2 Incentives matter: The case for market valuation of water

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Is it possible to value water? How are we to do so? Indeed, how does anyone value anything? There are three broad categories of answers to these questions.

One relies on the notion of an intrinsic value of a good, which suggests that a particular good has a definitive value which can be determined in some way. Theological speculations on the 'just price' of a good and other speculations on 'innate values' of various things often fall into this category (Woods Jr. 2005). A second category denies that a particular good is capable of valuation. Human lives, for example, are often classified as being incapable of valuation (Dietz & Vollebergh 1999, 344). The third category depends on observations about human behavior, in particular, observations about the actual choices made by real people with their scarce resources.

Markets fall into this third category. I contend that markets are connected with real choices made by real people, which lead to real consequences. These attributes enable markets to value resources in a superior manner compared to alternative arrangements.

Indeed, this chapter argues that markets provide the *only* way to value resources, including water, in a manner which does not provoke conflicts among competing users.

There are four important reasons why it is appropriate to value water (and other resources) with market processes.

First, markets are a low cost means to provide important signals

to people about the value of various uses of water. These signals help water flow to the uses where it produces the largest net benefit for water users. Second, markets allow the uses of water to vary with changes in knowledge and demand. Because they provide a dynamic – rather than a static – valuation, markets adapt to constantly changing circumstances. Third, markets encourage the production of new knowledge about water: new uses and new ways to think about these uses, new conservation methods, new delivery methods, etc. Thus, markets encourage investment in meeting human needs. Fourth, markets do not require large scale agreement among their participants on overall ends, allowing a diversity of individual ends to coexist peacefully.

In large part, the argument about markets for water is about governance of resources more generally. Markets excel in generating positive-sum transactions that benefit all parties – precisely the situation in which we should all aspire to be.

MARKETS AS LOW COST SIGNAL MECHANISMS

Transactions costs affect the ways that people organize their activities. They are real, concrete costs – such as the costs of making and enforcing contracts, and the cost of creating and enforcing property rights – which affect every day decision-making. Relative transactions costs determine whether or not people choose to conduct a transaction within a firm or in the marketplace, and whether or not it is possible to contract around an inefficient legal assignment of rights.

The cost of transacting is thus a critical component of any method which assigns value. Information costs are an important part of transactions costs (Morriss et al. 2002, 337). Transactions themselves also provide important information to others about the parties' valuation of resources, giving them a means to assess the value of their own assets and the costs of possible projects they are considering undertaking.

A market price is a remarkably compact source of fairly dense information. The market price of a commodity summarizes in a concise way (the price itself plus the terms at which the price is available) the current valuation of the good being priced (Hayek 1945; Wills 1997, 31). That valuation involves the various uses of the good in question plus the alternative uses of the resources used to make the good. The fact that markets can summarize information about myriad alternative uses of water into an easy-to-comprehend number – a price – is an all-important virtue.

Low cost transmission of information, particularly of complex information, is valuable for several reasons.

1. Less costly information means more transactions

It is a transaction cost to learn about the relative scarcity of a resource. When transactions costs fall, it means there are fewer barriers to transactions. When more transactions occur, it means that more voluntary trades occur; and more voluntary trades produce more wealth, for trade increases wealth. Increasing wealth is not only desirable in its own right but also often increases demand for improved environmental quality.

Institutions that reduce the cost of information increase the volume of transactions by lowering the cost of transacting. Today's paradigmatic example is the significant reduction in information costs produced by the dramatic drop in telecommunications costs. In turn, this was brought about by a combination of the significant steps toward deregulation of telecommunications (Hahn and Hird 1991, 233, 250), and the spread of the internet as a means of communicating price information.

All else equal, more voluntary transactions increase net social welfare because individuals do not engage in voluntary transactions unless they increase the welfare of the transacting parties. eBay is a well-known contemporary example of how increasing the volume of transactions increases welfare (Grimmelman 2005, 1749). Using eBay, individuals have found a market for countless items which are valued more highly by their buyers than by their previous owners. By broadening the potential market for these items, eBay has increased the number of transactions which are possible.

eBay does this primarily through three market-enhancements which lower transactions costs and thus increase the number of transactions. First, it reduces the search costs of finding items that buyers want. Second, it uses a feedback mechanism to provide a means to determine the quality of the buyer and seller. Third, through its PayPal subsidiary, eBay lowers the transactions costs of making payments. These features of the eBay market increase net welfare as goods move to users who value them more highly.

Water is no different from Beanie Babies™ in this regard. In the absence of a market for water, one of the problems which hinder mutually beneficial trades between users (for instance, two figurative parties called Smith and Jones) is that they lack the information needed to know that the transaction is possible, and that the transaction will produce an increase in their own welfare. Smith and Jones, in addition to people outside this transaction, have no way to know who values the water more. Even if we ask them to tell us, and then use some kind of administrative mechanism to award it to the most highly valued use, we don't know whether Smith and Jones have truthfully revealed their preferences. (Smith and Jones cannot be trusted to honestly reveal their preferences unless dishonesty is costly.) Further, because most studies show that demand for water is price sensitive, Smith's and Jones' preferences are themselves dependent on the cost of water. In the absence of a market, Smith and Jones are *unable* to compare their values for the water in question (Woods 2005, 21).

Smith wants to water her lawn; Jones wants a drink: How do we know which use is more valuable, or how a wider set of individuals would prioritize those uses? Without a market to allocate the water between Smith and Jones, we must use some alternative mechanism. Without prices, administrative allocations often rely on crude proxies for use-value. Thus residential users often pay the same price for the water they drink and the water used for their lawns, even though watering a residential lawn would likely be a lower valued use.

Sorting through individual valuations is also a costly exercise for our token decision-maker, who must gather, weigh and analyze information and then consider the truthfulness of responses. In addition, the decision-maker may be tempted to weight his decision in favor of personal considerations: Is Smith a family relative? Does the decision-maker hope to work for Jones after leaving his position of authority? Did Smith or Jones vote for the decision-maker in the last election?

These considerations – which are wholly unrelated to the value of water – often play a role in determining administrative allocations of resources. It is also costly to guard against consideration of such factors – this entails a variety of steps to verify legitimacy, all of which ultimately reduce the efficiency of the decision-making process.

However, if Smith is willing to sell to Jones, then we know that Smith values the water less than she values the alternative resources she can purchase with the money which Jones gives her in exchange for the water. Likewise, if Jones is willing to pay a price at which Smith is willing to sell, we know that Jones values the water more than the resources he must give Smith to secure it. We can make this conclusion with confidence, because Smith and Jones have proven it to be true by their actions.

In contrast to the alternatives, markets provide information on relative valuations at a low cost. Alternative arrangements require that resources be expended to learn, evaluate and compare people's preferences. These additional costs reduce the number of transactions, which reduces net welfare.[2]

2. Low cost transmission of information reduces uncertainty

When the price of a good falls, people consume more of it. In this respect, information is no different from other goods. Because markets are a less costly way to convey information than are alternative means of ordering the world, they enable people to utilize more information in their transactions. This is an effective way to reduce uncertainty: with more information rather than less, people can more accurately predict the outcome of their activities and transactions, and bear less risk while transacting.

Risk-bearing is generally a costly activity (which is why we pay insurance companies to reduce our risk of loss). To the extent that people are risk averse (Wills 1997, 233) – and we have reason to believe that most people are risk averse in most situations – reducing risk increases human welfare (Shavell 1987). More information and less risk means that people can be more certain of achieving their goals: they can devote fewer resources to hedging against uncertainties, which means they have more resources available to spend in alternative uses (e.g. devote to accomplishing their goals).

Why are markets a less costly way to convey information? First, they convey information in a compact form, reducing a wide variety of information to a single number– a price – whose movements and value are readily understood by market participants. If the price of a good rises – or falls – people receive a clear signal that the resource is becoming more – or less – valuable.

Moreover, complex financial instruments offer even more sophisticated signals. For example, in a futures market for a given commodity, movements in the price of that good today can be compared to price movements in the future (Anderson and Snyder 1997, 192; hereinafter Anderson and Snyder). As the spread between the future price and the current price changes, markets convey information about the expectations of market participants about the future.

There is good reason to believe that collective expectations about the future compiled in market prices are far more accurate than individual expectations. Because prices are based on a wider information set, markets are inexpensive and more accurate alternatives compared to speculation by individuals about the availability of a resource in the future (Surowiecki 2004).

Second, the very existence of the market itself provides an incentive to lower transactions costs. The existence of such costs provides entrepreneurs with incentives to gain market advantages by reducing those costs. Further, differences in prices across markets give entrepreneurs an incentive to engage in arbitrage, which ultimately eliminates the differences in prices (except for differences due to the cost of the arbitrage itself).

Consider financial markets, which are among the most efficient markets known (Macey 1994, 927). In a remarkably short period of time, market prices on major stock markets fully reflect new information. The result is that investors can rely on financial market prices to provide accurate signals about the value of goods and services, and these signals can be used to construct strategies which reduce risk.

Among the most prominent examples of this phenomenon is Southwest Airlines' successful price hedging strategy for jet fuel. Southwest buys financial instruments which reduce its vulnerability to increases in fuel costs: these instruments pay off if the price of jet fuel increases, which offsets the higher price the airline must pay for jet fuel (*Wall Street Journal* 2005).

How might such an arrangement affect water markets? One issue for many water users is whether water will be available in the future to meet projected needs. Farmers, for example, benefit from knowing whether or not they will have access to water to irrigate their crops before they make decisions about planting their fields. Recreational water users, and the businesses that profit from selling them ancillary services, benefit from knowing whether sufficient water will be available for a time period in which they wish to plan recreation.

Predicting the future availability of water requires weather prediction, but the natural sciences have not yet developed highly accurate methods to create long range predictions. In the face of such uncertainty, water markets would utilize the same mechanisms currently used for some commodity crops to enhance availability of water in the future (Kreitner 2000, 1102; see also discussion of spot markets for agricultural water in arid regions of Chile, Southgate and Figueroa, this volume, Chapter 3). Not only would water users be able to reduce their risk by using water futures, but also the predictive accuracy of a large number of water users would likely be greater than the non-market predictions of scientists alone (Surowiecki 2004).

Finally, information tells us about the performance of an institution. Information on the performance of private water firms is less

costly to acquire (because it is available more readily) than similar information for their non-market water counterparts (i.e. the state sector). Thus, it is far less costly to monitor the behavior of private firms, and this has clear benefits for their customers.

Not surprisingly, many state sector water institutions suffer from administration problems because they cannot effectively monitor their performance (Segerfeldt 2005, 21–22; hereinafter Segerfeldt; see also Robinson, this volume, Chapter 8). Indeed, public sector water institutions routinely fail at monitoring water use, one of the most basic information-related tasks. As a result, water is siphoned off and unaccounted for. This failure is not simply a failure of technology or competence, it is a failure caused by improper incentives (ibid. 23; see also Bhandari and Khare, this volume, Chapter 4).

3. Markets reduce the costs of information, which allows more complex transactions to occur

When information is less costly, transactions become more complex and more numerous. This enables individuals to accomplish their goals more precisely, which reduces transactions costs, reduces uncertainty and increases net welfare.

An important component of the cost of complexity is the cost of information. If individuals and firms only know one aspect of a commodity (e.g. quantity), then their transactions are limited to those which involve different amounts of the commodity. If, however, more aspects – such as the date and time of delivery – are known, then individuals and firms can vary their prices according to these numerous criteria.

When transactions become more complex, this enables individuals and firms to become more focused on the specific goals they seek to accomplish. In short, "[w]hen scarcity drives up the price of a resource, users of the resource are motivated to find alternative sources of supply, new technologies, or substitute resources" (Anderson and Snyder 18).

Water has a wide range of attributes which affect users in different ways. Consider the flow of water in a river: A unit of water in the river during a wet season has a different marginal value to the ecosystem than a unit during a dry season. The capacity of water systems can present challenges similar to those in electricity delivery, as 'peak' water costs more than 'off-peak' water as peak power costs more than off-peak power because of the greater marginal cost involved in operating at the system's limits (ibid.).

Water quality can also vary in a wide range of dimensions. Water which is allowed to stay in a river has effects on downstream users which are different than water which is removed from a river for use – even if the water is ultimately returned downstream. Water moved from one watershed to another by a user has different impacts than water which is returned to its original watershed.

It is not difficult to imagine a series of complex transactions involving water which could take place if such attributes were capable of being incorporated into markets. For example, recreational fishermen, conservation groups who are concerned with preserving an ecosystem, and tourism interests could combine to purchase rights to maintain minimum stream flows from agricultural users (ibid.124–130, 200–201). The agricultural users could, in turn, buy futures contracts that allowed them to hedge against low water levels that prevented abstraction of water for irrigation due to the stream flow contracts. The resulting transaction would be far more complex than a simple transfer of the right to a particular quantity of water. Such contracts could offer significant gains for all parties.

We have some historical evidence to support the idea that markets enable more complex transactions concerning water. During the nineteenth century, a large number of mutual irrigation companies were formed in the American West (ibid. 39–41). Economists Terry Anderson and Pamela Snyder write:

> *By using members' assets as collateral, mutual [irrigation companies] could enter capital markets to obtain the investment funds necessary to develop irrigation projects. The transferability of stocks ensured that water could be moved to higher valued alternatives, further ensuring the success of the operation. These*

features, combined with the security of rights provided by the doctrine of appropriation, stimulated an effective marketplace.

In more recent times, entrepreneurs have discovered ways to reduce waste water treatment costs through markets and complex transactions which involved multiple parties. For instance, an innovative treatment program enabled point- and non-point producers of waste to contract with each other in the Tar-Pimlico River Basin in Minnesota (Morriss et al. 2002, 345–46). These contracts saved millions of dollars in treatment costs. Others have found ways to extend water treatment systems without burdening municipal governments (Rapier 2005). By allowing more complex transactions, markets improve economic and environmental well-being.

Markets as dynamic signal mechanisms

One of the most important aspects of markets is their dynamic nature. Market prices quickly respond to constantly changing information. The change in prices sends signals to participants about the impact of events on the goods and services sold in markets. As discussed above, an individual can learn a great deal from market prices, and futures prices, about the likely course of events – even if that individual does not understand the underlying information which drives the changes in market prices (Thomsen 1994, 170). "The entrepreneur who discovers a higher valued use for water, for example, stands to gain from transferring his water to the higher valued use" (Anderson and Snyder 23).

Thus, markets are institutions which encourage individuals to adapt to constantly changing circumstances (Stroup 2000, 489).[3] Higher prices encourage new firms to enter an industry, expanding supply and often resulting in lower costs and higher quality for the consumer (Anderson and Snyder 11, 12–13). Because they tend to operate without such signals, public water companies often underprovide services to consumers (Segerfeldt 23).

The critical difference is that markets require individuals to face

the 'opportunity costs' of their actions (Anderson and Snyder 23). An opportunity cost is the cost of what a resource owner foregoes by not taking an action.

For example, suppose 100 acre-feet of water can be used to irrigate a cotton field and produce a net benefit to the water owner of $2/acre-foot. The same amount of water could be used to irrigate a 50 percent less water-intensive crop, and the surplus could be sold for $3/acre-foot. In this case, the cotton farmer's opportunity cost of not changing to the less-water intensive crop is $50. If net total value of water sales and crop sales from the alternative crop exceeds the net total value of the cotton crop, and the cotton farmer does not know about the possibility, an entrepreneur will be able to bid more for the farmer's land than the farmer currently earns, by taking into account the knowledge of the potential for shifting crops and selling the surplus water (Segerfeldt 31; Anderson and Snyder 192–193).

Recognizing opportunity costs requires transferable property rights, for a water rights owner who cannot transfer her rights will never be able to consider the full opportunity costs of her actions: other parties which have alternative uses for the water rights will have no incentive to approach her with a proposed transfer (Anderson and Snyder 24).

Markets are also dynamic signal mechanisms because they rapidly incorporate new knowledge. Entrepreneurs quickly utilize new information when it becomes available, and they spread it to others through their own behavior.

For instance, if new data reveals that soybean harvests in China are likely to be poorer than expected, those who possess that information will seek to purchase soybean futures, knowing that (other things equal) the market price for soybeans will increase as the Chinese harvest data become more widely known. The rising price of soybean futures will provide information even to those who are completely ignorant of Chinese soybean production estimates, enabling them to learn and benefit from the information uncovered by the specialists.

In contrast, administrative allocations – which either forbid transfers outright or which depend on seeking regulatory approval – interfere with this dynamic signaling process. Prohibitions on formal transfers can either eliminate the signaling altogether (by preventing transfers from occurring) or they decrease the effectiveness of market signals by driving the transactions underground. This reduces the potential for gains, by allocating gains to those who have the ability to block the transfer (Segerfeldt 24).

New information regularly appears in the field of water use. Today, we know far more about the value of in-stream uses than in the past (Anderson and Snyder 111) and we can measure water quality both more accurately and in more dimensions. We also possess more information about the effect of water uses on downstream users; we can make more sophisticated measurements of the return flows from irrigation, leading to more accurate calculations about the impact of irrigation on downstream water users. There is potential for significant gains from trade when dynamic information about water is available to water users, and when that information can be incorporated into water use rights and contracts.

Market incentives to create new knowledge

Markets create opportunities for entrepreneurs to profit by developing new knowledge about both market conditions and goods and services. A market participant has the opportunity to profit by making use of newly-discovered information. As a result, markets encourage investment in information. As Segerfeldt notes, "A private firm competing with other firms for the customers' favor must always be devising new and better methods and must be as efficient as possible" (Segerfeldt, 24; Dietz & Vollebergh 1999, 339)

Applied to water, the incentive to create knowledge is likely to produce investment in four areas, all of which will serve to enable better use, production, delivery and conservation.

First, if holders of existing water rights are to trade those rights,

then it is likely that entrepreneurs will invest in new technology to maximize the value of the rights. Indeed, where waste exists, so does an entrepreneurial opportunity (Morriss et al. 2002, 343). More efficient application of water in agriculture, for example, can free a portion of an existing allocation for new uses. Someone who invents a more efficient method of irrigation can thus create value for existing agricultural water users by allowing them to sell a portion of their water without reducing their agricultural production (Anderson and Snyder 11).

Second, entrepreneurs will invest in new sources of water, far beyond simply digging new wells. New sources of water exist, for only a very small percentage of the world's supply of fresh water is consumed by humans (Segerfeldt 14). Indeed, outside of a relatively few geographical areas, humanity faces only an economic scarcity – not a physical scarcity – of water (Segerfeldt 15; Anderson and Snyder 1–7). Potential water sources include reducing waste (Zilberman & Lipper 1999), recycling used water and developing greater understanding of hydrology. We could also allow water users who add water back into systems to receive credit for their inputs against their withdrawals.

Third, entrepreneurs will invest in alternatives to water use. Reducing use is not simply a matter of utilizing low-flow shower heads and front-loading washing machines. Water markets that fully price the use of water are likely to lead to less reliance on plants which require large amounts of water in landscaping in arid areas, for example. Similarly, other factors of production will be substituted for water in response to higher prices.

One stark example is the drastic reduction during the past century in the volume of water required to produce steel: in 1930, one metric ton of steel required 200 metric tons of water, today it requires an average of 20 metric tons. Indeed, some steel manufacturers today use only three to four metric tons of water (Segerfeldt 16; Anderson and Snyder Table 1.1, 9).

Similarly, agricultural uses vary considerably with respect to their demand for water. Farmers can readily shift to less water-

intensive crops and more efficient irrigation techniques if they have the opportunity to profit from water sales (Anderson and Snyder 10–11; Zilberman and Lipper 1999, 147).[4] Water companies will reduce waste in transmission if water becomes more valuable (Segerfeldt 31–32). Producers and consumers "respond rationally to water prices" (Anderson and Snyder 11).

Finally, one of today's urgent challenges with respect to water is simply the lack of adequate investment in producing and distributing safe water (Segerfeldt 15). It is not that we lack knowledge of how physically to deliver water to those who lack it; we lack the knowledge of how to do so cost-effectively. Entrepreneurs who discover ways to reduce the cost of creating and maintaining the infrastructure necessary to produce and deliver clean, safe water can profit from so doing.

Markets enable diverse human ends

A significant advantage of markets over alternative means of valuing and allocating goods is that markets do not require a social agreement on the values of the uses to which people plan to put the goods they purchase in the marketplace. Compared to non-market alternatives, markets generate fewer conflicts over whether the appropriate ends have been selected as high value uses.

For example, agricultural and residential users often compete for the same water resources. Without a market to enable transfers, agricultural water rights holders whose rights are reallocated to residential uses are not compensated for their loss, while the residential users receive something of a windfall. Both groups are thus likely to expend resources in the attempt to, respectively, block or facilitate the reassignment (Anderson and Snyder 25–28).

Economists refer to this phenomenon as "rent-seeking". Rent-seeking leads to dissipation of welfare through political competition. The money spent to capture the gains or prevent the losses from the transfer – both of which are referred to as "rents" by economists – benefits no one (except the lobbyists and lawyers involved) and creates no value (Krutilla 1999, 252–253). Whether the transfer will occur depends in part on some socially agreed upon relative valuation of agricultural and residential uses. If the society is democratic, it is costly to use the political system to make allocations. It also increases conflicts between agricultural and urban interest groups. If the society is not democratic, the decision is possibly cheaper (it simply may be "what does the dictator think is the appropriate outcome?"). Decisions in this situation are even less likely to rely on appropriate criteria, for the decision will affect the regime's ability to maintain itself in power.

Summary

Markets for water rights hold the potential to unleash significant entrepreneurial activity in water production and consumption. We need many additional entrepreneurs, whether small or large, to focus on water at all levels because more than one billion people lack access to clean and safe water – a number which "has held constant for decades" (Segerfeldt 1). In this environment, water rights have the potential to evolve into a more complex bundle than has so far been recognized with limited efforts to create water markets (Anderson and Snyder 44).

Marketable water rights will acquire quality, temporal, and other characteristics, all of which would allow a wide range of transactions not currently possible. We cannot fully anticipate what these transactions will look like, because we lack all of the information necessary to do so. We do know that decentralized free markets can more effectively utilize information than even the most sophisticated administrative arrangement. Unless there are significant problems with markets, these advantages should create a presumption in favor of relying on markets.

CRITICISMS OF WATER MARKETS IN PERSPECTIVE

Markets provide consumers with a wide range of goods and services, including vital ones such as food and housing. As Anderson and Snyder note, "Water certainly is necessary for life. But clothing and shelter are also necessities, and there is no justification for having governments control their allocation" (49). The mere identification of a good as a necessity is thus an insufficient justification for removing it from the marketplace.[5]

The standard justification for use of non-market arrangements is the idea that 'market failures' will occur more readily, and at a greater scale, than failure by an intervening institution.

Are major market failures likely to occur with water markets? There are certainly many self-styled opponents of water markets (Shiva 2002; Barlow and Clarke 2002), including many economists (outlined in Bate and Tren 2002, 35). These critics' primary complaints about water markets concern the alleged existence of externalities, the existence of a natural monopoly in water provision, and issues relating to affordability (and justice) of requiring the poor to pay for water. Do any of these concerns suggest that an alternative to water markets is superior?

Externalities

Externalities exist when there are attributes of a good which are not reflected in its market price, and thus are not considered by decision-makers using market information (Wills 1997, 63). For example, suppose in-stream flows produce habitat for fish. Since the affected fish are unlikely to be market participants directly, the fish-habitat aspect of the in-stream flow characteristic of water may not be a characteristic for which there is market demand (Anderson and Snyder 19). Many opponents of water markets contend that such externalities are pervasive (ibid, 19–20; Segerfeldt 76; Shiva 2002, 6), while market proponents find that externalities "are overused as an argument for governmental intervention in water markets" (Anderson and Snyder 52).

However, the issue is not whether externalities exist, but the relative size of externalities which might result from alternative arrangements. Consider, for example, the destruction of the Aral Sea – perhaps the largest environmental disaster relating to water in modern times. This tragedy resulted from the misallocation of water resources by the Soviet bureaucracy – the antithesis of a market allocation (Bissell 2002, 41).[6]

There are several responses that get to the heart of whether claims about externalities in water markets have any merit.

First, there is a real question about the magnitude of such problems. In many instances, a good's un-priced attributes relate to other attributes which are priced. For example, game fish species are highly valued by sports fishermen and businesses which cater to those fishermen. Maintaining in-stream flows for sport fish also maintains the flows for non-sport fish. To the extent that sport- and non-sport fish are part of the same eco-system, the benefits of maintaining a healthy eco-system for the sport fish will provide 'spillover' benefits to other fish. The mere existence of a fish which is currently unvalued for human use is thus not sufficient to demonstrate that a market-based water allocation scheme would produce an externality.

Second, even if such a fish species existed, with attributes such that there was no market demand for providing it with sufficient water to survive, we need not do away with water markets to solve the problem. By introducing a market actor with a budget and a mission to protect such species, we can create a demand for this previously un-priced attribute without disrupting the other beneficial aspects of water markets.

Third, many external effects result from efficiency-enhancing transactions. So, for example, if Smith sells Jones some water rights, a third party (Black) may be harmed in the marketplace by Jones' new water rights. "Naturally the third parties would like to restrict competition" by prohibiting the transfer (Anderson and Snyder 85). However, such harms cannot be compensated – they are inherent to the competitive market process, and are thus a vital part of improving humanity's living standards.

Fourth, external effects may not be widespread. Agricultural communities often voice concern about large scale water transfers to urban users, usually based on the high prices that cities are willing to pay to acquire water rights. These concerns fail to consider the way that the units of water are likely to be valued: the first units of water are the most highly valued and likely to fetch a higher price, but it is unlikely that relatively high prices will be offered for all the units. Moreover, the low return many farmers receive for their water use is based on their current total use. Since farmers would sell the units which are of lowest marginal value, their returns would increase as the urban marginal demand falls, making it unlikely that as much water would shift as the initial price gap might suggest (ibid. 85–86).

These qualifications reduce the number of concerns about externalities, but they do not eliminate all concerns. Let us consider how significant these are likely to be.

Externalities are the (mostly unforeseen) consequences of economic activities, including many that are not subject to transactions at all – but could be. Economist Harold Demsetz explained that

> *Property rights specify how persons may be benefited and harmed and, therefore, who must pay whom to modify the actions taken by the persons. The recognition of this leads easily to the close relationship between property rights and externalities… What converts a harmful or beneficial effect into an externality is that the cost of bringing the effect to bear on the decisions of one or more interacting persons is too high to make it worthwhile* (Demsetz 1969, 347–348).

How often is this true of water markets? It is certainly the case that there are aspects of water use which are not considered by the participants in a market transaction. For example, there may be unknown or unforeseeable impacts on an ecosystem when water is withdrawn at a particular time and place. By definition, therefore, no one in the market or in alternative institutions will be aware that such problems exist.

There may by other impacts, however, known to the scientific community but not to the market participants. Depending on the relative cost of doing so, entrepreneurs might respond to this situation by creating a new transaction – a new way of packaging water rights, for instance – which accounts for that information. Even when this involves disparate parties, there may be alternative contracting parties that solve the free rider problem (Anderson and Snyder 113–114; Bate 2003).[7]

All well and good, but sometimes such transactions may not occur because the transactions costs are simply too high. In these cases, markets will fail to provide a response capable of ensuring that all bad outcomes do not occur.

This is certainly true, but all institutions suffer from such problems. We cannot demand perfection from any institution or we are doomed to disappointment. The issue is whether markets fare better or worse when compared to the non-market allocation mechanisms touted as the solution to externalities (Bate and Tren 2002, 36).

Such solutions would occur "without the benefit of information contained in market prices" (Anderson and Snyder 21). As discussed earlier, however, markets excel at low cost information processing, relative to other institutions (Wills 1997, 42–45). Moreover, for a non-market institution to be preferable to markets in resolving an externality problem, the alternative must be less costly at solving the problem than the alternative of introducing a new market participant into the market (e.g. funding an organization of sporting enthusiasts to acquire in-stream rights).

The class of externalities where non-markets outperform markets would have to be either extremely high value, or quite numerous, to give a non-market alternative the advantage. However, the proponents of non-market arrangements have not provided a sufficient theoretical basis to set aside the presumption in favor of voluntary transactions in markets.

Natural monopolies

It is frequently claimed that water or various water projects constitute a "natural monopoly" (summary of literature in Anderson and Snyder 50–52). In this situation, supply of water would be controlled in each area by a single firm, which would then charge monopoly prices that harm consumers. (Somewhat paradoxically, market critics frequently propose a 'remedy' in the form of a state monopoly; for a critique of state monopolies see Robinson, this volume, chapter 8.)

This claim is flawed for two important reasons. First, the existence of a natural monopoly in any particular aspect of a water system does not justify the creation of a state monopoly on the entire system (Morriss 1998, 138–156). Suppose that the capital costs of water mains are prohibitively expensive, such that it is inefficient to provide multiple mains in a region. This fact does not justify creating a monopoly on water distribution. A wide range of potential strategies can be implemented to limit the natural monopoly to the specific geographical area where it exists. Delivery can be unbundled from supply (as was successfully done with natural gas) (Pierce Jr. 1994, 323–324) or contracts can provide incentives for appropriate performance by the operator of the natural monopoly aspect of the system (Morriss 1998, 184–186). At the same time, a local monopolist would (in order to maximize profits) have incentives to offer differential prices, ensuring that all consumers willing to pay the marginal cost of production are supplied. "Unlike the governmental and regulated alternatives, a private unregulated monopoly also would have strong incentives to hold down costs and supply an optimal quality of product" (Cowen and Brook Cowen 1998, 23).

Moreover, competition in water supply may be more widespread than many believe, because of the potential for competition between ground-water and surface water-based systems (Anderson and Snyder 1997, 51).

Second, the concept of a "natural monopoly" has come under critical academic scrutiny in recent years. More recent work has exposed serious conceptual flaws in the definition of natural monopolies, which casts doubt on the extent to which to which natural monopolies exist in the real world (Hazlett 1985, 6–7). The potential existence of a natural monopoly is thus an insufficient reason to reject the role of markets.

"Markets harm the poor"

Markets respond to resources and, by definition, poor people have fewer resources than those who are relatively better off. Many opponents allege that using markets to distribute water will make the poor worse off than an alternative (which does not rely on individuals' relative resource endowments). To make an accurate evaluation, we must consider the nature of the alternative institution: If water is not distributed via markets, how will it be distributed?

In the real world, administrative allocation systems tend not to favor the poor for the simple reason that the poor rarely possess enough political power to secure administrative allocations in their favor. Many state-subsidized water systems actually operate as a regressive tax, bestowing benefits on the wealthy while taxing the poor. So the appropriate benchmark necessary to make an accurate comparison is not a hypothetical "just" distribution which uses whatever ethical standard an opponent might favor, but the distribution which occurs with politically-determined, administrative resource allocations.

Nonetheless, with a market allocation of any good, the poor will get less than those who are relatively wealthier, simply because they have relatively fewer resources. The important question is whether they will obtain less water than in alternative, non-market arrangements?

The poor have actually fared comparatively well in market systems (Rosegrant and Gazmuri 1994); see also Southgate and Figueroa, this volume, Chapter 3). Real water costs for poor consumers have often dropped considerably when water systems compete to extend service to poor areas (Hinrichsen et al. 1998).

Moreover, privatization means that water systems significantly improve the quality of water which is delivered to poor neighborhoods. Where problems exist, in general the poor have been victims of incomplete markets rather than of overly aggressive extension of market forces.

By contrast, non-market water allocation mechanisms have not performed well generally or with respect to the poor. As Segerfeldt notes, "There are roughly as many extremely poor people in the world (people living on less than a dollar a day) as there are people without access to safe water. In fact, these are to a great extent the same people" (8–9).

Indeed, it is misleading to discuss "the poor" as if they were a monolithic group with identical interests. Many poor people in developing countries currently pay high prices for water because the only available clean water supply in their neighborhoods comes from water tankers or from distant wells (where the main cost is the time to fetch the water, and the inconvenience of not having piped water; both costs are generally not accounted for).

If markets result in water being delivered to poor neighborhoods by water mains, the cost of water– even if it is at a relatively higher price than the price for piped water in other neighborhoods – is still likely to be far less than the price they are currently paying. Even if opponents of privatization are correct when they claim that water markets increase the current price of piped water, the extension of water markets to poor areas is still likely to benefit the poor – especially through improved health and sanitation, convenience and competition.

Claims that markets cause the poor to suffer are thus underspecified, because the impacts of markets are likely to vary among groups within the larger population of "the poor." For many poor people around the world, water markets are likely to produce a net gain. At the same time, if an increase in price did negatively impact the poor, this could be offset by some kind of voucher or direct transfer, such as Chile's use of water stamps.

The alternatives to markets

For those who claim to identify a problem with markets, we must ask "Compared to what?" We cannot judge institutions in isolation; we must compare the strengths and weaknesses of alternative institutions before we can draw conclusions about any particular arrangement.

Fortunately we need not consider a wide range of alternatives to understand the institutional strengths of markets. All of the alternatives to markets share one of two common characteristics: they rely either upon administrative allocation of water rights or they are characterized by an absence of property rights in water. These two characteristics enable a comparison to be made between markets and a wide range of alternatives.

Rights-based vs. non-rights based allocations

In non-rights-based allocations, water belongs to the person who takes it. Without rights to water, it must remain in the commons until captured and consumed. (Moreover, if even capture does not convey rights, the water must be consumed rapidly, or it will be subject to capture by another.) Garrett Hardin explained non-rights-based allocation systems in his classic article *The Tragedy of the Commons*, which argues that resources left in the commons would inevitably and disastrously be over-exploited (Hardin 1968). The solutions Hardin considered were either privatization (e.g. the creation of rights) or "coercive laws or taxing devices" to prevent over-exploitation of the commons (ibid.).

Fortunately, subsequent analyses found that the tragic circumstances postulated by Hardin rarely exist in the world, precisely because their consequences are so disastrous (Ostrom 1990). Resources that may appear to be a "commons" are often regulated by systems of customary rights which operate as the functional equivalent to property rights. Thus in Hardin's paradigmatic case of the English common pasture, later research revealed the existence of customary institutions which limited the ability of individuals to add cattle to the common field. Here, and with many other

resources, customary institutions prevented the "tragedy of the commons" from occurring.

In instances where a rule of capture applies, however, the tragedy of the commons does occur. For example, during the 1990s, the groundwater regime in Texas tended toward a tragedy of the commons because it relied on the rule of capture and did not allow rights in ground water in place (Thompson Jr. 2000, 266–267; Zilberman & Lipper 1999, 151).

Opponents of water markets often assert that "community based" institutions are superior to markets (Shiva 2002, 19). Yet they lack explanations as to how such institutions create incentives for appropriate water use, and they are selective in their choice of communities.[8]

It may be legitimate to be concerned about who receives the initial allocation of rights, but once rights are allocated, nothing prevents the rights-holders from creating community-based common pools out of their rights. Indeed, some communities have managed just such arrangements.[9] Given the specificity of the cultural arrangements necessary to make such systems function, however, there seems little reason to force everyone to adopt such systems.

The lesson of the tragedy of the commons is that rights-based solutions have an important advantage over non-rights based institutions when we wish to protect a particular resource from overexploitation. Since water falls into this category of resources, a rights-based solution will (absent extraordinary circumstances) create better outcomes than a non-rights based solution.

Administrative vs. voluntary allocations

If we choose a rights-based allocation as the basis for our system, the remaining issues are how to allocate the initial distribution of rights, whether to allow reallocations of rights once they are allocated, and, if reallocations are allowed, whether voluntary reallocations may occur between individuals or whether these require approval by a centralized decision-maker. To some extent, errors in the initial distribution can be corrected through transfers, if they are allowed.

Thus the question revolves around whether or not to allow voluntary transfers of rights, or whether to limit voluntary exchanges of rights through some administrative mechanism.[10] Voluntary transfers imply that the transaction will produce a net gain in wealth for the parties; by definition, people do not engage in voluntary transactions that they believe will make them worse off.

The same cannot be said of involuntary transfers, however, since the only evidence is that the token administrative authority decided that the transfer was desirable.[11] Since the authority may possess motives which are less than desirable – a possibility in all systems short of a government staffed by angels (Federalist No. 51) – the mere existence of the transfer does not tell us that it increases net value.

If we allow voluntary transfers in a rights-based system, we have a market. If we permit only administrative reallocations to occur, no market exists. There are various intermediate regimes (in which rights might be taken for public use, for example, with compensation paid), but a comparison of these two extremes is useful.

Non-market allocations require administrators to collect a great deal of essential information. For example, an administrative decision about how water should be allocated among competing agricultural users must account for the relative costs and quality of the land, and its suitability for irrigation, as well as the users' plans for which crops to grow. A more complex issue would be a trade-off between urban and agricultural uses, a decision which would require an even wider range of facts to make a "correct" allocation (under whatever standard is used). The answers to such questions are neither obvious nor inexpensive to discover.

The key to this discussion is that administrative allocations require considerable information. It was precisely this point that led Nobel laureate economist Friedrich Hayek to make a convincing case for the superiority of markets over central planning generally. Hayek explained that markets are an efficient means to process

decentralized information, but central planners are not (Hayek 1945; Wills 1997, 42–43). The greater the cost of incorporating the information we desire from the planner, therefore, the less likely it is that the planner will use it to inform allocation decisions.

Advocates of non-market mechanisms make two assumptions. First, they assume that such mechanisms are superior to the market because they incorporate some information or value into the decisions that markets cannot capture, or have not captured. Second, they assume that this superiority is sufficiently large that it offsets the market's superiority in considering local knowledge. These are dubious assumptions, since the transaction costs involved in amassing and processing information (e.g. the plans of individuals, local knowledge of specific characteristics of individual plots of land, etc.) are significant.[12]

Moreover, they make the unrealistic assumption that the administrative mechanism will be designed so as not to incorporate inappropriate considerations into the decision making (e.g. political factors) (Anderson and Snyder 59–60). The transactions costs of "accountable government" are themselves considerable. Due process and separation of powers, for example, impose considerable transactions costs (Wills 1997, 108–109) and many countries lack even these basic elements of the rule of law. In combination, these unrealistic assumptions suggest that non-market alternatives are unviable.

Foundations for water markets

Markets generally require secure property rights and the rule of law to function (Anderson and Snyder 1997, 14). Water markets are no different.

What does it mean to provide secure property rights to water? Property rights must be "3-D" to support markets: definable, defensible, and defeasible (Yandle and Morriss 2001; Wills 1997, 23). For property rights to water to be *definable* requires that we define the characteristics of water which make up the bundle of rights. Early definitions of water rights in the American west focused on quantity and priority; today we also recognize the importance of a wide range of quality variables. *Defensible* property rights are rights which are recognized by law and capable of being defended in court against unauthorized interference by others. *Defeasible* property rights are rights which can be transferred to others.

The definition of rights for a commodity such as water presents challenges for the legal system, since the relevant dimensions are likely to change over time as our knowledge of water and our thirst for transactions involving water rights increase. The contours of water rights must therefore remain flexible, allowing courts to expand their boundaries as new knowledge is brought to bear. Thus, a common law process for defining water rights will likely be superior to a statutory definition, because the flexibility of the common law will make the rights more readily expanded to incorporate new dimensions.

A clear definition of water rights is most important: "Well-defined water rights give individuals a clear idea of what they own" and hence they define the realm of actions that are possible with this resource (Anderson and Snyder 23).

Unfortunately, water rights in the United States have often fallen victim to outdated knowledge through statutory definitions which fail to allow for expanding definitions of the dimensions of the property right. In-stream uses, for example, were forbidden by many western states which utilized the prior appropriation doctrine, which followed a "use it or lose it" approach and did not recognize preservation of stream flow as a "use" (ibid., 80–81). Similarly, transactions are obstructed by definitions of water rights that tie ownership of the rights to ownership of a particular parcel of land. This increases the transactions costs of a transfer, since the buyer of the water must also purchase the land associated with the water.

WATER MARKETS AND THE FUTURE

Water can be precious or worthless – it depends on the time and place where it sits and flows. In arid regions, water (when present)

tends to have higher values than in more humid areas, where flooding can give water a negative value in many instances. The value of water thus depends on a wide range of factors, a range that is difficult for human institutions competently to value outside the context of real choices by real people with real resources. All too often, administrative allocations of water freeze the definition of water, neglecting the fact that our knowledge of the value of water is dynamic.

Today, we know far more about water institutions, the attributes of water and its possible uses than we knew fifty or one hundred years ago. We also have ideas about how water might be used in the future. Yet we cannot say with any certainty what the most valued use of water will be tomorrow. In 1900, who would have predicted explosive growth in Phoenix, Arizona (in the middle of the desert) since World War II, the development of shrimp farming in arid regions in Texas, or the expansion of an extensive sport fishing industry throughout the Rocky Mountain west? Given all that we do not – and cannot – know about the future, there is a high premium on the adaptability of institutions that humanity chooses to use for the management of our most precious resources.

Fortunately, there is a simple, straightforward and inexpensive solution to the economic scarcity of water that plagues more than a billion of our fellow humans: we must clear away "the current morass of legislative and administrative rules" that obstruct the development of water markets (Anderson and Snyder 13). By enabling such markets to develop, we will unleash the enormous creative power of entrepreneurs to address the problems of inadequate water, inefficient uses of water, and poor water quality.

The obstacle to unleashing the value of water is that special interests do attempt to manipulate the state to protect their claim to this increasingly valuable resource. In an earlier history of the evolution of water law, I noted that "It was not the manipulation of water but the manipulation of government about water that marked the West" (Morriss 2001, 867). Attempts to rely on "cultural" explanations for water use neglect the fact that it is not an inherent

characteristic of a culture that determines water use, but the incentives created by that culture's institutions (Shiva 2002, 119).

What we do know is that policies matter in human terms. As Fredrik Segerfeldt noted, "there is actually an astonishing level of difference between countries at similar levels of development, suggesting that policies matter a lot … " (Segerfeldt 15). We have spent decades and billions of dollars on attempts to provide water without markets. Is it not time to try something else?

Notes

1. A more extensive version of this chapter is forthcoming in the proceedings of the Texas Tech University Center for Water Law & Policy's first annual conference on water law, *The Value and Ethic of Water*, under the title "Real People, Real Resources, & Real Choices: The Case for Market Valuation of Water," *Texas Tech Law Review*, vol. 38 (forthcoming 2006).
2. One caveat to the above is needed: I am assuming that the transactions which occur as a result of the reduced information costs made possible by markets do not themselves produce *compensable* harms for others. See Anderson and Snyder (1997, 140–141), discussing need to limit lawsuits to instances of actual damages. This is assumption is reasonable because if the transactions produced compensable harms, the victims would seek compensation. The restriction of concern to compensable harms is important, for there are a variety of harms which transactions may cause for which there is not only no compensation due but whose occurrence is not recognized as a loss. These include losses in the marketplace as a result of competition by others. If a competitor opens a store down the street from me and offers lower prices or better service and so lures away my customers, I have been harmed but the law does not recognize that harm as compensable. (In a section below, I discuss the externality-based critique in more detail.)
3. As Richard Stroup summarizes:
Entrepreneurship is the key to efficiency in a world where technology and relative prices change rapidly. Private firms are constantly adjusting their own organizations to handle changing problems and oppor-

tunities. For them the carrot is profit; the stick is failure to survive under competition. Feedback to them from the product market tends to be constant (Stroup 2000, 485, 489).

4. Shiva argues that "[b]y failing to recognize water as a limiting factor in food production, industrial agriculture has promoted waste" (Shiva 2002, 108). This claim, like many made in the anti-market literature, rests on a profound misunderstanding of current water institutions. What Shiva is observing is more likely the absence of markets, in which politically powerful agricultural interests have secured subsidized water. For example, Shiva cites the example of "sugar barons" in Maharashtra opposing the diversion of water from sugar production (ibid. 125). Of course the sugar barons are not operating in a market when they threaten that "a canal of blood will flow" if they do not receive their water, for there is no market mechanism to create "canals of blood."
5. Moreover, those who wish to remove one necessity from the marketplace but not others bear the burden of identifying a principled distinction that explains the different results.
6. Bizarrely, Shiva cites the Aral Sea disaster as a criticism of markets (Shiva 2002, 111–112). Her argument appears to be that the problem arose because of Soviet "industrial farming" and that such farming is somehow a market phenomenon (ibid. 112). The Soviet economy, however, was not a market economy. Of course, a market could never produce the Aral Sea disaster because the cost of acquiring the rights necessary through voluntary transactions would far exceed the benefits of the project. Only a government can create a disaster of such a magnitude for only a government can seize property rights on such a scale without paying compensation.
7. Ducks Unlimited is an example of a successful private effort to save sufficient wetlands to use for migration purposes ensure migratory waterfowl can successfully migrate. Similar groups include Trout Unlimited and The Nature Conservancy. See Anderson and Snyder (1997, 113–114). Similarly English fishermen banded together in associations to protect water quality (Bate 2003).
8. Shiva, for example, is highly critical of "cowboy economics" and the prior appropriation doctrine in the American West (yet she is seemingly ignorant of its roots in earlier legal systems). She fails to recognize that the development of prior appropriation was a community response to arid conditions in the West (Morriss 2001, 884–88). At the same time, she praises communal water systems in India, which were based on the existence of a landless caste whose neutrality in allocating water stemmed from their lack of resources. Shiva describes the system as follows:

   > *To ensure neutrality,* nirkattis *were chosen from the landless caste – the Harijans – who were granted autonomy from landowners and caste groups. Only the Harijans held the power to close and open the tanks or vents. Once the farmers laid down the rules of distribution, no individual farmer could interfere and those who did could be fined. This protection of the associations from the economically powerful ensured water democracy* (Shiva 2002, 30).

   Shiva does not explain how the existence of a "landless caste" is consistent with democracy nor how the Harijans would maintain their neutrality if they were allowed to own land. It is difficult to see the moral merit in a system which depends upon mass disenfranchisement.
9. Symposium discussion noted several water systems in New Mexico pueblos were excellent examples. Symposium, "The Value and Ethic of Water", Center for Water Law and Policy, Texas Tech University, Lubbock, Texas, November 2005.
10. I assume that some transfers will be permitted by the system, whether voluntary or involuntary, because there are very large dead weight losses from forbidding transfers entirely (Anderson and Snyder 1997, 60).
11. For example, as Anderson and Snyder (1997) note,

    > *Rents can also be obtained … by redistributing the economic pie using the coercive powers of government. Suppose, for example, that the government is willing to tax a segment of the population to provide a subsidy for an irrigation project that will allow grape production. If water is free to the grape farmer but costs taxpayers $60 per acre-foot and produces additional grapes worth $50, the grape farmer is clearly better off. Those who obtain the subsidized water from the project capture rents equal to the difference between what they have to pay and what the water is worth to them. In that process, taxpayers lose part of their income, but grape growers receiving the subsidized irrigation water enjoy an increase in their wealth* (48).

12. The existence of uncertainty in the neoclassical paradigm is often used as a justification for rejecting markets. As Anderson and Snyder (1997) note:

    > *some economists are skeptical about markets because individuals must act in a world of uncertainty without perfect information. In the traditional economics paradigm, uncertainty and information costs imply market failure that warrants government intervention. For example, in the presence of uncertainty about water availability, many states have drought plans ready to be implemented by "water experts" in state agencies. Economist Thomas Sowell notes that "the conduct of social activities depends upon the special knowledge of the few being used to guide the actions of the many"* (18–19).

    Such an analysis neglects the important incentive effects of markets and the role of entrepreneurs, as stressed by Anderson and Snyder. See also Anderson and Snyder (1997, 24); Segerfeldt (2005, 71). Some water market critics fail to grasp the local nature of knowledge that markets allow to be considered. Shiva, for example, argues that "cooperative management systems" are superior to markets because they are free from control by "dominant bureaucracies" (Shiva 2002, 123). Such a claim may have been true historically, and if so the cooperative management system is possibly the equal of a local market in its ability to take into account local information. There are multiple examples of institutions that manage resources in specific locations through customary law and other means; see Ostrom (1990). See also Wills (1997, 99–100). Such institutions are not inconsistent with markets, and indeed rely on markets for information about events outside the local community.

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