto-Safe Allocation Between Fishing and Processing Sectors*, 75 LAND ECON. 203 (1999).

43. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

quota. In part, this is due to accumulation limits that have been placed on quota holders and the fact that these are typically not markets in which accumulation of quota yields significant monopoly-type powers. In fisheries, some concern has been expressed[44] that the introduction of ITQs will mean the demise of smaller fishers as they are bought out by larger operations. The evidence does not seem to support this concern.[45]

Although hard evidence on the point is scarce, a substantial amount of anecdotal evidence is emerging about how tradable permit programs can change the way environmental risk is treated within polluting firms.[46] This evidence suggests that environmental management used to be relegated to the tail-end of the decision-making process. Historically, the environmental risk manager was not involved in the most fundamental decisions about product design, production processes, selection of inputs and so forth. Rather, the manager was simply confronted with established decisions and told to keep the firm out of trouble. This particular organizational assignment of responsibilities inhibits the exploitation of one potentially important avenue of risk reduction – pollution prevention.

Because tradable permits put both a cap and a price on environmental risks, it tends to get corporate financial officers involved. Furthermore, as the costs of compliance rise in general, environmental costs become worthy of more general scrutiny. Reducing environmental risk can become an important component of the bottom line. Given its anecdotal nature, the evidence on the extent of organizational changes that might be initiated by tradable permits should be treated more as a hypothesis to be tested than a firm result, but its potential importance is large.

Economic theory treats markets as if they emerge spontaneously and universally whenever unmet needs create profitable opportunities. In practice, the applications examined in this review point out that participants frequently require some experience with the program before they fully understand (and behave effectively) in the market for permits. In the literature, this is known as the "learning by doing" effect.

For example, in RECLAIM, the pre-implementation analysis

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44. Gisli Palsson, *The Virtual Aquarium: Commodity Fiction and Cod Fishing*, 24 ECOLOGICAL ECON. 275 (1998).

45. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

46. Olivia Hartridge, The UK Emissions Trading Scheme: a Progress Report, Address at the Proceedings of the Org. for Econ. Cooperation & Dev. Workshop on *Ex post* Evaluation of Tradable Permits: Methodological and Policy Issues (Jan. 21-22, 2003); Brian McLean, *Ex Post* Evaluation of the US Sulphur Allowance Programme, Address at the Proceedings of the Org. for Econ. Cooperation & Dev. Workshop on *Ex Post* Evaluation of Tradable Permits: Methodological and Policy Issues (Jan. 21-22, 2003).

assumed that large facilities would over-control their emissions and sell excess permits, thereby providing an adequate supply. However, most facilities installed controls, made process modifications, bought permits, or reduced production simply to stay in compliance. Large facilities did not go above and beyond what was required for compliance and did not focus on generating excess permits for revenue.[47]

This reluctance to trade seems to be changing with familiarity. Over the years, managers of RECLAIM facilities have apparently become more informed and more efficient in buying and selling credits. In addition, instead of just helping facilities buy and sell credits, brokers have now begun to discuss control options and other market opportunities with participants. As the price of permits has increased, the market has become more efficient because companies have invested time and effort to understand the market and to use it to minimize compliance cost.[48]

Kerr and Maré have econometrically estimated the effect of transaction costs on the cost-effectiveness of the U.S. lead phasedown program.[49] Although they found that refineries generally trade efficiently, they also found evidence that transaction costs do affect trading. Specifically, they found evidence to support the theoretical expectation that refineries would be less likely to trade in cases where transaction costs are high.

Focusing on "first-trade" transaction costs, which are defined as the cost of making one trade rather than not trading at all, a loss was found on the order of ten to twenty percent of potential gains from trade. This loss of cost-effectiveness comes not only from the failure to execute profitable trades, but also from dilution of value from the trades due to the transaction costs associated with each trade.

Kerr and Maré also found consistent patterns of failure to trade. Refineries that were part of small companies, smaller refineries, and refineries that did not have other refineries to trade with within their company, more frequently choose not to trade.

The evidence also seems to clearly suggest that the type of emissions trading system affects transactions costs. Credit-based programs (such as the Emissions Trading System) typically involve a considerable amount of regulatory oversight at each step of the process

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47. U.S. ENVTL. PROT. AGENCY (EPA), AN EVALUATION OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT'S REGIONAL CLEAN AIR INCENTIVES MARKET - LESSONS IN ENVIRONMENTAL MARKETS AND INNOVATION (2002).

48. *Id.*

49. Suzi Kerr & David Maré, Transaction Costs and Tradable Permit Markets: The United States Lead Phasedown (1999) (unpublished manuscript, *available at* http://www.motu.org.nz/abstracts/transaction_costs.htm).

(for example, certification of credits and approving each trade). In contrast, cap-and-trade systems rarely require either of the steps, using instead a system that merely compares actual and authorized emissions at the end of the year.

The type of emissions trading also seems to affect administrative costs. Requiring regulatory oversight for each step requires more time and more staff, than simply doing an end-of-year comparison of actual and authorized emissions. Specific design features (such as the substitution provision in the sulfur allowance program)[50] and the use of relative targets in the UK Emissions Trading Scheme[51] can also add considerably to administration costs.

Since the design features vary so much from program to program, it is difficult to generalize insights about how administrative costs vary across programs. Nonetheless, two general themes emerge. First, once sufficient experience has been gained, administration of tradable permit systems involves fewer administrative person-hours,[52] and second, the bureaucratic functions are quite different.[53]

The notion that fewer administrative hours are involved is not a universal finding and it typically results after some "learning by doing" has occurred. The U.S. EPA evaluation of RECLAIM, for example, found that shifting from a command-and-control system to a trading based compliance system required a significant shift in resources and, at least initially, required increased attention to compliance.[54] Whereas the old regulatory system could often be monitored by a simple inspection to ensure that the mandated equipment was up and running smoothly, emissions trading required checking actual emissions against authorized emissions (including those acquired through trade).

Focusing on emissions requires increases in both administrative resources (in the areas of compliance, inspections, and audits), and emitter resources over and above investments in abatement (planning a compliance strategy, implementing the appropriate combination of abatement and acquiring permits, monitoring emissions, and reporting compliance).

In addition to consequences for the amount of resources required, changing administrative functions have implications for the nature of the skills required by administrators as well. Those who can monitor and enforce compliance replace engineers who seek to identify the correct control strategies for sources and to negotiate permit exemptions.

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50. Ellerman, *supra* note 35.
51. Hartridge, *supra* note 46.
52. McLean, *supra* note 46.
53. *Id.*; Harrison, *supra* note 2.
54. EPA, *supra* note 47.

One rather unexpected finding that has emerged from *ex post* evaluation of emissions trading systems is the degree to which the number of errors in pre-existing emission registries are brought to light by the need to create accurate registries for trading permit schemes.[55] Although inadequate inventories plague all quantity-based approaches, tradable permits seem particularly effective at bringing them to light and having them corrected.

III. Lessons

A. Lessons for Program Design

1. The Baseline Issue

In general, tradable permit programs fit into one of two categories: credit programs or cap-and-trade programs. Air pollution control systems and water have examples of both types. Fisheries tradable permit programs are all of the cap-and-trade variety.

- Credit trading, the approach taken in the U.S. Emissions Trading Program (the earliest program), allows emission reductions above and beyond baseline legal requirements to be certified as tradable credits.[56] The baseline for credits in that program was provided by traditional technology-based standards.

- In a cap-and-trade program, a total resource access limit (the cap) is defined and then allocated among users. Compliance is established by simply comparing actual use with the assigned firm-specific cap as adjusted by any acquired or sold permits.

Establishing the baseline for credit programs in the absence of an existing permitting system can be very difficult. For example, the basic requirement in the Clean Development Mechanism component of the Kyoto Protocol is "additionality." In other words, the traded reductions must be surplus to what would have been done otherwise. Deciding

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55. Pederson, *supra* note 3; Juan-Pablo Montero, *Permits, Standards, and Technology Innovation*, 44 J. ENVTL. ECON. & MGMT. 23 (2002); Hartridge, *supra* note 46.

56. THOMAS H. TIETENBERG, RESOURCES FOR THE FUTURE, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY (1985).

whether created entitlements are "surplus" requires the existence of a baseline against which the reductions can be measured. When emissions are reduced below this baseline, the additional reduction can be certified as surplus.

Defining procedures that assure that the baselines don't allow unjustified credits is no small task. A pilot program for Activities Implemented Jointly, which was established at the first Conference of the Parties in 1995, is useful for demonstrating the difficulties of assuring "additionality." Results under this program indicate that requiring a showing of additionality can impose very high transaction costs, as well as introduce considerable *ex ante* uncertainty about the actual reductions that could be achieved.[57]

Many credit-based programs keep a large element of the previous regulatory structure in place. For example, some programs require regulatory pre-approval for all transfers (e.g. wetlands credits and water trading). In addition, other specific design features (such as the opt-in in the sulfur allowance program[58] and the use of relative targets in the UK Emissions Trading System[59] also add administrative complexity.

Theory would lead us to believe that allowance systems would be much more likely to achieve the efficiency and environmental goals than credit programs and the evidence emerging from *ex post* evaluations seems to support that conclusion.[60] This is of considerable potential importance in climate change policy since only one of the three Kyoto programs (Emissions Trading) is a cap-and-trade program.

2. The Legal Nature of the Entitlement

Although the popular literature frequently refers to the tradable permit approach as "privatizing the resource,"[61] in most cases it doesn't actually do that. Rather, it privatizes the right to access the resource to a pre-specified degree.

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57. Henning Rentz, *From Joint Implementation to a System of Tradeable CO_2 Emission Entitlements*, 8 INT'L ENVTL. AFF. 267 (1996); Henning Rentz, *Joint Implementation and the Question Of 'Additionality'—A Proposal For A Pragmatic Approach To Identify Possible Joint Implementation Projects*, 26 ENERGY POL'Y 275 (1998); Catrinus J. Jepma, *The EU Emissions Trading Scheme (ETS): How linked to JI/CDM?*, 3 CLIMATE POL'Y 89 (2003).

58. Ellerman, *supra* note 35.

59. Hartridge, *supra* note 46.

60. Leonard Shabman et al., *Trading Programs for Environmental Management: Reflections on the Air and Water Experiences*, 4 ENVTL. PRAC. 153 (2002).

61. NICOLAS SPULBER & ASGHAR SABBAGHI, ECONOMICS OF WATER RESOURCES: FROM REGULATION TO PRIVATIZATION (1993); Lee G. Anderson, *Privatizing Open Access Fisheries: Individual Transferable Quotas*, *in* THE HANDBOOK OF ENVIRONMENTAL ECONOMICS 453 (D. W. Bromley ed. 1995).

Economists have consistently argued that tradable permits should be treated as secure property rights to protect the incentive to invest in the resource. Confiscation of rights or simply insecure rights could undermine the entire process.

The environmental community, on the other hand, has just as consistently argued that the air, water, and fish belong to the people and, as a matter of ethics, should not become private property.[62] In this view, no end could justify the transfer of a community right into a private one.[63]

The practical resolution of this conflict in most U.S. tradable permit settings has been to attempt to give "adequate" (as opposed to complete) security to the permit holders, while making it clear that permits are not property rights.[64] For example, the section of the Clean Air Act which deals with the sulfur allowance program provides:

> "An allowance under this title is a limited authorization to emit sulfur dioxide. . . . Such allowance does not constitute a property right.[65]

In practice, this means that although administrators are expected to refrain from arbitrarily confiscating rights (as sometimes happened with banked credits in the early U.S. Emissions Trading program), they do not give up their ability to adopt a more stringent cap as the need arises. In particular, administrators would not be required to pay compensation for withdrawing a portion of the authorization to emit as they would if allowances were accorded a full property right status. It is a somewhat uneasy compromise, but it seems to have worked.

3. Adaptive Management

One of the initial fears about tradable permit systems was that they would be excessively rigid, particularly in light of the need to provide adequate security to permit holders. Policy rigidity was seen as possibly preventing the system from responding either to changes in the resource base or to better information. This rigidity could be particularly damaging in biological systems by undermining their resilience. Resilient systems are those that can adapt to changing circumstances.[66]

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62. STEVEN KELMAN, WHAT PRICE INCENTIVES? ECONOMISTS AND THE ENVIRONMENT (1981).

63. BONNIE J. MCCAY, OYSTER WARS AND THE PUBLIC TRUST: PROPERTY, LAW AND ECOLOGY IN NEW JERSEY HISTORY (1998).

64. One prominent exception is the New Zealand ITQ system. It grants full property rights in perpetuity. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

65. 42 U.S.C. § 7651b(f) (2005).

66. C. S. HOLLINGS, ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT

Existing tradable permit systems have responded to this challenge in different ways depending on the type of resource being covered. In air pollution control, the need for adaptive management is typically less immediate and the right is typically defined in terms of tons of emissions. In biological systems, such as fisheries, the rights are typically defined as a share of the TAC. In this way, resource managers can change the TAC in response to changing biological conditions without triggering legal recourse by the right holder. Some fisheries and water allocation systems have actually defined two related rights.[67] The first conveys the share of the cap, while the second conveys the right to withdraw a specified amount in a particular year. Separating the two rights allows a user to sell the current access right (perhaps due to an illness or malfunctioning equipment) without giving up the right of future access embodied in the share right. Though share rights have not been used in air pollution control, they have been proposed.[68]

Water has a different kind of adaptive management need. Considerable uncertainty among users is created by the fact that the amount of water can vary significantly from year to year, implying that caps are likely to vary from year to year. Since different users have quite different capacities for responding to shortfalls, the system for allocating this water needs to be flexible enough to respond to this variability or the water could be seriously misallocated.

These needs have been met by a combination of technological solutions (principally water storage) and building some flexibility into the rights system. In the American west, the appropriation doctrine that originated in the mining camps created a system of priorities based upon the date of first use. The more senior rights have a higher priority of claim on the available water in any particular year and consequently could be expected to claim the highest price.[69] Other systems, most notably in Australia, use a system of proportionality that resembles the share system in fisheries.[70]

(1978).

67. Michael D. Young, *The Design of Fishing-right Systems - the NSW Experience*, 31 ECOLOGICAL ECON. 305 (1999); Young, *supra* note 30.

68. R. Andrew Muller, *Emissions Trading with Shares and Coupons—A Laboratory Experiment*, 15 ENERGY J. 185 (1994).

69. In the western U.S., the number of rights expected to be fulfilled in any given year is determined by snowpack measurements and satellite monitoring of streamflows. Charles W. Howe & Dwight R. Lee, *Priority Pollution Rights: Adapting Pollution Control to a Variable Environment*, 59 LAND ECON. 141 (1983); Marie L. Livingston, *Institutional Requisites for Efficient Water Markets*, *in* MARKETS OF WATER: POTENTIAL AND PERFORMANCE 19 (K. William Easter et al., eds., 1998).

70. Livingston, *supra* note 69.

4. Caps and Safety Valves

Even if the apparent "schedule" of targets is equivalent to those under direct regulation—in the face of "shocks"—a cap may be binding in a way that is not the case for other policies such as environmental taxation. This has been particularly true in RECLAIM,[71] the Australian water case[72] and New Zealand fisheries.[73]

The experience with the price shocks in the RECLAIM case shows how to handle unexpected, and sometimes rather large, changes in circumstances that can cause the cost of achieving the cap to skyrocket. The general prescription is to allow a "safety valve" in the form of a predefined penalty that can be imposed on all emissions over the cap in lieu of meeting the cap. This penalty can be different from the normal sanction imposed for noncompliance during more normal situations. In effect, this penalty would set a maximum price that would be incurred in pursuit of environmental goals in unusually trying times.[74] RECLAIM rules specified that if permit prices went over an established threshold, the program would be suspended until a solution was determined. An alternative (substantial) fee per ton was imposed in the interim with the revenue used to subsidize additional alternative emission reductions.[75]

5. Initial Allocation Method

The initial allocation of entitlements is perhaps the most controversial aspect of a tradable permits system.[76] Four possible methods for allocating initial entitlements are:

- Random access (lotteries)
- First-come, first serve
- Administrative rules based upon eligibility criteria

71. RECLAIM participants experienced a very large unanticipated demand for power that could only be accommodated by older, more polluting plants. Permit prices soared in a way that was never anticipated. Harrison, *supra* note 2.

72. In the Australian water case excessive withdrawal would trigger substantial increases in salinity. Young, *supra* note 30.

73. In the New Zealand fisheries case, a lack of understanding of the biology of the orange roughy led to a cap that permitted unsustainable harvests. Suzi Kerr, *Evaluation of the Cost Effectiveness of the New Zealand Individual Transferable Quota Fisheries Market*, *in* TRADABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM 121 (OECD ed., 2004).

74. Marc J. Roberts & Michael Spence, *Effluent Charges and Licenses Under Uncertainty*, 5 J. PUB. ECON. 193 (1976); Harrison, *supra* note 2; WILLIAM PIZER, RESOURCES FOR THE FUTURE, CHOOSING PRICE OR QUANTITY CONTROLS FOR GREENHOUSE GASES (Climate Issues Brief 17, 1999).

75. Harrison, *supra* note 2.

76. RAYMOND, *supra* note 7.

- Auctions

All four of these have been used in one context or another. Both lotteries and auctions are frequently used in allocating hunting permits for big game. Lotteries are more common in allocating permits among residents while auctions are more common for allocating permits to non-residents. The first-come, first-serve approach was historically common for water usage, especially when water was abundant.

Though an infinite number of possible distribution rules exist, rules that pay some attention to prior use tend to predominate. Under virtually all implemented tradable permit programs discussed in this article, existing sources get free allocations of rights rather than having to pay for them as in an auction. Existing sources only have to purchase additional permits they may need over and above their initial allocation (as opposed to purchasing *all* permits in an auction market).

Free distribution has its advantages and disadvantages. Recent work examining how the presence of preexisting distortions in the tax system affects the efficiency of the chosen instrument suggests that the ability to recycle the revenue from the sale of these permits (rather than give it to users) can enhance the efficiency of the system by a large amount. That work, of course, supports the use of taxes or auctioned permits rather than free distribution.[77]

How revenues are distributed, however, also affects the attractiveness of alternative approaches to environmental protection from the point of view of the various stakeholders.

- To the extent that stakeholders can influence policy choice, using free distribution in general and prior use in particular as allocation criteria may have increased the feasibility of implementation of transferable permit systems.[78] Interestingly, the empirical evidence suggests that the amount of revenue needed to hold users harmless during the change is only a fraction of the total revenue available from auctioning.[79] Allocating all permits free of charge is therefore not inevitable in principle, even if political feasibility considerations affect the design.

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77. Lawrence H. Goulder, *The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting*, 72 J. PUB. ECON. 329 (1999).

78. Gert T. Svendsen, *Interest Groups Prefer Emission Trading: A New Perspective*, 101 PUB. CHOICE 109 (1999); RAYMOND, *supra* note 7.

79. A. Lans Bovenberg & Lawrence H. Goulder, *Neutralizing Adverse Impacts of 2000 CO_2 Abatement Policies: What Does it Cost?*, *in* BEHAVIORAL & DISTRIBUTIONAL EFFECTS OF ENVIRONMENTAL POLICY (2000).

- Although reserving some free permits for new firms is possible, this option is rarely exercised in practice. As a result, under the free distribution scheme, new firms typically have to purchase all permits, while existing firms get an initial allocation free. Thus, the free distribution system imposes a bias against new users in the sense that their financial burden is greater than that of an otherwise identical existing user. In air pollution control, this "new user" bias has retarded the introduction of new facilities and new technologies by reducing the cost advantage of building new facilities that embody the latest innovations.[80]

- Basing the initial allocation on prior use may promote inefficient strategic behavior. When the initial allocation is based upon historic use, and users are aware of this aspect in advance, an incentive to inflate historic use (to qualify for a larger initial allocation) is created.[81] This strategic behavior can intensify the degradation of the resource before the control mechanism is set in place.

- Finally, Raymond's detailed review of the initial allocation processes for three major tradable permit programs concludes not only that equity norms play a large role in crafting the initial allocation in these three cases, but also that applying these norms is much more complicated than simply relying upon prior use.[82] His analysis suggests that in terms of prevailing equity norms, auctions may have a tough time gaining a foothold in initial allocations despite their attractiveness from an efficiency point of view.[83]

Compromises designed to gain political feasibility within the system may also affect the level of the cap, at least initially. Some tendency to over allocate quota in the initial years has been evident.

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80. The "new source bias" is, of course, not unique to tradable permit systems. It applies to any system of regulation that imposes more stringent requirements on new sources than existing ones. Michael T. Maloney & Gordon L. Brady, *Capital Turnover and Marketable Property Rights*, 31 J.L. & ECON. 203 (1998); Randy A. Nelson et al., *Differential Environmental Regulation: Effects On Electric Utility Capital Turnover and Emissions*, 75 REV. ECON. & STAT. 368 (1993).

81. Harald Bergland et al., *Rent Seeking and the Regulation of a Natural Resource*, 16 MARINE RESOURCE ECON. 219 (2001).

82. RAYMOND, *supra* note 7.

83. *Id.*

- The evaluation of the Dutch phosphate quota program, for example, shows that initial quota was over-allocated 10 to 25%.[84]

- Initial allocations were also inflated in the initial years of the RECLAIM program.[85]

In the climate change case, a primary concern has been about "hot air."[86] (Hot air is the part of an Annex I country's assigned amount of CO_2 that is likely to be surplus to its needs without any additional efforts to reduce emissions). Hot air resulted from the initial allocation under the Kyoto Protocol because assigned amounts are defined in terms of 1990 emission levels and for some countries (most notably Russia and the Ukraine) economic contraction has resulted in substantially lower emissions levels. Hence, these countries would have surplus permits to sell, resulting in the need for less emission reduction.

Other initial allocation issues involve determining both the eligibility to receive permits and the governance process for deciding the proper allocation. In fisheries, for example, the decision to allocate permits to boat owners has triggered harsh reactions among both crew and processors.

Finally, some systems allow agents other than those included in the initial allocation to participate through "substitution" or "opt-in" procedures. This is a prominent feature of the sulfur allowance program, but it can be plagued by adverse selection problems.[87]

Traditional theory suggests that tradable permits offer a costless trade-off between efficiency and equity, since, regardless of the initial allocation, the ability to trade assures that permits flow to their highest valued uses. This implies that the initial allocation can be used to pursue fairness goals without lowering the value of the resource.

In practice implementation considerations must deal with a host of competing demands, including fairness, political feasibility, strategic considerations, and concern over allowing the entrance of new firms. The failure of initial allocations to completely respond to equity concerns

84. Wossink, *supra* note 6.

85. Harrison, *supra* note 2.

86. Michael G. J. Den Elzen & Andre P. G. deMoor, *Analyzing the Kyoto Protocol under the Marrakesh Accords: Economic Efficiency and Environmental Effectiveness*, 43 ECOLOGICAL ECON. 141 (2002).

87. Juan-Pablo Montero, *Voluntary Compliance with Market-Based Environmental Policy: Evidence from the U.S. Acid Rain Program*, 107 J. POL. ECON. 998 (1999); Juan-Pablo Montero, *A Market-Based Environmental Policy Experiment in Chile* (Ctr. For Energy & Envtl. Policy Research, Working Paper MIT-CEEPR 2000-005, August 2000).

has caused the introduction of other means to protect equity considerations (such as restrictions of transfers). These additional restrictions tend to raise transaction costs and to limit the cost-effectiveness of the program.

6. Transferability Rules

While the largest source of controversy about tradable permits seems to attach to the manner in how permits are initially allocated, another significant source of controversy is attached to the rules that govern transferability. According to supporters, transferability not only serves to assure that rights flow to their highest valued use, but it also provides a user-financed form of compensation for those who voluntarily decide to no longer use the resource. Therefore, restrictions on transferability only serve to reduce the efficiency of the system. According to critics, allowing rights to be transferable produces a number of socially unacceptable outcomes including the concentration of rights, the destruction of community interests and the degradation of the environment.

Making the rights transferable does allow the opportunity for some groups to accumulate permits. The concentration of permits in the hands of a few could either reduce the efficiency of the tradable permits system[88] or it could be used as leverage to gain economic power in other markets.[89] Although it has not played much of a role in air pollution control, concentration has been a concern, if not a major issue, in fisheries.[90]

Typically, the problem in fisheries is not that the concentration is so high that it triggers antitrust concerns,[91] but rather that it allows small fishing enterprises to be bought out by larger fishing enterprises. Some observers see smaller fishing enterprises as having a special value to society that should be protected.[92]

Protections against "unreasonable" concentration of quota are now

88. Robert W. Hahn, *Market Power and Transferable Property Rights*, 99 Q. J. ECON. 753 (1984); Lee G. Anderson, *A Note on Market Power in ITQ Fisheries*, 21 J. ENVTL. ECON. & MGMT. 291 (1991); Henry Van Egteren & Marian Weber, *Marketable Permits, Market Power and Cheating*, 30 J. ENVTL. ECON. & MGMT. 161 (1996).

89. Walter S. Misiolek & Harold W. Elder, *Exclusionary Manipulation of Markets for Pollution Rights*, 16 J. ENVTL. ECON. & MGMT. 156 (1989); E. S. Sartzetakis, *Raising Rivals' Costs Strategies via Emission Permits Markets*, 12 REV. INDUS. ORG. 751 (1997).

90. Gisli Palsson & Agnar Helgason, *Figuring Fish and Measuring Men: The Individual Transferable Quota System in Icelandic Cod Fishery*, 28 OCEAN & COASTAL MGMT. 117 (1995).

91. Adesoji Adelaja et al., *Market Power, Industrial Organization and Tradeable Quotas*, 13 REV. INDUS. ORG. 589 (1998).

92. Palsson, *supra* note 44.

common. One typical strategy involves putting a limit on the amount of quota that can be accumulated by any one holder. In New Zealand fisheries, for example, these range from 20% to 35% depending upon the species,[93] while in Iceland, the limits are 10% for cod and 20% for other species.[94]

Another coping strategy, one that attempts to resolve market power problems without restricting transfers, focuses on trying to mitigate the potential anticompetitive effects of hoarding. The U.S. sulfur allowance does this in two main ways. First, it sets aside a supply of allowances that could be sold at a predetermined (high) price if hoarders refused to sell to new entrants.[95] Second, it introduced a zero-revenue auction that, among other features, requires permit holders to put approximately 3% of their allowances up for sale in a public auction once a year. The revenue is returned to the sellers rather than retained by the government—hence the name "zero-revenue auction."[96]

Another quite different approach involves directly restricting transfers that are perceived to violate the public interest. In the Alaskan halibut and sablefish ITQ program, for example, several size categories of vessels were defined. The initial allocation was based upon the catch record within each vessel class and transfer of quota between catcher vessel classes was prohibited.[97] Further restrictions required the owner of the quota to be on board when the catch was landed. This represented an attempt to prevent the transfer of ownership of the harvest rights to "absentee landlords."

A rather different transferability concern relates to the potentially adverse economic impacts of permit transfers on some communities. Holders who transfer permits will not necessarily consider the interests of communities that have depended on their commerce in the past. For example, in fisheries, a transfer from one quota holder to another might well cause the fish to be landed in a different community. In air pollution control, owners of a factory might shut down its operation in one community and rebuild in another, taking their permits with them.

One common response to this problem in fisheries involves

93. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

94. *Id.*

95. This set aside has not been used because sufficient allowances have been available through normal channels. That doesn't necessarily mean the set-aside was not useful, however, because it may have alleviated concerns that could have otherwise blocked the implementation of the program.

96. Gert T. Svendsen & Jan L. Christensen, *The US SO_2 Auction: Analysis and Generalization*, 21 ENERGY ECON. 403 (1999).

97. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

allocating quotas directly to communities. The 1992 Bering Sea Community Development Quota Program, which was designed to benefit remote villages containing significant native populations in Alaska, allocated 7.5% of the walleye pollock quota to these communities.[98] In New Zealand, the Treaty of Waitangi (Fisheries Claims) Settlement Act of 1992 effectively transferred ownership of almost 40% of the New Zealand ITQ to the Maori people.[99] For these allocations, the community retains control over the transfers and this control gives it the power to protect community interests. In Iceland, this kind of control is gained through a provision that if a quota is to be leased or sold to a vessel operating in a different place, the assent of the municipal government and the local fishermen's union must be acquired.[100]

A final concern with transferability relates to possible external effects of the transfer. Economic theory presumes that the commodity being traded is homogeneous. With homogeneity, transfers increase net benefits by allowing permits to flow to their highest valued use. In practice, without homogeneity, transfers can confer external benefits or costs on third parties, resulting in allocations that do not maximize net benefits.

When the location of the resource use matters, spatial issues can arise because the transfer could alter the location of use.[101] Spatial issues can be dealt with within the tradable permit scheme, but those choices typically make transfers more difficult. Both RECLAIM and the Netherlands' Nutrient Quota programs place restrictions on the spatial area within which the permits may be traded.[102] The U.S. Wetlands program requires regulatory pre-approval of trades in part to control potentially harmful spatial aspects of trades. In the sulfur allowance program,[103] no regulatory restrictions are placed on permit trades, but permit users do have to assure that any permit use does not result in a violation of the National Ambient Air Quality Standards.

7. The Temporal Dimension

Standard cost-effectiveness theory suggests that a cost-minimizing

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98. Jay J. C. Ginter, *The Alaska Community Development Quota Fisheries Management Program*, 28 OCEAN & COASTAL MGMT. 147 (1995).

99. J. H. Annala, *New Zealand's ITQ System: Have the First Eight Years Been a Success or a Failure?*, 6 REV. FISH BIOLOGY & FISHERIES 43 (1996).

100. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

101. Thomas H. Tietenberg, *Tradeable Permits for Pollution Control When Emission Location Matters: What Have We Learned?*, 5 ENVTL. & RESOURCE ECON. 95 (1995).

102. *See* Harrison, *supra* note 2; Wossink, *supra* note 6.

103. Ellerman, *supra* note 35.

tradable permit system must have full temporal fungibility, implying that allowances can be both borrowed and banked.[104] Banking allows a user to store its permits for future use. Borrowing allows a permit holder to use permits earlier than their stipulated date.

Tradable permit schemes differ considerably in how they treat banking and/or the role of forward markets. The author is unaware of any existing system that is fully temporally fungible. Older pollution control programs have had a more limited approach. The Emissions Trading Program allowed banking, but not borrowing. The Lead Phase Out Program originally allowed neither, but eventually permitted banking. The sulfur allowance program has banking, but not borrowing, and RECLAIM has an overlapping time frame for compliance that is equivalent to a highly restricted banking and borrowing system.

How important is temporal flexibility? The message that emerges from this review is that this temporal flexibility can be quite important. Ellerman discusses the considerable role that both banking and forward markets have played in the U.S. sulfur allowance program.[105] Harrison reports that during the tremendous pressure placed on the market by the power problems in California, even the limited temporal flexibility in RECLAIM allowed the excess emissions to be reduced by more than a factor of three—from about 19 % to 6%.[106] Pedersen also notes the importance of temporal flexibility for investment in the Danish greenhouse gas program.[107]

8. Design Preconditions

This discussion of design lessons also raises the question of when tradable permits might be appropriate policy instruments and how effective permit systems might be implemented. The evidence is very persuasive that tradable permit systems have worked extremely well in many circumstances, but it is equally clear that the success of tradable permit systems seems to rest on certain preconditions.

Some preconditions suggested by this review include:

- either the absence of significant externalities or an ability to deal with them in system design.

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104. Jonathan D. Rubin, *A Model Of Intertemporal Emission Trading, Banking, and Borrowing*, 31 J. ENVTL. ECON. & MGMT. 269 (1996); Catherine Kling & Jonathan Rubin, *Bankable Permits for the Control of Environmental Pollution*, 64 J. PUB. ECON. 99 (1997).

105. Ellerman, *supra* note 35.

106. Harrison, *supra* note 2.

107. Pederson, *supra* note 3.

- a reasonable ability to monitor resource use (emissions or withdrawal) and an acceptable capability to enforce compliance.

- a sufficient level of information to set a politically acceptable cap.

- permit holders who are sufficiently knowledgeable about the system and the menu of choices to use it effectively.

- a sufficient number of participants to make an active market.

The degree to which each of these preconditions is met is, of course, a continuous variable. Nonetheless isolating these conditions sets the stage for thinking about defining the appropriate niche for tradable permit systems.

B. Lessons About Program Effectiveness

How well have tradable permits performed? The evidence has been mixed. In certain applications, such as the sulfur allowance program and several of the fisheries, tradable permits have lived up to the high expectations of the theory. They have produced both lower costs and better environmental quality. In other areas, such as wetlands banking, they have neither lowered costs nor provided improved environmental quality.

The air pollution programs, on balance, seem to be the most successful in achieving both economic and environmental objectives. In part, this seems to be due to the presence of fewer (though certainly not zero) externalities in these programs. Fisheries must cope with potentially severe bycatch problems in multispecies fisheries. And water control authorities must cope with the consequences of trades on downstream users. Small-scale, complex resources with multiple externalities may be better managed by cooperative arrangements than by tradable permits.

In retrospect, through they have generally represented an improvement, actual permit markets generally fail to meet the expectations created by theory and by *ex ante* simulations for two reasons: (1) the theory, which we use to define desirable outcomes, fails to incorporate all of the practical impediments of actual permit trading programs, and (2) the bureaucracy is, on occasion, forced to make compromises in order to gain support for the program. It is important to keep these two sources of imperfection separate because they imply rather different things. The former implies that the estimated cost savings are unrealistic because they are naive. The latter implies either that potential cost savings are being intentionally passed up in a quest for other goals or unintentionally passed up due to ignorance. Bureaucratic deviations are a particularly fruitful area for close scrutiny since they offer the possibility for further cost savings.

The academic community has emphasized the importance of co-management of environmental resources with users having a substantial role.[108] Although tradable permit systems in principle allow a variety of governance systems, only in fisheries and water is there any evidence of an evolution in this direction. The current predominant form in both air pollution control and fisheries seems to be a system of shared management with users playing a smaller role than envisioned by most co-management proposals. For those resource regimes located in the United States, it is common for the goals to be set at the national level and considerable "top-down" management to be in evidence. The management of water resources seems closest to user-controlled co-management schemes. In those systems, the rights markets tend to be at the "informal" end of the spectrum.

It should not be surprising that although tradable permit systems potentially allow for a considerable role for users, a nontrivial co-management role exists only in fisheries and water. The pollution and natural resource cases exhibit an important asymmetry. For air pollution control, the benefits from resource protection fall on the victims of air pollution, not on the polluters who use the resource. From a purely self-interest point of view, resource users (polluters) would be quite happy to pollute the air if they could get away with it. On the other hand, water users and fishers can both benefit from protection of the resource. Their collective self-interest is compatible with resource protection. This suggests that the incentives for collective action should be quite different in these two cases and this difference could well explain the lower propensity for collective self-governance in the case of air pollution.

A main element of controversy in tradable permits systems involves both the processes for deciding the initial allocation and the initial allocation itself. These problems seem least intense for air pollution and most intense for fisheries. Though a rich set of management and initial allocation options exists, current experience seems not to have been very creative in their use.

Tradable permit programs are sometimes held to be a relatively rigid approach to resource management. This expectation is based upon the belief that, once they are instituted, property rights become

108. ELINOR OSTROM ET AL., THE DRAMA OF THE COMMONS (2002).

institutionalized and therefore impervious to change. In fact implemented tradable permit programs have exhibited a considerable amount of flexibility and evolution over time. A variety of new design features (such as zero revenue auctions),[109] bycatch quotas,[110] and drop-through mechanisms[111] have emerged that are tailored to the characteristics of particular resources.

Until recently it appeared that emissions trading was introduced only after more familiar systems had been tried and proved inadequate. It now appears that the introduction of new permit trading programs has become easier as experience is gained from implemented programs such as the sulfur allowance and lead phase-out programs, as well as the many operating programs in fisheries.

To date, at least using a free distribution of permits (as opposed to auctioning them off) seems to have been a key ingredient in the successful implementation of emissions trading programs.

It seems at best an oversimplification for conventional wisdom to hold that emissions trading affects costs, but not environmental quality. In retrospect we now know that the feasibility, level, and enforcement of that limit can be affected by the introduction of permit trading. In addition, permit trading may trigger environmental effects that are not covered by the limit.

Credit programs seem to be characterized by more transactions costs and more administrative costs than cap-and-trade programs. Other program design features can also influence both administrative and transactions costs. Transactions costs can be lowered by making transactions and prices transparent, while administrative costs can be lowered by continuous emissions monitoring and by the use of software that streamlines monitoring and reporting.

Regulators, environmental managers, and resource users have experienced considerable "learning by doing" effects with the result that tradable permit markets tend to operate much more smoothly after they have been in existence awhile.

The literature contains some support for the fact that permit trading encourages both emission reducing innovation and the adoption of newly available emission-reducing technologies, but available evidence is too sparse to draw firm conclusions.

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109. Svendsen & Christensen, *supra* note 96.

110. NAT'L RESEARCH COUNCIL COMM. TO REVIEW INDIVIDUAL FISHING QUOTAS, SHARING THE FISH: TOWARD A NATIONAL POLICY ON FISHING QUOTAS (1999).

111. Young, *supra* note 67.

C. *Lessons for Theory-Based Expectations*

Theory creates expectations, and in the case of tradable permits, the expectations have been high, sometimes unreasonably high. Several assumptions behind the theory may be violated in practice.

One case in point is the assumption that the tradable commodity is homogeneous. In many applications the tradable commodity is clearly not homogenous. The location or timing of permit use may matter as might the extraction or emission methods used by the permit holder. The impact of the non-homogeneity is intensified when the associated environmental benefits or damages are external to the users. In this case, permit holders who use or trade permits cannot be expected to maximize society's net benefits when they maximize their own.

Another aspect of tradable permit systems that seems to have been under appreciated is endogeneity. The choice of a policy instrument can affect aspects of implementation that are frequently considered exogenous, but which in fact are not. These include the targeted degree of control, the feasibility of implementation, the likelihood of compliance, the form and intensity of monitoring and enforcement, as well as the degree of technical change.

The role equity plays in the design of operating tradable permit systems has been more important than typically believed.[112] Analysis that assumes that fairness is either completely handled by the initial allocation or has no analytical importance may miss a comparative, material aspect of policy instrument choice. Theory tells us that a cost-effective allocation will ultimately be achieved regardless of the initial allocation of permits. In principle, this allows equity goals to be pursued via the initial allocation and cost-effectiveness goals to be handled by transfers. In practice, initial allocations are frequently either used to improve feasibility (thereby reducing or eliminating their ability to address fairness issues) or they prove inadequate in addressing equity concerns (especially when equity concerns arise from transfers). Responding to fairness concerns about transfers frequently involves placing restrictions on them, restrictions that reduce the cost-effectiveness of the system.

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112. Thomas H. Tietenberg, *Ethical Influences on the Evolution of the U.S. Tradeable Permit Approach to Pollution Control*, 24 ECOLOGICAL ECON. 241 (1998); RAYMOND, *supra* note 7.

Permit markets certainly have achieved a large and growing niche in the collection of favored policies to control access to the commons. This review of the evidence suggests that is appropriate, but it also suggests that resource context and program design not only matter, they matter a lot.