"Water Quality Trading in the Presence of Discrete Abatement Costs: An Experimental Analysis of Contract Length and the Timing of Investment"

Luke Jones and Christian Vossler

Department of Economics, 505A Stokely Management Center, University of Tennessee, Knoxville, TN 37996

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This paper uses laboratory experiments to investigate institutional features of point-source to point-source water quality trading (WQT) markets. The experimental design focuses on the contract length of permit trades, the timing of abatement investment decisions, the structure of abatement costs, and the way that these features affect trade volume and efficiency. The findings from these experiments are the material to be presented at the 2010 AAEA Joint Annual Meeting. The results from these experiments inform the discussion on why WQT to date has failed to produce the anticipated level of trading activity, and come at a time when WQT initiatives are being increasingly implemented and supported throughout the U.S.

Having observed the success of the U.S. sulfur dioxide trading program, policymakers have endorsed water quality trading (WQT) in hopes of cost-effectively meeting water pollution reduction targets. In 1996, the U.S. Environmental Protection Agency (EPA) set forth basic guidelines for WQT in the Draft Framework for Watershed-Based Trading (U.S. EPA, 1996) and in 2003 issued its final policy on WQT under the Clean Water Act (U.S. EPA, 2003). The EPA has published numerous training, instructional, and evaluative materials for WQT (U.S. EPA, 1998, 2004, 2007, 2008). For almost 7 years the EPA has funded market-based water quality projects through the Targeted Watersheds Grant Program, including allocating up to $3.7 million to WQT in 2008 (U.S. EPA, 2009a, 2009b). After more than a decade of EPA support, the number of WQT initiatives in the U.S. is increasing substantially, but the majority of these initiatives are still realizing only a limited number of trades. A 2004 report identified more than 70 WQT programs in some phase of development throughout the U.S., about twice as many as there were in 1999 (Breetz, et al., 2004; Environomics, 1999). Yet according to a recent EPA evaluation only 100 facilities have engaged in trade (U.S. EPA, 2009). It is well known that WQT in the U.S. has been mostly unsuccessful, leading numerous authors to speculate as to why trades are not occurring (Boisvert, Poe, & Sado, 2007; Farrow, Schultz, Celikkol, & Van Houtven, 2005; Hoag & Hughes-Popp, 1997; King, 2005; King & Kuch, 2003; Sado, Boisvert, & Poe, Forthcoming)

One of the postulated reasons for the lack of trade is the non-marginal nature of abatement costs that are present in many applications of WQT. As discussed by Sado et al. (Forthcoming), Caplan (2008), Boisvert et al. (2007), and the EPA (1996), the abatement options available to sources of water pollution are often restricted to large investments associated with significant increases in abatement capabilities. Furthermore, these investments are often irreversible over a short time frame. Boisvert et al. (2007) and Sado et al. (Forthcoming) argue that these circumstances may impinge on the flow of trade in markets with few buyers and sellers such as the markets present in many watersheds. Their logic is that firms that invest in abatement technology lack confidence that there will be sufficient demand for their excess permits. Likewise, firms that forgo investment have no assurance that there will be a sufficient supply of permits for them to meet their abatement allocations.

Boisvert et al. (2007) suggest that such settings may favor multi-period permit trading contracts as opposed single-period contracts. Furthermore, the present authors hypothesize that the timing of abatement investment decisions is critical in the presence of non-marginal abatement costs. That is, whether abatement investment decisions are made before or after the negotiation of permit trading contracts will have an effect on those investments and the volume of trade. It remains an open question as to how non-marginal abatement costs actually affect the outcome of permit trade in practice, and to what extent contract length and timing alter this outcome. An experimental investigation is conducted to test the influence of non-marginal abatement costs on the volume of trade and the efficiency of the permit trading system, and to inform the structuring of contract length and timing in WQT markets.

Although the experimental literature on emission permit trading is vast (see (Bohm, 2003; Muller & Mestelman, 1998) for reviews), the majority of these experiments are designed with a focus on the SO2 market. Few experiments have isolated the unique features of WQT markets, and the authors are aware of no permit trading experiments that have attempted to capture discrete abatement investments, contract length and timing. To address these issues, we design an experiment loosely following the experimental setting of Ben-David, Brookshire, Burness, McKee, & Schmidt (1999). Subjects are given an endowment and an allocation of permits at the beginning of each period. In the baseline seting, subjects first trade perimts by negotating one-period contracts through a bilateral trading institution, and then make abatement investment decisions. Subjects may not make abatement decisions that are non-compliant: the smallest amount of abatement that a subject may undertake is that which meets the abatement requirement, given permit holdings. At the end of each period, subjects receive a payoff equal to their endowment plus the gains from trade less abatement costs. The decision to implement a bilateral trading instiution is motivated by observations in the literature. Boisvert et al. (2007) suggest that settings with non-marginal abatement costs may benefit from bilateral negotiations as opposed to open market exchange. In a separate analysis Sado et al. (Forthcoming) corroborate this suggestion with simulations of phosphorus emissions trading in the non-tidal Passaic River Watershed. Woodward and Kaiser similarly note that bilateral negotiations have characterized most WQT markets to date and that they expect this to continue (2002). The experiment implements three treatment variables following a 2x2x2 design: 1) The timing of the abatement investment decision indicates whether the abatement decision occurs before or after the negotiation of contracts; 2) The contract length is effective for either one or two periods; 3) The abatement cost structure is either continuous or discrete.

This research should appeal to those working in the area of water quality management as well as those interested in trading experiments, and the authors believe it has the potential to generate substantial discussion at the meeting. The paper addresses an important policy question, the relevance of which is most evident in the amount of support that the EPA has devoted to WQT over the past ten years and the subsequent flourish of speculation over its failure in practice. The reasons why WQT programs are not working remain unknown. This paper is the first to systematically address the issues of non-marginal abatement costs, contract length and contract timing, features that are hypothesized to be key elements in WQT and potentially contribute to its success or failure in practice.

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