Water Markets and Water Rights Markets in the Western United States

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Introduction

Supply reliability is the most important issue facing water agencies in the arid western United States (US). Shortages of firm water supply stem from three sources. First, population pressure and rising environmental water needs are increasing average demand. Second, many climate change scenarios forecast that average supplies will decrease in many parts of the western US, compounding the problem (Kundzewicz *et al*. 2007). Third, the western US is characterized by substantial inter- and intra-annual variability in supply, both of which are also forecasted to increase under many climate change scenarios (Kundzewicz *et al*. 2007). Water agencies have historically dealt with supply risk and increased demand by building additional storage capacity. Now that the best reservoir sites have been taken, water managers are increasingly turning to improved water management institutions to address anticipated shortfalls in supply. One such institution that has gained popularity in recent years is water markets.

Water can be transferred in one of two ways. First, a water right may be transferred from one user to another.[2] Second, a water right may be leased to another user for a set period of time (perhaps the buyer receives a pre-specified quantity of water each year for the duration of the contract), but the underlying water right does not change hands. A transfer may be an isolated, bilateral market exchange of water or a water right. In other instances, water and/or water rights are transferred relatively frequently within close geographical proximity. Both water transfers (leases) and water rights transfers with varying degrees of market activity are considered here.

Water markets and water rights markets allow for the reallocation of water from low to high valued uses, thereby increasing overall efficiency. These theoretical benefits of water markets have been demonstrated (Hartman and Seastone 1970). The empirical costs and benefits vary, depending on hydrology, geography, institutions, and history. This article is an overview of water and water rights markets in the western US, specifically when and where they work well and why. Western water law and institutions are introduced, followed by a discussion of impediments to water market development and the range of institutions found in the western US. The impacts of transfers on other rights-holders and interested parties are discussed, as are recent trends in western US water and water rights markets.

Institutional Background

Prior appropriation is the law that governs water allocation in most states in the western US. The governing principle of prior appropriation is “first in time, first in right.” The first to claim

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[2] When a water right is transferred, the new rights-holder must submit an application to the state to change the use of the water. Many water rights are transferred from agricultural use to municipalities that have purchased the water to meet future projected growth. The water could remain in agriculture for some period of time, though the city owns the underlying water right.

water on a particular river or other body of water has the most senior right to the water. In dry years, senior rights are satisfied before more junior rights receive any water. If a water right is not used for a number of years (as specified by state law), the water right is forfeit (Getches 1997).

Water may not be wasted under prior appropriation. Water may only be put to uses that are considered beneficial under state law. Prior appropriation states generally consider domestic, municipal, agricultural, and industrial uses of water to be beneficial. Some states have further defined stock watering, power generation, mining, recreation, and/or fish and wildlife to be beneficial uses. Modern interpretations of beneficial use generally prohibit inefficient use of water. A common example is that irrigators may not apply more water than their crops need (Getches 1997).

The law of prior appropriation developed organically. When settlers first moved to the western US, they initially adopted riparian water rights, inherited from states in the Eastern US and ultimately from English common law. Under riparian rules, water users had the right to as much water as they could take from waterways adjoining their land. Migration into the western US, water lead to land becoming relatively scarce, increasing the marginal benefit of establishing firmer property rights. Miners in California employing hydraulic mining to extract gold, found that they needed a property rights regime more conducive to their purpose. Prior appropriation developed from the miners' need to use water on public land and at some distance from existing waterways, neither of which would have been possible under the riparian system of water rights (Hundley 2001; Anderson and Hill 2004). A number of western states possess a hybrid of riparian and prior appropriation water law.[3] This generally occurs when a state with riparian water law has transitioned to prior appropriative rights but still recognizes existing riparian rights. The riparian rights are converted to appropriative rights and must now be put to beneficial use, even if they were not before the transition to prior appropriation (DOI 2001).

Property rights evolve in response to technological innovation, the opening of new markets and changes in relative factor market scarcities. Anderson and Hill (2004) place this evolution within an economic framework by observing that people invest in establishing and protecting property rights for natural resources as long as the costs do not outweigh the benefits. One example they provide to support their model is the development of water law in the western United States described above.[4]

Over the past thirty years, there has been another shift in property rights for water; they have become more transferable. Due to population pressures and society's growing belief in the importance of environmental and recreational water use, water has become an increasingly valuable resource. The differential between water rights-holders who are using water in relatively low-value uses and those who do not have sufficient water but are willing to pay large sums of money to acquire it has led to pressure to make property rights for water more transferable. Several modest, recent examples are a 2007 Arizona law (HB2488) that allows water to be transferred out of a groundwater basin in a drought emergency situation (*Water*

[3] Western states with hybrid water law doctrine are California, Kansas, Nebraska, North and South Dakota, Oklahoma, Oregon, Texas, and Washington.

[4] Another example that Anderson and Hill give is that of land ownership on the Great Plains. As population increased in the latter half of the 19th century, stockgrowers' associations began to attempt to restrict entry onto their grazing lands and to lobby for restrictions on land use. It was only with the invention of barbed wire in the 1870's that it became possible to enforce exclusive ownership of grazing land in a cost-effective manner.

Strategist 2007); an Oregon law (SB 89) that extends an existing pilot program allowing several irrigation districts to approve temporary water transfers within district boundaries (*Water Strategist 2007)*; a 2008 Colorado law (HB1141) that water rights leased or temporarily donated to the Colorado Water Conservation Board are not subject to abandonment (*Water Strategist* 2008); and a Utah law (HB 117) allowing water rights-holders to lease water out for up to 10 years, to protect or restore habitat for several fish species (*Water Strategist* 2008).

Impediments to Trading and Market Institutions

In spite of changes to state law that have facilitated water and water rights transfers, market activity is rarer than one might expect, given the high value differential that often exists between potential buyers and sellers. Young (1986) discusses the very large extent to which water's distinctive characteristics impede transfers. Water's mobility makes it difficult to contain and measure; an exclusive, transferable property right can consequently be difficult to establish. Water also exhibits economies of scale in conveyance, distribution, and storage, making its allocation through natural monopoly likely. Further, although water is a precious resource, it is expensive to transport.[5] The costs of transportation and delivery can be significant. As an extreme example, of the $250/acre-foot the Metropolitan Water District of Southern California paid in 2002 for delivered water, 55% was for the cost of conveying the water from northern California, through the environmentally sensitive San Joaquin–Sacramento Valley Delta, to the Los Angeles Basin (DWR, 2004).

Another cost of trading water are transaction costs. According to Dahlman (1979), these are the costs of search and information, bargaining and decision, and policing and enforcement. Colby (1990) defines transaction costs to be the costs associated with acquiring regulatory approval for a transfer. She lists examples of these policy-induced transaction costs: attorneys' fees, engineering and hydrologic studies, court costs, and fees paid to state agencies. In some states, these costs are high because new laws to facilitate water and water rights transfers have not been implemented; regulatory transaction costs are high through inertia. In other cases, these costs may be intentionally high so as to minimize the transfer of water. Transaction costs tend to be higher for water rights transfers than they are for leases (Howitt 1998). Colby (1990) notes that transaction costs tend to be higher in states where there is more pressure on existing water supplies. She asks should public policy minimize the cost of transferring water. Alternatively might transaction costs have a role in facilitating efficient reallocation by taking into account the social costs of transfers that are costly to delineate and incorporate explicitly.

There is much variation across states in the institutions governing water and water rights transfers. , Water rights transfers must be approved by the State Engineer in many states, who heads the administrative body in charge of water policy implementation; whereas rights transfers in Colorado are evaluated by basin-specific water courts. Several states' water codes require the State Engineer (or other relevant decision-maker) to consider some aspects of public welfare in deciding whether to approve a rights transfer, though "public interest" is not generally defined in state statutes. By contrast, Colorado water courts do not consider economic or social impacts resulting from a rights transfer, and the state of Oregon only allows protests which claim injury to another water right. In some western states (for example, California,

[5] One exception is water banks located on reservoirs, where the cost of transporting water from one member to another is effectively zero.

Colorado, Idaho, and Nevada), water rights are real property, meaning that they can be owned separately from the land on which the water is used or diverted. In other western states (for example, Arizona, Montana, New Mexico, Oregon, Wyoming), a water right is appurtenant to the land (DOI 2001). This attachment can limit transferability, though some states, Arizona in particular (Colby 1990), have witnessed land transfers occurring for the sole purpose of acquiring the associated water. Quantification of the amount of a water right that can be transferred such that other rights-holders are not harmed can be expensive. It is easier to transfer irrigation water in New Mexico or within groundwater management areas in Arizona, where the portion of a water right that can be transferred is administratively defined, than it is to transfer a water right in Colorado, where quantification is determined on a case-by-case basis (Colby 1988). Such differences in state law affect the ease with which water and water rights can be transferred.

The nature of the institutions that govern water trades in a region have an enormous impact on how water markets develop. Carey and Sunding (2001) explore this issue by contrasting water market formation on two very different water projects: the Central Valley Project of California (CVP) and Colorado-Big Thompson (CBT). Although the situation in California is changing, CVP trades are generally short-term lease transactions within the agricultural sector. By contrast, water markets (both lease and rights transfers) on the CBT are active, commonly anonymous, mediated by brokers, and transacted at a well-established price. Historical circumstances are largely responsible for these differences in present-day markets. The CBT operates as a single water district, encompassing both agricultural and urban areas, which lowers trading costs significantly compared to the more jurisdictionally fragmented CVP. Proportional water rights in the CBT make transfer of short-term and permanent rights easy compared to the CVP, where a priority rationing system requires that water be quantified and potentially adjudicated before it is traded away. Downstream users in the CBT have no right to instream flows, which severely limits the legal recourse of third parties who are harmed by a water rights transfer. By contrast, California state law contains a number of provisions for the protection of downstream users.

Direct and Secondary Impacts

Water and water rights transfers generally affect more than just the two parties who sign a contract. Water's mobility and non-exclusivity make it likely that there are interactions and dependencies among users. Further, the statutes of all western states establish state or public ownership of waters within state boundaries (Getches 1997).[6] States' statutory authority to manage water to the benefit of society and the popular perception of water as a public natural resource mean that changes in water allocation attract attention from a number of affected parties. Affected parties fall into two groups: those who are directly affected by a water or water rights transfer, and those for whom the impacts are secondary.

Direct Impacts

Transferring water from one location to another affects other water users and the riparian ecosystem, by changing water quality, flow volumes, or the timing of flows. Direct impacts of water and water rights transfers are the effects of the transfer on other water users that are not accounted for in the market transaction. Such externalities are virtually inevitable in water and water rights transfers, due to the fact that multiple users can often utilize the same water

[6] The statutes of all 19 US states with prior appropriation water law or a combination of prior appropriation and riparian water law establish that water "belong[s] to the public," is the "property of the people of the state," or something similar. Private rights are thus considered use rights only (Getches 1997).

simultaneously. For example, an agricultural producer who practices flood irrigation creates a wetland which may benefit migratory birds. This producer has created a positive externality. Multiple users may also use the same water in sequence. If an upstream user sells water or a water right to another party outside the drainage, availability of water to the downstream user is likely be negatively affected. Such environmental and physical externalities can be either positive or negative, as in the two examples provided here. They ought to be taken into account when evaluating the social efficiency of a trade. Externalities affecting other rights-holders and the environment are generally addressed (or should be) in the state regulatory approval process.

Secondary Impacts

The term secondary impacts refers to the economic harm that communities in an exporting region experience due to a water transfer. These impacts are generally measured in terms of diminished income, increased unemployment, and reduced property and sales tax revenues. A common example is an irrigation district that exports water out of the basin rather than using it as an input to agricultural production. Although the irrigation district and its member farmers may benefit financially from the transaction, the fields left fallow for lack of water signify fewer workers hired and fewer secondary processing firms employed in the exporting basin.

Secondary impacts are pecuniary externalities. They are the effects of a transfer on other people resulting from the market transaction itself (and the resulting change in resource prices) rather than from direct physical effects on other users' water availability. Secondary impacts are controversial. If an agricultural input such as water can be more productively utilized elsewhere, then the resource reallocation resulting from water exports increases overall efficiency. However, transfers create both winners and losers, as secondary impacts can be quite disruptive to the exporting region. In their analysis of Colorado water exports from the Arkansas River Valley, Howe, Lazo and Weber (1990) find that exporting communities are harmed by the transfer but that the overall benefits to the state more than offset these losses. Other researchers studying ag-to-urban transfers in Colorado and California have found similar results (Howe and Goemans 2003; Howitt 1994). In short, while a trade may cause decreased income and higher unemployment in the exporting region, such losses are generally more than offset by gains in the purchasing region. Indeed, if overall efficiency were not increased by a transfer, it would likely not take place.

Although economic theory does not recognize the legitimacy of such pecuniary externalities, the reality is that trades often do not receive regulatory approval without allowances for such economic impacts. Many water transfers provide for some compensation (National Research Council, 1992; Howe, 2000; Hanak, 2005). For example, recent long-term ag-to-urban transfers in southern California (between the Metropolitan Water District of Southern California and Palo Verde Irrigation District and between the San Diego County Water Agency and the Imperial Irrigation District) both include compensation for third parties in the form of funding for local community improvement programs (MWD 2004, SDCWA 2007). How much compensation is appropriate and how best to use this money to assist exporting communities can be controversial, as shown by the San Diego/Imperial Irrigation District transfer in particular.

The extent to which secondary impacts are significant depends in part on the value of the ceased agricultural production that facilitates the water transfer. Economic theory predicts that the least productive agricultural land will be removed from production, which would tend to minimize secondary impacts. Charney and Woodard (1990) find this to be the case in their analysis of early land and water purchases in Arizona, though they also suggest that water

exports might draw upon more productive land if municipal purchasers are interested in acquiring rights with higher seniority or easy access to transport.

Research into the effects of the 1990 California Drought Bank shows that secondary impacts can be minimized through advance planning. Dixon, Moore, and Schechter (1993) find that farmers who participated in that temporary water market used revenues from water exports to increase farm investment, which partially offset the negative impacts of the Bank. They suggest that farmer participation in multi-year fallowing programs should be rotated, since there is likely a limit to how much on-farm investment any one farmer can make over time. Spreading fallow acreage geographically and across crops minimizes negative economic impacts on any one business or sector of the farm economy, thereby reducing overall impacts (Dixon, Moore and Schechter 1993; Howitt 1994). Howitt (1994) found that on-farm employment reductions were lower than anticipated, as many farmers preferred to maintain their work force at a loss rather than re-hire at the conclusion of the Bank.

Issues and Trends in Water and Water Rights Trading

A number of studies have used actual water market transaction data to compare water market institutions and development across the western United States (Loomis *et al*. 2003; Brookshire *et al*. 2004; Howitt and Hansen 2005; Brown 2006; Brewer 2007; Hansen 2008). Although the studies differ in scope and focus, several themes emerge from them collectively. First, water markets tend to work well in places for which some or all of the transaction costs and institutional constraints discussed above are minimized. Markets are more likely to occur in locations with well-developed conveyance systems that can facilitate the physical transfer of water. Water market activity is greater in locations where water rights have been fully defined through an adjudication process (Brookshire *et al*. 2004 in particular make this point). State laws that allow water to be sold separately from the land also facilitate market activity (Easter *et al*. 1999).

Second, leases of water rights are far more common than water rights transfers. (This is true regardless of whether volume transferred under long-term leases and sales is counted once in the transaction year or cumulatively during the duration of the contract.) Hadjigeorgalis and Lillywhite (2004) observe that regulatory constraints on permanent transfers tend to increase lease activity. The analysis of Hansen (2008) suggests that much lease activity may be a response to temporary need rather than institutional constraints on permanent transfers.

Third, water markets are increasingly used to augment environmental flows, to improve wildlife habitat, and for recreational use. Loomis *et al*. (2003) document significant transfers to these environmental purposes across the western United States in the late 1990's. Reallocation of water from existing users to environmental purposes by administrative fiat can be contentious; voluntary transfers through markets are far less so. Loomis *et al*. (2003) point out that the marginal value of water for environmental use must now exceed the value of water in agricultural production in some parts of the western United States; if this were not the case, these transfers would not be occurring. Generally speaking, the environment, recreation, and wildlife have not historically been considered beneficial uses of water. Thus, state laws must change before water can be purchased or leased for these purposes. Landry (1998) summarizes the diversity of states' experiences with instream flow laws and regulations. He explains that since 1987, the states of California, Idaho, Montana, Oregon, and Washington have all enacted legislation allowing public agencies and private individuals to purchase water and/or water rights. In 1986, Colorado, Utah, and Wyoming each enacted legislation allowing

specific public agencies to purchase instream flow rights. (Colorado also permits leasing of water rights.) By contrast, Arizona, New Mexico, and Nevada do not have legislation allowing for market transfers of water rights for environmental protection. However, court decisions in all three states have established instream flow rights, to varying degrees.

Finally, a growing trend in water markets is the transfer of water from agriculture to municipal use. Water markets are driven by the high value differential between low-value agricultural producers and municipal agencies needing to acquire a firm supply of water. Long-term agriculture-to-urban leases and rights transfers are common in the growing metropolitan regions of Arizona, California, Colorado, Nevada, New Mexico, and Texas in particular. Municipalities' water rights acquisitions are a risk management strategy, as water is often leased back to irrigators until such time as the municipalities need the water to satisfy projected demand increases.

Another type of ag-to-urban transfer is dry-year options, where the buyer pays a premium for the right to lease water after supply risk has been resolved. Real-world data on options are scarce. Watters (1995) and Villinski (2003) each used existing water transfer prices to calculate option value. However, more recent water options literature tends to be either simulation-based (Gómez -Ramos and Garrido 2004; Characklis *et al*. 2006; Brown and Carriquiry 2007, to name a few) or experimental (Hansen, Kaplan, and Kroll 2010). Dry-year options have a significant political advantage over rights transfers and leases in that they provide a way to transfer water in dry years, when value to the buyer is greatest, without permanently shutting down agriculture in the exporting region (Howitt 1998). However, growth in water options is hindered by the fact that municipalities acquiring water to meet growing urban demand are acutely concerned with reliability of supply. They perceive that ownership of a water right is more secure than a long-term lease or dry-year options and are consequently willing to pay a premium for water rights, on an annualized basis (Hansen 2008).

Concluding Thoughts

Markets give water managers additional flexibility to acquire water resources in a cost-effective manner. Flexible contract arrangements such as leases and dry-year options further augment the range of options available to water managers and are likely to become increasingly important in western water markets. This is especially true if average precipitation levels decrease and variability in timing and volume of flows increases, as expected. However, the strong preference of municipal water users for acquiring water rights over leases and options may temper development of these latter types of markets, at least in some parts of the West.

Water markets may also provide an indirect benefit to society by encouraging better water management. When the opportunity cost of water is clearly signaled with a market price, water is more efficiently utilized. It remains to be seen whether the institution of prior appropriation, with the relatively new development of more easily transferable property rights, will be flexible enough to reallocate water in a world with higher demands and a possibly decreased, more variable supply.

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