



A TRANSACTIONS COST APPROACH TO THE THEORETICAL FOUNDATIONS OF WATER MARKETS¹

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ABSTRACT: Water marketing is often cited as a means of alleviating the stresses attached to allocation of water use. Frequently, marketing is suggested in a context that implies substitution of competitive markets for the allocation based on the prior appropriation doctrine. This study examines water marketing from the perspective of a transactions cost approach to the private and broad social agreements (contracts) that support water allocation. It examines the major behavioral challenges faced by any contract, and the alternative approaches to those challenges, with respect to water allocation. It also examines the impact of market design on the existence of externalities, costs imposed by transactions on society and individuals not party to the transaction. It finds that the most robust water market designs will be found in systems with sufficient property rights protection to support investment, sufficient hydrologic information to provide accurate analysis of third party effects, conjunctive management of surface and groundwater, and a governance structure capable of administering the rules while not determining outcomes.

(KEY TERMS: prior appropriation; property rights; transactions costs; water law; water markets/marketing/externalities; water scarcity economics.)

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INTRODUCTION

Diversion rights to water in the western United States (U.S.) have been allocated over the past century and more through what is known as the prior appropriation doctrine. Under prior appropriation, water is appropriated in perpetuity by he who first diverts water for a beneficial use, and receives an assigned priority in the order of the claim. The right is subject to several constraints in most states, including ongoing use by the original appropriator or his/her heirs or assigns. Because early uses were

primarily mining and agriculture, most western water sources have been appropriated for those uses. Today, while agriculture in particular remains a large water user in the western U.S., diversion rights are subject to demand pressure from growing populations, industry, and changing social preferences. In addition, climate change has led to increased stress from longer and more severe drought.

Given that the waters of most western basins are already fully appropriated, and that changing economics and social preferences create pressure to reallocate water from its earlier uses, how is the task to be accomplished?

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This paper addresses whether water can most efficiently be reallocated through a policy approach, by competitive markets, or through some third arrangement; the role of property rights in answering that question; and from a transactions cost perspective, the fundamental features of a viable transfer mechanism.

In a 1959 article, R.H. Coase (1959) put the following proposition:

Whether a newly discovered cave belongs to the man who discovered it, the man on whose land the entrance to the cave is located, or the man who owns the surface under which the cave is situated is no doubt dependent on the law of property. But the law merely determines the person with whom it is necessary to make a contract to obtain the use of the cave. Whether the cave is used for storing bank records, as a natural gas reservoir, or for growing mushrooms depends, not on the law of property, but on whether the bank, the natural gas corporation, or the mushroom concern will pay the most in order to be able to use the cave.

In the context of water law and prior appropriation, to what extent does the initial appropriation of water by a user, for a specified beneficial use, determine the future use of that water? Does the underlying legal structure (prior appropriation) have to be abolished or rescinded to accomplish reallocation, or do property rights created under prior appropriation provide sufficient basis for ongoing transfers between uses and users?

Approaches Found in the Literature

Much of the literature on water reallocation and the prior appropriation doctrine treats reallocation as a public policy decision, implicitly assuming that public authorities are empowered to determine who has access to water and for what purpose. For many writers, some working from a public trust perspective, the prior appropriation doctrine is an impediment to be removed so that a more enlightened or community-based process might take its place (Pisani, 1996; Wood, 2007).

There would appear to be three basic approaches to the reallocation:

1. Claim of public ownership, and claim of federal ownership of water in Bureau of Reclamation projects

Several state constitutions declare water to be the public property of the state (e.g., Idaho: Article XV, Section 1; California: Article X, Section 5; Colorado:

Article XVI, Section 5), and also provide that “the right to divert and appropriate the unappropriated waters ... to beneficial uses, shall never be denied.” In most states, this language provides the legal basis for appropriation and state jurisdiction over appropriation and transfers.

For some, the language provides the basis for a view that because water is public property, its allocation is a matter for public process determination, and thus, ongoing politics (Pisani, 1996; Clifford *et al.*, 2004). There is also a developing body of case law making water allocation and use subject to several Federal Acts through Federal agency jurisdiction [Klamath Irrigation District *v.* The United States, (2005)], and the Federal government exercises policy impact on areas such as navigation, reserve rights, water quality, and species protection. The Interior Department Solicitor (1983), following the ruling in Nevada *v.* United States (1983) opined that legal title to water in irrigation projects developed under the 1904 Newlands Reclamation Act lies with the U.S. Bureau of Reclamation, having been obtained through appropriation under the laws of the individual states.

Beneficial title, however, was noted by the Solicitor to lie with the landowner-irrigator. A line of Supreme Court cases has held that the right to beneficial use of water, which approaches the standing of a property right, resides with “he who first put the water to beneficial use” [Ickes *v.* Fox (1937), Nebraska *v.* Wyoming (1945), Nevada *v.* United States (1983)].

The view that the user has no property right but only contract rights to fair treatment finds support from some commentators (Sax, 1967) as well as the above-cited Federal Court of Claims decision [Klamath Irrigation District *v.* United States (2005)]. However, “the ... predominant view ... appears to be that beneficial ownership is a true ownership interest, in the property law sense.” (Fereday *et al.*, 2004)

2. Regulatory approaches to reallocation

A regulatory approach to water reallocation is, on its face, attractive from the standpoint of social equity and efficiency. Commentators frequently decry the failure of markets for allocating water, and conclude that the best option is to entrust a public agency with the job (Dellapenna, 2005).

Two Model Regulated Water Codes (Riparian and Appropriative) hold out a means whereby allocation can be accomplished through a system of state permits overseen by expert agency personnel (Dellapenna, 1997, 2007). In an attempt to serve both efficiency and equity, however, the Codes contain provisions that are necessarily politically contentious. Both codes appear to anticipate that nonpolitical agency personnel will be capable of balancing social and economic interests, in

the absence of clear, legislatively based policy prescription. Indeed, the editor of the model codes has stated “What works best ... is to treat water as inherently public property for which basic allocation decisions must be made by public agencies” (Dellapenna, 2005).

By arguing that “basic allocation decisions must be made by public agencies,” Dellapenna appears to beg the question of how underlying policy is adopted, as well as to ignore existing property rights claims. On the Klamath River in Oregon and California, even with clear policy prescription in place [an Endangered Species Act – required Biological Opinion], the exercise of agency authority resulted not in smooth reallocation but in high-level political intervention on behalf of the dominant economic interests (Slaughter and Wiener, 2007). In economic terms, agency personnel are necessarily agents, not principals. As such, while they can make expert determination of fact and apply established rules, they cannot make the underlying social determinations.

3. Markets based on well-defined property rights

While provisions of the prior appropriation doctrine can frustrate changing social policy preferences, the ownership created thereby provides the basis for the large-scale investment required for efficient water use. As one commentator put it: “Western prior appropriation law is a property rights-based allocation and administration system, which promotes multiple use of a finite resource. The fundamental characteristics of this system guarantee security, assure reliability, and cultivate flexibility. Security resides in the system’s ability to identify and obtain protection for the right of use. Reliability springs from the system’s assurance that the right of use will continue to be recognized and enforced over time. Flexibility emanates from the fact that the right of use can be transferred to another, subject to the requirement that other appropriators not be injured by the change.” (G.J. Hobbs, 1997: 2)

This paper takes the view that a property right sufficient to enable the beneficial owner to control returns from diversion and use of water is a necessary condition for reallocation through market mechanisms.

A FRAMEWORK FOR DISCUSSION OF WATER MARKETS

Several articles in the literature discuss the creation and use of water markets. Some address desirable reforms of prior appropriation to support

markets (Hamilton *et al.*, 1989; Huffaker *et al.*, 2000), and some treat markets as a novel idea (Clifford *et al.*, 2004). Many rudimentary markets exist in the several western States, attempting to address a wide range of issues (Houston *et al.*, 2002; Clifford *et al.*, 2004; Chong and Sunding, 2006). Most were created in response to specific situations or to promote environmental objectives. Transfers arranged through the California Drought Emergency Water Bank in 1991 and 1992, and current water purchases in the Klamath basin by the Bureau of Reclamation are examples of governmental use of water purchases for temporary reallocation, but are not markets and should not be characterized as such.

This discussion works from a transactions cost perspective to ask what institutional bases of markets – and the processes whereby those institutions are created and altered over time – best support marketing and use of water, or other public-domain resource?

Property Rights and the Nature of Contract

A contract is an agreement that allocates benefits and responsibilities to the various parties. Expanding on the social contract theorists (Hobbs, 1651; Locke, 1689; Rousseau, 1762), we can think of contracts at many levels, including an underlying unwritten understanding between members of society who share a common social and legal system.

The social contract is considered here to be an informal, evolving social understanding with regard to mutual responsibilities and the nature of government. Such contracts can evolve and be enforced over an indefinite time period through continuous, informal negotiation (private ordering) among the parties in response to need; parts of the contracts may occasionally be subject to adjudication (North, 1981, Ch. 3).

The property rights literature indicates that ownership matters, ownership being the right to use, to appropriate returns, and to change the form and/or substance of an asset (Williamson, 1985, p. 27). The concept is clear: few people will invest in an asset whose returns are controlled by an external third party, unless the third party is itself controlled through political means. Applying this concept to water institutions, rights allocation must be such that parties have an ownership stake, have investment at risk, and have contract rights sufficient to significantly impact allocation decisions.

The property rights literature also assumes that judicial enforcement of contract rights is efficient – that contract disputes are usually, and most efficiently, resolved through legal action (Williamson, 1985, pp. 28-29). In the judicial process, the underlying standard

is the original contract, or constitutional or legislative provision, with little room for changes in context or preference. Over time, however, the values that underlie the original agreement (e.g., constitutional provision for water appropriation) change, but a formal renegotiation, involving society as well as the immediate parties, may not be economically feasible.

From this perspective, judicial enforcement of agreements is not efficient, leaving most dispute settlement to take place through private ordering. In such a world, bargaining is pervasive, and *ex post* (after the original arrangement, legislation, or contract) institutions matter (Williamson, 1985, p. 29). In practice, while many features of water law are honed through judicial actions, underlying decisions regarding resource allocation are taken through an on-going dance involving water users, environmental and other non-ownership interests, legislatures, State water agencies, and others.

Over time, western water users in most states have modified the terms of their contract, as circumstances have changed and new stresses arisen. At times, these modifications have altered the prior appropriation doctrine itself, such as broadening beneficial use to include instream uses, water banking, and underground storage for recharge.

In this discussion, "private" does not mean the exclusion of public entities, but that alterations are the result of negotiation, however carried out, among parties with ownership interests in the contract, and not by unilateral action of a public agency. Revisions to an original contract may involve sanction by a public entity, and be codified through revisions of the law, e.g., the definition of beneficial use, appropriation of instream rights, movement or sale of water out of basin or out of state, and other provisions. A recent Idaho negotiation that altered the nature of prior appropriation on the middle Snake River required approval by the State Legislature and Governor, Congress, the President, the state water resource board, a water users' association, an association of environmental groups, and a Native-American tribal council. Among many other provisions, the agreement accomplishes the transfer of up to 527,000 M³ (427,000 acre feet) annually from irrigation to provide flow augmentation in the middle Snake River for salmon (Nez Perce Water Rights Settlement, 2004).

A Transactions Cost Approach to Water Institution Design

Transactions costs are the costs associated with contracting: obtaining information and enforcing contract provisions. Such costs are not trivial, but their

consideration is frequently absent from neoclassical economic analysis (economists are aware of these costs, but assume them away for purposes of theoretical clarity).

Literature that has grown out of Ronald Coase's path-breaking 1960 article, "The Problem of Social Cost" (Coase, 1960, 1988, pp. 95-156) illustrates the implications of transactions costs for neoclassical economic theory in the real world, and in consequence, the effects of institutional structure on the nature and scope of possible transactions (Williamson, 1985; Coase, 1988; North, 1990). Coase demonstrated that in the absence of transactions costs, the initial distribution of bundles of legal rights between parties to an exchange would not matter. Under those circumstances, the parties would costlessly negotiate preferred outcomes in full consideration of potential payoffs and limitations.

Coase undertook the proof not to demonstrate that zero costs were possible, but to show that because costs are universally positive, bundles of legal rights, or institutions, do matter. In a world of positive costs, the world we live in, institutions matter because institutions affect information and enforcement costs (Coase, 1988, pp. 114-115).

One effect of positive transaction costs is the existence of externalities, social costs that cannot be reflected in a competitive market, causing the value of production to be less than optimal (Coase, 1988, p. 158). Examples include pollution from the burning of gasoline in automobiles, and global warming from burning fossil fuels for energy. Within a drainage basin, externalities can include water supply impacts on downstream users from the transfer of a water right upstream, and in a State with "Rule of Capture," the near-absolute right to pump water from underneath one's land. Groundwater pumping by one user lowers the water table accessed by many others, depending on basin hydrology.

Positive transactions costs reduce optimal allocation in two ways: first, by preventing otherwise-optimal transactions, and second, by shifting costs from the parties to society (externalities). In a drainage basin, shifting the diversion location may negatively impact a third party. Depending on the state, the injured party may either be able to stop the transfer entirely, or be unable to avoid injury. Either outcome prevents optimal allocation. Pumping from an aquifer in a state with Rule of Capture may injure tens of thousands of other individuals, many of whom may own rights in other states, who have no ability to enforce their rights and may have no knowledge of the withdrawals.

Institutional arrangements, such as governance and financial markets, can enlarge the set of possible transactions by reducing costs. This is true even

though the institutions carry substantial costs in themselves. Instruments such as insurance further reduce costs by spreading the risk of unknown events (an information cost), thereby reducing the risk cost for some transactions to a level below the expected return. Douglass North (1990) has shown that government – a social institution with decision making capabilities and having a monopoly on the legitimate use of force – reduces costs by enabling society to accomplish defense, security, and other agreed public ends without endless negotiation, and without privately arranged contract enforcement.

Considering the overall payoff matrix – the distribution of transaction costs and benefits to the parties, and beyond the parties to society as a whole – the lower the level of transactions costs, the lower the differential between private cost and social cost (Coase, 1988, p. 158). Colby (1990) examines “publicly imposed transactions costs” as a means of moving externalities into the market through policy action, possibly because the paper does not consider property rights enforcement a transactions cost. This paper takes the opposite view: that even though an individual transaction may be more costly to the parties with rights enforcement than without, it becomes less costly to society, thus reducing externalities and moving closer to optimal allocation.

More recently, the drastic reduction of information costs made possible by the Internet (self-governing communications protocols and standards) and communications technology has led to a vast expansion of possible transactions. This expansion has in turn contributed to a major global productivity increase, accompanied by shifting of the locus of production for many goods and services (frequently called “outsourcing”). As management and information costs fall, production that was previously localized because of cost barriers has re-located, resulting in higher overall production and welfare, from the same resources. Earlier in the 20th century, the post-WWII international economic system – IMF, World Bank, a succession of trade agreements under GATT – generated much of the post-WWII prosperity by reducing the cost of negotiating and enforcing contracts. In general, as innovations have reduced transactions costs, the economically feasible subset of all potential transactions has grown.

THE CHALLENGE OF RESOURCE ALLOCATION

Whatever one’s preference for either the mechanics or outcomes of resource allocation, there are three challenges that must be met if the effort is to be

successful. The first stems from the state of knowledge about the future, the second from underlying human behavior, and the third from the nature of the asset to be allocated (Williamson, 1985, p. 31). As noted, this discussion treats allocation as a matter of contract, not as a policy issue reflecting political arrangements.

Constrained Future Knowledge

The first challenge is the extent to which the future is known or foreseeable. Some future events are knowable, at least for a near-term future. The U.S. population absent migration, for example, is predictable for about 20 years into the future, because most of those who will be here then have already been born, and mortality rates are reasonably constant. Migration is not knowable, but for a large population can be predicted within reasonable errors for that period of time. For a longer time period impacted by climate change, say 100 years, population is far less predictable, as are other socioeconomic variables, technology, and many physical variables including climate itself. For that reason, the International Panel on Climate Change periodically adopts socioeconomic scenarios, potential outcomes without assignment of probability, instead of forecasts.

Opportunism

The second challenge is the tendency of individuals to engage in opportunistic behavior. All contracts normally expect the parties to engage in simple interest seeking on the basis of known information. Opportunism is the very human tendency to go beyond simple interest seeking, to take advantage of asymmetrical information or opportunity, including incomplete or distorted disclosure. It can also include more odious forms of behavior, and may be active or passive, before or after the contract.

For many years prior to passage of the Securities and Exchange Act of 1934, insider trading and market manipulation were considered sound business practice; companies did not publish financial reports (B.M. Smith, 2001, pp. 25-30). Similarly, during drought a farmer may extend his well further into the aquifer to gain an advantage at his neighbor’s expense. Clearly, if all water users did likewise, any shared use of the resource would collapse.

The effects of opportunistic behavior can result from failure to adequately specify property rights (both constraints on, and protection of, the right), and from adopting reforms with future effective

dates. In many states, groundwater is either not regulated or is not conjunctively managed together with surface sources (Glennon, 2002). In Arizona, water law reform in 1980 prohibits appropriation of groundwater in excess of natural recharge, beginning January 1, 2025. Holland and Moore (2003) find that the future restriction on groundwater withdrawals will increase the rate of withdrawal prior to the effective date of the restriction. In Texas, while surface water is governed by prior appropriation, groundwater is governed by the Rule of Capture, under which landowners have an absolute right to pump water from under their property. Several normal constraints of prior appropriation – that the diversion right is limited to the requirements of the beneficial use, that third party injury be avoided, and that water not be wasted – do not apply. In one case, a partnership has purchased land above the Ogallala Aquifer, proposing to pump water drawn from it to San Antonio and other cities. Water may be withdrawn at rates up to 1.23 million M³ (1,000 acre feet) per acre, or 60 billion gallons per year from 81 hectares (200 acres) of land. The subsurface water flows to the partnership's land from other areas in Texas, Oklahoma, and potentially as far north as South Dakota (Glennon, 2002, Ch. 6; Public Citizen, 2008).

Asset Specificity

The final challenge is presented by *asset specificity*, which refers to the unique nature of the asset itself. Water in nature is unique in many ways, including that it may or may not exist at any given location at a given time. In western parlance, it is also “fugitive,” able to run away down a water course, seep into the ground, or evaporate back into the air. Knowing the average precipitation or average flow at a particular point does not tell you what there will be next year, nor the flow a few miles down the river.

Colby *et al.* (1993) found that prices for water vary across a region in part due to the “specific attributes of the right.” Blackstone perhaps best captured both the specific nature of the asset and the use constraint on the property right: “Water...is a moveable, wandering thing, and must of necessity continue common by the law of nature; so that I can only have a temporary, transient, usufructuary right therein: wherefore if a body of water runs out of my pond into another man's, I have no right to reclaim it. But the land, which that water covers, is permanent, fixed, and immovable: and therefore in this I may have a certain, substantial property, of which the law will take notice, and not of the other” (Blackstone, 1765-1769: Book 2, Ch. 2, p. 18).

Any allocation scheme must be able to handle the consequent variation in water availability and value. This is one reason for the design of prior appropriation, the dominant legal structure for water in the western U.S., where water scarcity makes unworkable the riparian doctrine, common in the eastern U.S. where rainfall is much higher. The property right relates to a priority right to divert, and is usufructuary, meaning that *the right is to use water when it is available*, and not to hoard or waste it. It takes the form of a queue, in which those first in line may fulfill their entitlement before those behind them receive any. The security provided by one's place in the queue is a fundamental contributor to the value of the right. The lack of obligation to share is one of the major complaints about prior appropriation, but at the same time allows users to calculate the hydrologic and climate risk of insufficient supplies without the complexity of political risk.

DEALING WITH THE CHALLENGES

To deal with the three challenges, Oliver Williamson (1985) identifies a universe of four decision models, each of which responds differently to the set of challenges. The optimal model depends on the characteristics of the market and the assets in question (Table 1).

Planning

A contract can be based on *a priori* planning, in which case the relevant risks are assigned and appropriate means to resolve conflict are identified, as in a mortgage contract. Information about the future is not constrained to a degree beyond that which was anticipated in the original contract terms. Even very long-term contracts may be feasible, as in the British 100-year lease on Hong Kong. The Chinese government honored the lease through to its conclusion in 1997, and the British government honored its

TABLE 1. Resource Allocation Models.

Contract Model	Behavioral Challenge (can the model accommodate)		
	Constrained Future Knowledge	Opportunism	Asset Specificity
Planning	No	Yes	Yes
Trust	Yes	No	Yes
Competition	Yes	Yes	No
Governance	Yes	Yes	Yes

obligation to cede Hong Kong back to China. These obligations were honored despite two revolutions in China that drastically changed that country's political system, and a fundamental shift in Britain's position in the international power structure, during the interval.

With water in the western U.S., such is not the case. When the legal infrastructure supporting western development – prior appropriation and the Homestead, Mining, Carey, Reclamation, and Warren Acts – came into being between 1862 and 1911, the agreed social priority was development. The various Acts and the Federal agencies created to implement those acts reflected public opinion. Today, the legal infrastructure still exists, but public priorities have changed. The Clean Air, Clean Water, and Endangered Species Acts are testimony to that changed opinion, but must be implemented by 19th and early 20th century institutions created for other purposes. The planning behind the Bureau of Reclamation, the Bureau of Land Management, the Forest Service, and the Corps of Engineers did not, and could not have, anticipated the later Acts. As illustrated in the Klamath Basin in 2001, long-term central planning may not be up to the adaptive task when social priorities or physical circumstances change over time (Slaughter and Wiener, 2007).

A planning model assumes the absence of constraints on relevant information that future events of significance are knowable. This is a heroic assumption. For farmers in the Bureau of Reclamation Klamath (Oregon) Project, their contract provided that Reclamation would deliver water when available, except in cases of *force majeure*, unforeseeable events such as earthquakes or volcanic eruptions that might prevent water delivery (Braunworth *et al.*, 2002; Slaughter and Wiener, 2007). The term “*force majeure*” could not, at the time, have included changing social priorities. When the courts, some 95 years later, determined that the Endangered Species Act constituted a *force majeure* event, the irrigation customers, having not anticipated that risk, moved immediately to the political arena.

On the other hand, a planning model, because obligations are prescribed and an efficient public judicial process is assumed, handles both opportunism and asset specificity well. A planning-based contract takes those characteristics into account.

Trust

A second contract model is based on trust. In this situation, the parties tacitly understand that none will take undue advantage of changed circumstances at the expense of others. It works, particularly with

regard to constrained future knowledge and asset specificity, when the parties are subject to strong informal institutional constraints such as may be found in a tribal village or among the elite classes in Britain or Japan, reputation being all-important. Despite calls in modern cultures for greater social trust and harmony, a trust model does not work well where there is significant social, physical, legal, or cultural distance between the parties. With limited exceptions to the contrary, most economic progress has resulted from institutions created specifically to overcome the inability of trust to control opportunism – including banks, insurance, judiciaries, and limited executives (North, 1990; Slaughter, 2002).

A trust model does not require comprehensive knowledge in advance of the contract because of the nature of the underlying relationship. Participants can depend on others to not take advantage of changed circumstances, but to work things out on the basis of known self-interest. The model works well where the requisite conditions are present. On the other hand, cultures where trust is the primary basis of business intercourse tend not to grow beyond the boundaries of persons known to each other (e.g., southern Italy, tribal cultures). North (1981) makes clear that the industrial revolution could not have occurred until institutions to support wide-ranging trade and scale economies were in place.

Arrow notes that the “efficacy of alternative modes of contracting [varies] among cultures because of differences in trust” (Arrow, 1969, p. 62 cited in Williamson, 1985, p. 9). Fukuyama (1995) describes the consequences of varying levels of trust between high and low-trust societies, focusing on contract enforcement as the primary transactions cost, to the exclusion of information. Common cultural links, where they exist, make it possible to deal collaboratively with a highly specific asset.

There are limits, however; the presence of opportunism can be fatal to trust-based arrangements, even in the most close-knit communities. The son of one pioneer family remembers it this way:

In the late 1940s I would walk to the diversion box with my grandfather to take our irrigation turn. Sometimes this was in the day, sometimes in the middle of the night with the light of a Coleman lantern. This was in a small Mormon town in northern Utah of less than 1,000, where everyone know everyone else [and all but one family] attended the same [Mormon] Church Ward. When we would go divert the water to our land my grandpa always took with him a loaded .32 special rifle. As I remember there was never anyone else around and never any trouble. ...However as a young boy raised in a

law abiding and conservative Mormon rural town the message was clear. There was something different about water. Water transcended other commodities as well as the civil order of our lives. This imprint has lasted a lifetime and it is impossible to understand the social and economic importance of water to western society without this depth of understanding. Access to water in the arid west cannot be compared with other commodities in the ordinary meaning of economic goods. And because arid western economies could not exist without access to scarce water resources it forms the foundation of these societies. (Don Reading, unpublished memoirs, Boise, Idaho, 2000)

In another instance, an historian relates the case of an Idaho farmer killed with a shovel by a co-religionist neighbor during an early morning confrontation over a head gate (Fiege, 1999, pp. 81-83). In Mark Twain's words, "Whiskey is for drinking. Water is for fighting over."

Competitive Markets

The third means of enforcing contract terms and handling changed circumstances is a competitive market in which, following Adam Smith (1776), the parties automatically enforce the rules, through their individual responses at the margin to changed conditions. For a market to work, costs imposed on society by one individual's actions must be reflected in prices and conditions faced by other market participants; that is, costs must be internal to the market. Changed circumstances and opportunistic behavior are not a problem as long as information is fully available to all participants. Each can change his/her behavior at the margin, and no monopoly may exist. Sunk capital, of course, may temper adjustment in the short term: existing roads, the lack of public transit, and widely dispersed housing limit individual abilities to immediately respond to rising energy costs, for example. Over time, however, different choices as to automobiles, housing and employment location, public transit, and other variables can and will be made.

A competitive market on the neoclassical model handles both constrained future knowledge and opportunism well, provided that the asset in question is reasonably homogeneous and traded in a broad market. Changes in conditions lead to price adjustments at the margin, which lead directly to adaptation. Opportunism is automatically constrained, because all parties have access to the same or similar products from multiple vendors, provided the market is reasonably transparent. Thus, no customer must

accept the price of any one vendor, and no vendor must yield on price to a single customer.

Asset specificity is not handled well by competitive markets, because the very uniqueness of the asset to be traded (e.g., water diverted from its natural source in a given location or quality) violates the requirement for competing buyers and sellers.

Governance

The final option is governance, wherein a collective or public entity acts as referee in an allocation process, but does not control outcomes. The governor/referee helps to specify rules as necessary, enhances transparency, and enforces contract terms, as decided through legislative, judicial, agency, or consultative processes. Governance in this manner provides the mechanism through which society may attempt to imitate the outcomes of a competitive market while reducing externalities.

Utility regulation provides a reasonable analogy. While public utility commissions set rates, they do not do so arbitrarily. Policy criteria for the standards to be applied (e.g., lowest price to the ratepayer, incorporation of environmental costs, etc.) are set in advance by state legislatures and Congress. Commissions then consider utility revenue applications with regard to capital structure, allowable return on invested capital, expenses undertaken on behalf of ratepayers, plant to be included in the rate base, and allocation of costs to customer classes. In contrast to the role proposed by Dellapenna (1997, 2007), utility commissions and their staffs do not normally make policy with regard to the social ends to be served.

Application to Water

Water exhibits constrained future knowledge, opportunism, and asset specificity. Contracting *before the fact* is made difficult by climate variability, demand growth, new uses, and changing social preferences. Thus, planning models are unlikely to be successful.

A trust model will have limited application, due to opportunism that is necessarily present with an asset-specific resource. A neoclassical market is not possible, if only because water diversion must be very specific in place and time for surface users, and only slightly less so for groundwater users. Information on market values, normally obtained from multiple transactions between many buyers and sellers, will not be available because the market is in fact many small markets, each constrained in time and place (Colby *et al.*, 1993).

The combination of asset specificity, knowledge constraints, and opportunism normally requires some level of governance. The presumption of constraints on knowledge of the future, however, excludes governance of a planning nature, and the property rights literature reminds us that ownership matters. Thus, an efficient solution in the presence of asset specificity must incorporate a large measure of ownership on the part of participants, coupled with a governing presence to enforce the rules. Such an institutional arrangement will be characterized by a large measure of private ordering, *post hoc*, through which the participants continuously innovate to deal with stresses on the original contract due to drought, population growth, changes in social preferences, and other sources.

DISCUSSION

Now return to consideration of R.H. Coase's cave, and whether the initial assignment of legal rights determines the future use of that asset.

The cave proposition led to Stigler's assertion of the Coase Theorem (Stigler, 1966, p. 113; cited in Coase, 1988), which Coase defined as "with zero transaction costs, private and social costs will be equal, ... [and] social value will be optimized." (Coase, 1988, p. 158).

In the real world, where transaction costs are always greater than zero, who owns the cave clearly does matter, at least to the claimants, and private and social costs are frequently not equal. But does existing ownership matter for the purpose of optimizing social value, if that optimization requires that a different entity own the cave (or water)?

Coase's answer is that the existing ownership does not matter, so long as the law determines with whom prospective users must deal, and the quality of their property right after making the deal. If the property right is sufficient to the purpose (and if the characteristics of the asset are such that it can be traded), then social value can be optimized at any time.

Further, if optimization requires that the asset be transferred from a private to a public use, it does not matter from the standpoint of overall social cost whether the transfer is effected by means of a tax on the existing rights holder or by public purchase from the existing rights holder. The only difference is in with whom the public contracts for use of the water (Coase, 1988, p. 157). Clearly, it does matter to the existing rights holder, and quite possibly to the specific public budget(s) involved, but aside from jurisdictional questions, it need not matter to society as a

whole. Total social costs (including all private costs) are the same whether the asset is paid for or confiscated. If the institutional support is adequate, 19th and 20th century allocations to mining and agriculture can change going forward without resorting to means that might be considered the taking of a private interest for a public purpose.

In this insight lies the import of property rights in water diversion, and the import of getting governance right. Applied to the Texas case, is the ability of an individual landowner to mine water from the Ogallala Aquifer a failure of policy, of markets, or of property rights?

Pumping groundwater in excess of the rate of replenishment has opportunistic effects, even if it is both legal and the information on which it is based available to all. This result is due to the physical nature of groundwater. Assuming the physical reality is that unlimited pumping will eventually exhaust the aquifer, how is that outcome to be avoided?

An attempt to bring private costs into line with social costs through policy – legislative or "expert" assignment of rights to use water – would entail a potentially endless process of public input and legislation. The outcome of such a process would be highly contentious, politicized, inefficient, and constantly subject to revision as in the Klamath experience (Slaughter and Wiener, 2007).

Competitive market solutions under current law are impossible, because the social costs of Rule of Capture water sales are external to the market: the water is free to the pumper, even though his actions reduce not his own reserves but those of other pumpers in his own and other states, while overall scarcity of clean water makes the commodity valuable in the market. The only market response available to others is to do likewise, thereby gaining as much value as possible before the resource is exhausted.

A trust model exhibits similar shortcomings: it does no good for Oklahoma or Colorado farmers to trust Texas landowners to observe their interest, because they have no market or legal hammer to wield.

The problem comes down to the property right not being defined in such a way that the currently externalized costs are brought into the market. In this case (in contrast to Idaho, and Arizona from 2025), Texas does not view subsurface water as a common pool resource with surface water, limiting withdrawals to the natural rate of recharge. Texas need not confiscate existing rights nor plan for the currently and politically desirable end uses of water, using policy to correct a perceived case of market failure. Texas need only constrain the property right in groundwater to the natural rate of recharge, going

forward, in order to prevent waste, to properly value water, and to promote optimal utilization.

Further, following from the Coase analysis, Texas can acquire existing rights through purchase rather than regulatory taking, without imposing additional costs on society. Exactly that path has been followed in Idaho, where the Idaho Water Resource Board, in combination with the Bureau of Reclamation has acquired consumptive rights from large irrigation projects for the purpose of enhancing river flows for salmon. One of these agreements reduced diversions by nearly 122 million M³ (98,000 acre feet) annually, removing irrigation from 10,000 hectares of land (Bell Rapids Letter of Intent, 2005, available from author; Nez Perce Water Rights Settlement, 2004). Another, with the U.S. Department of Agriculture (USDA), has placed up to 40,000 hectares into a groundwater conservation reserve, freeing up 250 million M³ (200,000 acre feet) for fish and hydropower (USDA Conservation Reserve, 2006).

The level of institutional support for rights transfers matters, because in most states it is easy to challenge a transfer under prior appropriation provisions, and difficult to quantify injury for the purpose of mitigation. Facing high hurdles, few transfers are attempted.

J.R. Lund (1993) found that when state action reduced the risk of a water transfer being unsuccessful, more transfers tend to be undertaken, suggesting that states undertake to more firmly assign property rights, make transactions more transparent, and disseminate information on market conditions. These actions all work to reduce both information and enforcement transaction costs.

Work by the Idaho Department of Water Resources (IDWR) and the University of Idaho's Idaho Water Resources Research Institute (IWRRI) over the past quarter century has served to significantly reduce transfer costs for groundwater on the Eastern Snake River Plain Aquifer. Policy actions and research have included adoption of transfer protocols and procedures, limitation of transfers to the consumption, not diversion, right (irrigation consumption, or evapotranspiration, normally constitutes from 30% to 80% of water diversion, depending on irrigation technology), and hydrologic modeling that allows calculation of the mitigation required to prevent injury to other water right holders. The latter eliminates the practical requirement that buyers prove no injury, shifting the calculation to the state, and thereby significantly reduces barriers to transfers. A hydrologic model resulting from collaboration between IDWR and IWRRI allows calculation of the 100 year flow effects of moving groundwater extraction from any one of 11,000 grid cells on the aquifer to any other, and to 14 reaches of the

Snake River (Dreher and Young, 2002; Cosgrove *et al.*, 2006).

Further work by the model's authors indicates that when there are many transfers, only the net differential need be mitigated instead of requiring full mitigation for each transfer (Johnson *et al.*, 2008). With the addition of an accounting system to track and assign ownership to hydrologic effects, a market in hydrologic credits becomes possible. At that point, effects are largely internalized and efficiency improved (Johnson *et al.*, 2008, p. 35).

Characteristics of Institutional Support for Water Marketing

Based on the prior discussion, an efficient water allocation structure might exhibit the following characteristics:

- (1) A basis for usufructuary diversion rights, sufficient to support investment and transfers. This has been defined as property rights sufficient to support owners' direction of use and returns from use. For most western states in the United States, the underlying legal structure is an implementation of the prior appropriation doctrine.
- (2) One or more nonjudicial, or quasi-judicial governing structure(s) to serve as referee(s) and administrative rulemaker(s), and to ensure transparent access to information on water transfers. Such institutions might serve under custom, mutual agreement of the parties, or color of state authority, with powers to make policy with regard to all water issues other than allocation itself. They might also monitor the application of the Clean Water and Endangered Species Acts, and other constraints on water rights (Colby, 1990), for purposes of enhancing market transparency. Surface and groundwater should be conjunctively managed within a basin. Geographic overlap and differing competencies as found in California and Washington State may be possible, though split jurisdictions would be expected to complicate administration.
- (3) Hydrologic modeling sufficient to support calculation of potential injury to third parties resulting from a water transaction, on the basis of which mitigating measures can be determined. For the Snake River Plain Aquifer in southern Idaho, modeling by the University of Idaho is sanctioned by the IDWR (Cosgrove *et al.*, 2006).
- (4) Continuous *post hoc* ordering. *Post hoc* ordering occurs when parties with significant interest in an allocation arrangement possess sufficient

ownership that they are able to change allocation (contract) terms through negotiation with each other, directly or through public institutions. They are distinctly not customers of a resource provider, with claims only to fair treatment, but analogous to those shareholders in a corporation who have sufficient ownership to affect major decisions. Issues addressed through *post hoc* ordering include changes to address new social preferences, demand growth, and other pressures: e.g., expanding beneficial use to include in-stream and aquifer recharge; changes to burden of proof with regard to third party injury from transfers; conjunctive management of surface and groundwater rights; accounting for water rights transfers; quality constraints; and reduction of barriers to transfers through hydrologic research and models to simulate transfer effects and surface/groundwater interactions.

CONCLUSIONS

The role of governance is to reduce transactions costs, both of information and of contract enforcement. By accomplishing that end, barriers to optimizing transfers can be reduced, and externalities brought into the market. This benefit accrues to society, not necessarily to an individual transferor, as some costs would no longer be externalized.

Information costs can be reduced through means including improved transparency, hydrologic modeling, accounting for net effects of water transfers, and unified administration. Contract enforcement costs can be reduced through improved definition of the property right, including adjudication of all rights in the basin; conjunctive management, through which both surface and groundwater are managed through a single structure; limitation of transfers to the consumptive component of the diversion right; and the addition of recharge, water banking, and in-stream as beneficial uses.

In sum, uniqueness of water in nature prevents the existence of classical competitive markets in water rights and leads to opportunism that makes trust a dubious institutional choice; unknown future changes of climate, population, and social preference make planning a litigious option. The most robust water markets will be found in systems with sufficiently specified property rights to support investment, sufficient hydrologic information to provide accurate analysis of third party effects, conjunctive management of surface and groundwater, and a gov-

ernance structure capable of administering the rules while not determining outcomes.

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