

## Introduction to special section on Water Markets and Banking: Institutional Evolution and Empirical Perspectives

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[1] This special section on Water Markets and Banking: Institutional Evolution and Empirical Perspectives presents various economic approaches and legal and institutional discussions to better understand the issues surrounding the allocation of water. The interest in water markets and water banking stems from the growing recognition that demand for water is outstripping its availability worldwide. Novel and innovative adaptation strategies for decision making are needed to address increasing scarcity in the face of climate change, drought, and continuing population growth. One set of adaptive strategies being explored consists of market-type allocation institutions, but how do we design these institutions within the variety of legal settings that exist around the world and how well do alternative market structures and arrangements function? The first three papers in this special section present case studies using alternative economic methodologies to understand the operation of water marketing and banking in Australia, the United States, and South Africa. Other authors present an analysis of prices observed for water trades in the southwest region of the United States to explore how market prices convey information about the operation of the institution itself. By looking at the experience in the Chilean water markets, another paper focuses not on the history of prices but on a wide-ranging and qualitative assessment of the success of the market institution. In another paper we are presented with a comparison of formal and informal water markets in Australia. Finally, two papers address legal and institutional issues in the design of water market allocation institutions.

[2] Water is scarce worldwide. This scarcity is driven by increasing world populations, cyclical drought, climate change, and rigid institutional allocation structures. It is made worse by inflexible, but historically stable, institutional structures used to allocate water. An alternative, and more flexible, set of structures can be broadly called water markets and water banks. The literature is casual in the definition of the distinctions of marketing and banking. One may think of banking as being the temporal anchored trade by some allocation mechanism and water marketing as the formal change in perpetual ownership. Both “marketing” and “banking” involve some type of exchange process between willing traders. Both markets and banks allow for the transfer of water usage, and reflect the value of the water between uses. It is because of these features that the interest

in these allocation mechanisms has grown recently. Numerous authors (who are cited in the various papers in this special section) have constructed the theoretical arguments that some type of market based trading mechanism would greatly increase the efficient use of water. The basic argument is well established: water is a natural resource with varying value in different uses and within clearly defined social and political constraints, should be encouraged to move to its highest valued use.

[3] Much of the early empirical work regarding water markets was focused on describing their nature and documenting the observed trades, for example, by counting the number of water trades or exchanges in a basin. More recently, some countries and smaller political jurisdictions have redefined the institutional structures for water allocation. This has hastened the need to understand beyond theoretical considerations how well these alternative institutions perform from an empirical standpoint and what are some of the institutional design issues that remain. The specific goal of this special section is to further this process of understanding the operation of and challenges faced by water allocation institutions around the world.

[4] There are eight papers in this special section. By employing different methodologies, all widely used in economics, applied to various countries around the world, the researchers present a wide-ranging analysis of the social, political, legal, and economic institutions that manage, administer, allocate, and adjudicate water between competing uses. Yet there emerges a common thread that places the efficient market model as the appropriate reference standard by which we can judge the performance of these institutional arrangements and suggest improvements.

[5] *Burke et al.* [2004] develop an integrated approach for water banking on the Klamath Project in south central Oregon, United States. The region is the center of an ongoing controversy that brings to the fore the increasing demand for water to restore habitat and protect endangered species. As water is shifting between uses, one outcome has been decreased water availability for traditional uses. Their approach integrates hydrologic and economic aspects, focuses on irrigators, and estimates an underlying supply curve for water. They find supply to be relatively price elastic (flat), which implies that relatively small increases in water prices brings forth quite large quantities of water for sale. In this situation, Burke et al. explore alternative market formulations for use by the U.S. Bureau of Reclamation to make price a more effective tool for allocating smaller quantities of water at the margin. They conclude that while

intraproject banking is effective, expansion to an interproject banking scheme might be appropriate.

[6] *Tisdell et al.* [2004] use economic experiments to explore the role of information in a water trading environment in Australia. Experimental settings present subjects with structured decision-making settings. This methodological approach allows for alternative treatments, hypothesis testing, and replication. In this set of experiments, participants played the role of farmers facing monthly water demand and uncertainty in rainfall and crop loss. They were allowed to trade water. The central design of the experiments allowed subjects to trade within three alternative information structures. Providing subjects with information about aggregate water use and environmental targets in a forum where players could communicate and discuss produced the greatest profit and least environmental damage. Giving information about individual water use was counterproductive, encouraging the group to set less stringent environmental targets.

[7] *Brookshire et al.* [2004] analyze the development of water rights prices in three markets (Arizona's Central Arizona Project, Colorado's Big Thompson, and New Mexico's Middle Rio Grande Conservancy District) in the semiarid southwest of the United States. Using a structural model of supply and demand for water in these markets, controlling for market-specific characteristics, the authors attempt to characterize the operation of the market through prices. This paper is an attempt to move beyond simple description of markets to identify the forces operating within those markets. While there is evidence that demand forces drive the market price, data limitations prevented the identification of the supply curve. A significant proportion of the market price remains influenced by individual basin factors such as institutional arrangements.

[8] *Nieuwoudt and Armitage* [2004] present two case studies in South Africa: the lower Orange and the uMhlatuze Rivers. The analysis focuses on demand-side response in water allocation after passage of the South African Water Act of 1998. The act sets irrigators rights as secondary to the guaranteed rights of human needs and environmental concerns. Previously, irrigator rights were riparian in nature. The authors use discriminate analysis to find that water rights move to the highest economic return in the Orange River region. The market development appears to be resulting from existing scarcity and the growing table grape industry coupled with undeveloped arable land. Nieuwoudt and Armitage offer suggestions as to how to further the market development in the region. Within the uMhlatuze River a water trading market has not developed. The authors suggest that many in this second region would like to purchase water, but no one is willing to sell, possibly stemming from high capital investments to date and high risk aversion.

[9] *Bauer* [2004] looks at the evolution of increasing understanding of the development Chilean water markets since 1990 from a qualitative and interdisciplinary stance. After the return to democracy, Chile instituted a new Water Code, with the goals of emphasizing private property rights in the agricultural sector and to promote markets for efficient allocation. This paper moves away from the past trend of looking at water allocation theoretically to provide an analysis of the performance of actual markets and the

impacts of trading. Issues associated with equity, river management, and environmental protection are discussed. Bauer finds that the impacts have been significant leading to further private investment, tighter governmental regulation of water, and that the creation of nonconsumptive use has encouraged hydroelectric power development. Chile's Water Code has not resulted in more effective water markets, and several problems remain, including continuing low irrigation efficiency, limited extension of markets, and problems with the definitions of water rights.

[10] *Bjornlund* [2004] focuses on rural communities under stress and the use of formal and informal markets to shift risk positions by irrigators. He studies the Murray-Darling River system, which supports 75% of the irrigation and provides 41% of the total gross value of agricultural production in Australia. The region is also important in supporting national parks and forests and has significant cultural, social, and environmental values. The creation of markets in the basin is viewed as being an important instrument in reversing environmental degradation. Bjornlund discusses how different jurisdictions in the basin have evolved alternative approaches to manage and allocate water. However, the findings are not unambiguously positive, as Bjornlund notes that regulations are required to avoid some negative effects produced by water markets.

[11] *Matthews* [2004] changes our focus away from the actual operation of markets and banking around the world to a discussion of the need for a well-defined property rights structure to support markets. This issue is central to our discussion in that some of the papers in this special section have noted problems with existing property rights' structures. Matthews raises 10 questions to illustrate the fundamental nature of water rights systems. These questions include what water is relevant in a rights structure, is there a clear designation of ownership and competing rights, what are the rules for establishing and transferring rights, are there operational rules for using water, is there enforcement in delivery/satisfaction of water, and is the overall system integrated? He concludes that there is a central need to standardize property rights systems and make them simpler.

[12] *McCann and Easter* [2004] continue the discussion of markets to incorporate more completely the transactions costs associated with alternative water allocation mechanisms. This paper is much needed as currently transactions costs are only included in market assessments in a very limited way, if at all. This paper also relates directly to the earlier papers looking at fundamental changes in water allocation rules in Australia, Chile, and South Africa. McCann and Easter identify the costs of gathering information, enacting water market policy, and designing and setting up the actual markets. McCann and Easter present a taxonomy of types of transactions costs that should be considered and identify various types of settings for a water market that will yield different levels of transactions cost. They call for a well-documented study of transactions cost.

[13] The eight papers in this special section exemplify and illustrate the variety of economic approaches available to the researcher to analyze water markets and water banking. These include experimental methods, simulation, and statistical analysis. Further, the empirical work presented provides ample evidence that the design and implementation of markets to allocate water is still in its infancy,

despite the strong theoretical identification of the private and social benefits created by those markets. These papers also highlight the fact that no water market can succeed without paying close attention to the regulatory and legal frameworks within which it exists.

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