Transaction Costs in Water Transfers: The issue of local control

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I. Introduction

As water becomes increasingly scarce relative to demand, it becomes increasingly important to maximize the value that we derive from it. For years, economists have been advocating increased reliance on water markets as a means of rationalizing water use, the objective being to facilitate the allocation of water to its highest-value uses.[1] Yet in many parts of the arid West, water markets have been surprisingly slow to take hold. Despite some recent progress, perhaps nowhere is this truer than in California.[2] The conditions of extreme drought recently experienced by the state make it even more incumbent to better understand why water markets have been so slow to emerge.

This question has not, of course, been ignored by economists, who have pointed to various sources of transaction costs, especially associated with the administration of the state's permit system and rules established by government entities, especially state and federal agencies. Other economists have pointed to various features of state water law itself, which imposes certain broad restrictions on out-of-basin transfers and transfers that impose impacts on third parties.

In many jurisdictions, including California, water markets may be inhibited by legal standing enjoyed by many entities to object to transfers that may harm them.[3]

There is likely merit to all of these arguments, but I suggest here another possibility that may help explain the relative paucity of water markets and water transfers more generally. Specifically, I will argue that potential sellers may experience *loss aversion* with regard to amenities associated with their historical uses of water. In California (and in many other western jurisdictions), potential sellers of water are largely farmers in rural areas. The historical development and use of water has not only enabled them to engage in irrigated farming, it has formed an important portion of the basis for their farming communities, local economies, and their rural ways of life. The prospect of water leaving their localities raises the specter of losing the local amenities that they have grown accustomed to having, and they may feel this prospective loss deeply: perhaps more deeply than they value an equivalent amount of gain from selling the water: what behavioral economists call loss aversion. Associated with loss aversion is the related phenomenon that farmers may value what they own more than that which is owned by someone else, what is known as the *endowment effect*. When this occurs, prospective sellers must be offered a larger sum to induce them to part with their water than seems consistent with objective measures of the value of the water in production.

These factors alone would deter some transactions from occurring. An additional ramification is interest in maintaining local control over water supplies, to guard against outcomes about which farmers are loss averse. Part of their interest is in preempting decisions that might be made at higher levels of jurisdiction, including state and federal levels, fearing such decisions would put the status quo at risk. Being able to mandate that water allocation decisions are subject to local control would help to guard against the potential loss of local water supplies.

The rest of this paper will develop these arguments in more detail. Section II briefly lays out some relevant principles of prospect theory, especially loss aversion. It is perhaps appropriate to stress that loss aversion is modeled not with regard to the water itself but rather, with regard to local amenities for which water is a factor input. Section III turns to two different sources of evidence that are suggestive of the existence of loss aversion among farmers: the political economy literature on agricultural subsidies and the sociological literature on rural communities. Section IV examines the institutional context in California for water transfers to occur, focusing specifically on groundwater. Section V then turns to a qualitative examination of evidence on attitudes towards local control and restrictions on groundwater exports, using a database of local groundwater management plans (GMPs) created between 1992 and 2013. Section VI reports the results of an econometric analysis that applies public choice concepts to analyze two provisions contained in the GMPs: export restrictions and statement of local control. Section VII concludes.

II. Prospect theory and loss aversion

In recent years, prospect theory has posed major conceptual challenges to traditional utility theory. Two related components of prospect theory will be directly relevant for this study. The first is the *endowment effect*, the notion that individuals ascribe greater value to things in their possession than to equivalent things owned by others. When the endowment effect is operant, then one must be offered more to part with a good than one is willing to pay for that same good owned by someone else. This is commonly phrased as willingness to pay being less than willingness to accept. The second is what is known as *loss aversion*, the notion that individuals respond asymmetrically to gains and losses, feeling losses more deeply than nominally equivalent gains.

Early studies of prospect theory focused on documenting that these phenomena exist, typically within an experimental setting. The experiments tended to be relatively simple ones involving household items like candy bars or coffee mugs.[4] Now that the endowment effect and loss aversion have been shown to exist pretty conclusively, researchers have begun to explore their implications in a variety of different areas, including finance[5]; insurance[6]; real estate[7]; public health advertising[8]; labor supply[9]; political economy[10]; educational outcomes[11]; international trade[12]; environmental protection[13]; and even professional sports[14].

The literature on the applications of prospect theory to natural resource development and use is not as richly developed, even though Elinor Ostrom pointed out its potential importance in local governance efforts twenty-five years ago. According to Ostrom, loss aversion may affect the rhetoric of debates over governance, making political leaders more likely to speak in terms of crises. She also argues that the same phenomenon may make it so that users adopt new governance rules only when there are clear signs of impending resource degradation.[15] Both of these manifestations of loss aversion would help explain what seems to be a consistent pattern over time that episodes of severe drought tend to spur new institutional developments in water governance.

In one of the only existing studies that applies prospect theory to water markets, Ranjan and Shogren examine the impact on water transactions of the possible loss of right to water sold in a market[16]. Their model yields the intuitive result that transactions are discouraged when the seller fears a loss of right if he participates in the market. However, their paper is theoretical and does not address the question why participants should be loss-averse about water. This paper expands on their basic idea, but it goes further in developing the notion of loss aversion and why it exists. Furthermore, it summons evidence from a number of different sources and literatures to

provide both qualitative and quantitative evidence that suggest that loss aversion may be operant among farmers in general and in local groundwater management districts in California.

The result that loss aversion may reduce the propensity to trade in water is consistent with recent studies in the international trade literature that document that the presence of loss aversion may discourage trade among countries. These studies also speak to certain political anomalies, especially the common phenomenon that declining industries benefit disproportionately from protectionist policies. This is thought to occur because loss aversion within declining industries intensifies political efforts aimed at resisting that decline[17]. To the extent that loss aversion may also occur in agriculture, it may be possible to observe similar efforts that attempt to stem decline there as well.

Broadly speaking, existing studies apply the notion of loss aversion to specific goods and services, which are then analyzed in isolation from other goods and services. Here, I develop the notion that consumption of one good X may be linked in utility or profit with other goods Y that are also of value to the consumer. This implies directly that under certain conditions, loss aversion with regard to Y may also be manifested in loss aversion with regard to X. This notion is then applied specifically to farming, where local concern for loss of rural amenities associated with water development and use may be reflected in loss aversion with regard to the water itself. The relevant consequences are a general resistance to trading water and a wedge between the willingness-to-pay for water by cities and rural communities' willingness-to-accept for that water, both of which reduce the likelihood of rural-to-urban water transfers.

The approach taken here is to assume that there is loss aversion with regard to good Y, and that good X is a factor input into production of Y: $Y = f(X, Z)$, where Z is a vector of other

inputs. The standard analysis of loss aversion assumes that the utility derived from Y takes on the following specification, with the reference point at the origin:

[Insert Figure 1 about here]

For intuition on how loss aversion with regard to the input X could arise, consider the simplest case where there is a perfect one-to-one correspondence between use of X and production of Y: X = Y. In production terms, this occurs under a fixed factor-ratio(Leontief) production technology with constant returns to scale, and where Z is a completely inessential factor input. In this case, the utility function from use of X would exactly mirror the function for Y. Loss aversion in Y would translate directly into equivalent loss aversion in X, with the reference point remaining at the origin.

Relaxing the assumptions of this production technology may attenuate the connection between loss aversion in Y and loss aversion in X, but will not necessarily sever it. Suppose first that this production function is subject to the more standard assumptions of production theory, with $df/dx > 0$, $d^2f/dx^2 < 0$, and $d^2f/dxdz > 0$. Compared to the previous case, diminishing productivity in X means that a given amount of loss aversion in Y translates into a smaller amount of loss aversion in X. This is because a given loss of X implies a smaller loss of Y when there are substitution possibilities between X and Z in production of Y. This substitutability attenuates the connection between loss aversion in Y and loss aversion in X because the more easily Z can be substituted for X, the less crucial X becomes in production of Y. Thus, even though there is loss aversion in Y, producers will not necessarily bemoan the loss of X, since its loss does not necessarily imply loss of Y. In the extreme case where X and Z are perfect substitutes, loss averse producers will not care at all about the loss of X, if sufficient Z is

available to take its place at comparable input prices. In this case, producers will not be loss averse in X at all, as its absence has no ramifications for their ability to produce Y.

This discussion implies that several factors will determine whether producers subject to loss aversion in a good will also experience loss aversion in a factor input used to produce that good. The productivity of the factor input, the extent to which it is subject to diminishing productivity, and the availability of good substitutes in production, may all matter in this regard. Factor inputs that are highly productive, not subject to significant diminishing productivity, and which are crucial inputs into production, will mirror output of the good in terms of generating loss aversion in the producer.

III. Loss aversion in agriculture and rural communities

In this section, we consider evidence that taken altogether, suggests that loss aversion may be a significant factor among farmers and residents of rural communities. The evidence brings to bear insights from scholars in two distinct fields: rural sociology and political economy.

a. Water and local communities

The standard economic approach does not treat industries as much more than the sum of a number of firms hiring labor, capital and other resources to produce goods for sale in markets. When markets are competitive, outputs are priced at their marginal costs of production and factor inputs receive their marginal revenue product. Shifts in supply and demand induce expansions or contractions in production, firms enter and exit markets, and resources flow to their highest value uses. The same economic dynamic is generally thought to apply to all industries, and rarely are location or local context modeled as mattering in influencing resource allocation decisions, except through factors such as transportation costs. Farming may differ from other

industries in terms of market structure and factor intensity, but is otherwise thought to be driven by the same economic imperatives as any other industry.

When one turns to the literature on rural sociology, however, one gets a very different picture of farming. A number of scholars have suggested that farming, far from being "just another industry," should be properly viewed as integrated into local communities and social networks. A rich scholarly tradition emphasizes social and cultural factors that intensify the attachment of people to their land, farming, and more generally, an agricultural way of life[18]. This attachment is commonly portrayed as something that transcends economic value narrowly defined, and it is believed to be particularly strong when it is long-standing, especially when it stretches out over multiple generations, and when the local community consists of indigenous people or low-income residents[19]. Anything posing a threat to agriculture, therefore, can be viewed as threatening the community itself or indeed, the very local way of life.

In arid regions such as the western United States, where water is crucial for irrigated farming, the possibility of losing water can raise concerns that farming production may be fundamentally threatened, even when economic studies suggest otherwise[20]. When production is threatened, of course, other aspects of the local economy that are dependent upon farming, such as other non-farm local businesses, the tax base, and the quality of local public services, may also be threatened[21]. In the rural sociology literature, however, scholars have also emphasized the threat to certain intangible local amenities such as the rural way of life, community cohesion, and a sense of community well-being. For example, according to Brown and Ingram:

> *"Because water is essential to the quality of life and also to a secure future, Westerners place a value on water which transcends its material worth. While water is certainly a means to economic improvement, its role in establishing or maintaining a feeling of community well-being results in a strong symbolic and emotional attachment."*[22]

Threats to these more intangible community-centered values, they argue, are important and may well outweigh the pure economic value emphasized by economists.[23]

In terms of our model: to the extent that local residents highly value their rural communities, they may feel loss aversion at the prospect of any developments that threaten to disrupt those communities and the flow of amenities derived from them. This would include loss of the water that contributes to creating and maintaining these communities, particularly when there are no good substitutes for the water, as seems likely. As a result, though local communities may be willing to engage in local exchanges of water that do not leave the locality and thus disrupt their communities, they may be reluctant to export water. They may also organize to impose restrictions on exports of water from the locality in various ways, in order to overcome the free riding that may occur if individuals try to export water for their own purposes to benefit at the expense of the community. And they may oppose efforts to exercise control by actors at higher levels of jurisdiction, fearing that these efforts may lead to loss of local control over local water supplies. In section V, I will present evidence that speaks to these implications of loss aversion.

b. The political economy of agricultural subsidies

In the broad sweep of the history of farming in the United States, there has been a persistent pattern of subsidies to farmers that have been remarkably resistant to any sort of scaling-back once they are in place. Subsidies were first manifested in early public land programs, in which public lands were offered to 19th century farmers on increasingly liberal terms over time, as the early auction system was succeeded by programs that offered smallholder-sized parcels of land at progressively lower prices.[24] In many parts of the country, especially the arid west, even free-land policies were not enough to promote successful farming, because of local adverse growing conditions. Consequently, a federal reclamation program was

established around the turn of the 20th century to develop and supply water to farmers in selected service areas in a number of western states[25]. The subsidy embodied in the Reclamation Act of 1902 took the form of an interest subsidy on the cost of developing the water. This interest subsidy periodically ratcheted up over time as Congress enacted legislations in 1914, 1926 and 1939 that called for payment moratoria, grace periods, and extensions of repayment periods. Evidence suggests that these periodic subsidy expansions tended to occur during times of economic hardship for farmers[26].

Modern-day agricultural subsidy programs that call for price supports on agricultural commodities originated during the Great Depression and especially, with the passage of the Agricultural Adjustment Act(AAA) in 1933. The AAA imposed supply controls on several key agricultural commodities, compensating farmers with rental payments for taking land out of production. In order to implement the AAA, the Department of Agriculture was required to establish production control committees at the county level. More than 4,200 of these local committees were created, and these committees provided focal points around which local political pressures for farm subsidies could coalesce. Beginning in 1938 and lasting through World War II, organized lobbying pressure led to a series of steady increases in federal loan rates, at each point increasing the magnitude of the price subsidy[27].

These early increases in the federal loan rates were facilitated by wartime conditions, which kept prices high and the cost of the price subsidy program low. The end of the war, however, saw a return to normalcy and a dramatic increase in program costs as prices fell. Despite soaring costs, farm lobbying efforts were extremely effective in maintaining the subsidy. Significant attempts were made by Presidents Nixon and Reagan to reduce the magnitude of the

price subsidies, but in both instances Congress refused to go along. More recent attempts have also largely failed to reduce farm subsidies in any substantive way.

The persistence of farm subsidies poses something of a puzzle for public choice economists. Scholars have portrayed this as a classic case of concentrated benefits going to a well-organized interest group with high stakes when costs are diffused over a much larger group. However, this explanation seems unsatisfactory. Farmers comprise less than 2% of the population of the United States currently, and they have been a tiny minority for many decades. It is hard to identify another well-defined group that has enjoyed the political clout, and political success, that farmers have, over such an extended period of time. Some evidence for why is provided by cross-country comparisons, which reveal that virtually all industrial societies tend to protect and subsidize farmers[28]. This has several implications, one of which is that answers cannot be found in the particular institutional context of the United States. Whatever is going on seems to be broader than the circumstances of any one country.

Some insights are provided by recent developments in trade theory and in particular, the economic and political conditions under which protectionist policies will occur. Trade theorists have asked, for example, why declining industries tend to receive so much trade protection[29]. In political terms, this question is very similar to our question of why farming continues to receive what seems to be disproportionate protection in the form of price supports and other subsidies. In both cases, standard political models predict less protection than the industries actually receive. However, Freund and Ozden and Tovar have shown that workers in declining industries may experience loss aversion, which may generate greater political demand for protection than otherwise might occur. This would explain protection disproportionate to the apparent size and stakes of the affected groups. It would also explain observed cyclical patterns over time with a

characteristic asymmetry in the amount of protection conferred in downturns versus the amount removed during upturns[30]. The observed historical pattern of farming subsidies becomes more explicable when loss aversion is considered.

IV: The institutional context for groundwater management in California

The discussion so far hints that farmers may be subject to loss aversion with regard to the traditional amenities enjoyed in their rural settings, which could generate potentially strong opposition to actions that would lead to the loss of water that helped create those amenities. As we have seen, actions they could take include lobbying for favored political treatment on the national level to maintain their agricultural way of life. But it could also include organizing at the local level to protect local water supplies, within the institutional environment created by statutes and common-law rulings. Let us now briefly describe that institutional environment in California, with special reference to those institutions relating to groundwater management.

Historically, the state of California has taken a largely hands-off approach to managing groundwater. In the 19th century, landowners owned what were almost entirely unconditional rights to the water lying under their lands, under the common-law doctrine of *cujus es solem*, or absolute dominion[31]. Under *cujus*, groundwater was treated like all other sub-surface minerals: the absolute property of the landowner with virtually no restrictions on use. This included all uses of water, including, importantly, the exportation and sale of the water to non-contiguous lands. Throughout the 19th century, the courts virtually without exception upheld the principle that landowners were permitted to do whatever they wanted with their underlying groundwater.

An important change in the courts' treatment of groundwater occurred in 1902-03, when the state Supreme Court(Court) handed down the landmark case of *Katz v. Walkinshaw*. In *Katz*, the Court established the new principle that all landowners enjoyed co-equal, or *correlative*,

rights to the underlying groundwater. From this point on, groundwater rights were treated under the common law as conditional upon the rights of other right-holders, imposing significant new common-law constraints on the exercise of a groundwater right. The *Katz* ruling occurred while southern California was in the throes of an extreme drought while simultaneously, technological advances were permitting farmers to pump groundwater faster and deeper[32]. This episode is a good example of new institutional developments occurring during times of crisis, though it may not speak to loss aversion among farmers as suggested by Ostrom, because the connection to the process of judge-made rulings is unclear.

In 1928, the state constitution was amended to require that water use be confined to reasonable and beneficial uses. Though this action was initially taken in response to a seemingly egregious misuse of a right to surface water, the Court subsequently ruled, in *Peabody v. City of Vallejo*, that this same principle also applied to groundwater[33]. In 1949, the Court adopted, in *Pasadena v. Alhambra*, the doctrine of *mutual prescription*, in what turned out to be the first basinwide adjudication of groundwater rights in California history[34]. Under this new doctrine, groundwater rights were adjudicated on the basis that all groundwater rights in the basin were adverse to all others, regardless of priority. Like *Katz*, the holding in *Pasadena* was a major departure from existing common-law doctrine and again, it occurred in the wake of sustained drought conditions in the 1930's, which among other things reduced groundwater tables in Pasadena by more than 100 feet[35].

The state legislature began to take steps to protect groundwater supplies in the 1960's, amidst general concerns over continuing groundwater depletion in many parts of the state. In 1961, the legislature passed the Porter-Dolwig Ground Water Basin Protection Law, which authorized the Department of Water Resources(DWR) to study and develop ways to protect

groundwater. The original enabling legislation calling for protection of groundwater quality was enacted in 1969, when the legislature passed the Porter-Cologne Water Quality Control Act. After an extremely severe drought in 1976-77, the legislature directed the DWR to undertake an investigation into groundwater conditions around the state. In 1980, the DWR summarized its findings in Bulletin 118-80[36]. Among other things, this document updated previous work identifying and defining the state's groundwater basins, especially in the San Joaquin Valley and central coastal region. It also identified eleven basins that it characterized as subject to critical conditions of overdraft, most of these in the south San Joaquin Valley, where critical conditions of overdraft were defined as conditions:

> *"when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." (p. 3)*

Two years later, in 1982, in response to the report of a special commission of the governor that called for statewide groundwater management, a special referendum was put before the voters that would have significantly curtailed pumping in the eleven "critically overdrafted" ground-water basins. This referendum was, however, soundly defeated by a wide margin[37].

The failure of statewide groundwater management reform in the early 1980's is worth examining more closely for what it indicates about the political dynamic surrounding such efforts. In particular, there is fairly strong evidence that an important reason it failed was that it represented limits imposed on local control of groundwater resources[38]. Several entities came out strongly in favor of maintaining local control, including the Farm Bureau, the Chamber of Commerce, and the Cattlemen's Association, all of which represent farmers or local businesses. It is also suggestive that in interviews, representatives of each of these organizations expressed a strong preference for policy to be made not in the courts but rather, in the legislature, where they believed they would have more influence[39].

It was not until the late 1980's that legislative efforts to promote groundwater management began to be implemented. By this time, it was clear that the only politically feasible option for groundwater management would be one based upon local control. In 1989, the legislature enacted AB 255, the first-ever statewide legislation that empowered local agencies to prepare local groundwater management plans. In 1992, the state enacted AB 3030, which permitted existing agencies to develop groundwater management plans(GMPs) for local basins. Under AB 3030, GMP's could include provisions addressing groundwater overdraft, groundwater quality, seawater intrusion, monitoring of groundwater levels, and facilitation of conjunctive use of groundwater and surface water. It also imposed certain restrictions on the power and jurisdiction of local agencies to manage local groundwater supplies. These included restrictions on its power to limit or suspend extractions and the mandate to limit adverse impacts on local business activities. AB 3030 did empower local agencies to levy fees and assessments to support groundwater management, but only if approved by a majority of local voters. Finally, GMP's could not be created if a majority of landowners within the service area, based on assessed land value, objected to the plan. Thus, even though local residents were acceding to groundwater management, they were retaining a right to veto if a majority of local residents were opposed.

AB 3030 relied totally on voluntary compliance, and what plans that were developed varied dramatically in quality and detail, and a number were implemented either poorly or not at all. Consequently, in 2002 AB 3030 was superseded by SB 1938, which required local agencies to create basin management objectives and required groundwater management plans to meet various criteria in order to qualify for state support for groundwater projects. Like AB 3030, SB 1938 also empowered local agencies to levy groundwater assessments and fees, subject to majority support within the service area. Furthermore, it required agencies developing GMP's to

involve other local agencies overlying the same groundwater basin. However, it did not make groundwater management mandatory, relying instead on financial incentives to boost participation. SB 1938 was tweaked in 2011, when the legislature enacted AB 359, which refined what measures groundwater management plans were required to include.

The latest important development occurred in summer of 2014, when the legislature, in response to three years of intense drought, enacted laws making groundwater management mandatory. The laws call for local groundwater management to be implemented by local agencies, either existing ones or new ones designated for this particular purpose. The laws require local agencies to develop and implement GMP's that provide for sustainable management of local groundwater supplies. In order to carry out these plans, these agencies are empowered to regulate groundwater extractions, collect fees, levy fines, and take legal actions for noncompliance with the rules contained in the GMP. In the event that local agencies fail to develop and implement a GMP within a specified time frame, the state is empowered to step in and develop one in its stead. Most localities are given until 2020 to develop a GMP, and must achieve complete compliance by 2040.

The broad objectives of the 2014 legislation are provided in Section 1 of AB 1739, which states that:

> *"The people of the state have a primary interest in the protection, management, and reasonable beneficial use of the water resources of the state, both surface and groundwater, and that the integrated management of the state's water resources is essential to meeting its water management goals."*

It goes on to explicitly recognize the damages caused by excessive groundwater use, and declares that failure to effectively manage groundwater supplies in order to prevent overdraft "infringes on groundwater rights." It also emphasizes the notion of sustainability, declaring that successful groundwater management requires actions to "sustainably" manage groundwater

basins. Finally, it reaffirms the importance of local management, stating that groundwater resources "are most effectively managed at the local or regional level."

On the surface, the 2014 legislation represents a major change in state groundwater management policy, a distinct move away from the largely laissez-faire policy regarding groundwater that the state has followed through its history. By moving away from voluntary to mandatory compliance, it mandates, rather than suggests, that groundwater management be undertaken. It provides meaningful enforcement power to local agencies to engage in groundwater management. And the specter of state intervention if no local actions are taken should provide added incentive for localities to take seriously the exercise of groundwater management. However, on another important level, the 2014 legislation represents not change, but continuation of the recent history of consistent reliance on local decision-making and control. As we have seen, one of the clearest and most persistent patterns in this recent history has been the determination of localities to maintain control over their local resources. Let us now turn to some evidence that this desire to maintain local control may well persist under the new rules.

V: Evidence on local attitudes toward groundwater exports

Some insights into local groundwater management efforts may be gleaned by examining groundwater management plans (GMPs) created under AB 255, AB 3030, and SB 1938. These plans – 131 in total – were all devised by localities to address local, often deteriorating, groundwater conditions in various parts of the state. All of these pieces of legislation required local agencies to invite public participation in the process of creating a GMP. These included publicizing how interested parties could participate in the development of the plan and to make copies of prepared plans available to the public. Local agencies would in turn comply by: advertising public hearings in local newspapers, specifying date, time, location, purpose of the hearing;

inviting public participation; and publishing the outcome of the hearing. In some cases, local agencies formed advisory committees consisting of local growers to provide input into the creation of the GMP, and to provide ongoing monitoring of implementation of the GMP. Hearings held by these advisory committees would be open to the public. Overall, there appeared to be extensive opportunity for local stakeholders to weigh in on both the drafting and ongoing implementation of a GMP.

Groundwater management legislation governing these GMPs distinguishes between provisions that all GMPs must contain (mandatory), and provisions that may be included (voluntary). Mandatory provisions include: general basin management objectives, groundwater monitoring protocols, and plans to involve other agencies located within the basin. Voluntary provisions include: control of salt water intrusion, well management, facilitation of conjunctive use, and groundwater replenishment. Since local agencies are afforded more flexibility in meeting voluntary goals, the content of the GMP's regarding voluntary provisions are more likely to reflect local preferences regarding how to approach groundwater management. Thus, the analysis here focuses mostly on several voluntary provisions of these GMP's: restrictions on groundwater exportations, water conservation measures, groundwater pumping taxes or fees, statements of policy relating to local control, and miscellaneous measures that shed further light on local attitudes towards groundwater management. Figure 2 briefly summarizes several key features of these GMP's, in terms of their content and how commonly they appeared in the different GMP's.

[Insert Figure 2 about here]

a. Export restrictions

One common provision contained in these GMP's was a statement explicitly prohibiting groundwater exports that resulted in a net reduction in the total amount of water available within the district, unless officially approved by district officials, usually the Board of Directors. A statement to this effect appeared in fifty-one of the 131 total GMP's examined in this sample, or 39%. A fairly typical statement of this principle is found in the 2011 GMP of the Kings County Water District:

> *"The District generally does not support groundwater pumping for export out of the District unless it involves a transfer or exchange of water that will not reduce the total water supply available to the District." [Kings County Water District GMP(2011), p. 47][40]*

Some districts make their net exportation provisions more stringent in dry years, when any exports approved by the Board of Directors must be in exchange for greater quantities of imports in normal years.[41] This statement is sometimes accompanied by an explicit prohibition on exports of surface water if it means increased pumping of groundwater. Occasionally, this prohibition on net loss is relaxed if the exported groundwater can be exchanged for water of higher quality. The prohibition can also be relaxed in districts that have water banking arrangements with other local entities, but since banking arrangements were relatively rare, this exemption is also rare. Overall, the prohibition on groundwater exports is commonly applied and subject to few exceptions.

From an overall supply standpoint, the flip side of restrictions on groundwater exports are efforts to import more supplies. A common component of the GMP's was an emphasis on the need to bring in more water in order to improve local groundwater conditions, often with explicit plans on how to do so. If, for example, a district already had a surface water supply arrangement with an outside entity such as the Central Valley Project, the plan might call for pursuing supplemental supplies with that entity. Or districts might be pursuing joint arrangements with

other local agencies. Generally speaking, a key component of local groundwater management strategies is to seek out new supplies while taking steps to keep groundwater from exiting the locality.

It should be mentioned that the same localities that opposed the exporting of groundwater commonly permitted groundwater to be transferred locally, within the district, often actively promoting it. The Shafter-Wasco ID, for example, called for "encouraging" exchanges of water among District users[42]. Similarly, the Alta ID noted that intra-district transfers of water were taking place "on a routine basis."[43] The suggestion is that local districts are not opposed in principle to water transfers: indeed, they appear to recognize that significant gains can occur from reallocating water. However, they are only willing to support such reallocations if they occur locally.

b. Water conservation measures

Even more common than prohibitions on groundwater exports was the almost universal absence of limitations on individual groundwater pumping, either in the form of physical restrictions or financial disincentives such as pumping taxes or fees. Figure 2 shows that the vast majority of GMP's contained no provisions for restrictions on groundwater pumping, and those that did specified it to be voluntary or mandated that restrictions would be imposed "only as a last resort". Most made clear their position that any such restrictions were controversial, highly undesirable, and that they would have negative consequences for the local economy, even while some grudgingly conceded that they would probably be effective. This was the position, for example, of the Alta Irrigation District in its 1994 GMP:

> *"Pumping restrictions would definitely reduce the amount of groundwater use. This is a controversial item and pumping restrictions would be the last item to be considered. This step could have severe economic implications since the local economy that has been developed with a reliance on groundwater would be*

> *detrimentally impacted. Initially, any program requiring pumping restrictions would be voluntary rather than mandatory."*[44]

Similarly, the 2000 GMP of the Gravelly Ford Water District said of limiting pumping extractions:

> *"It is highly unlikely that groundwater "management" would come down to this. It is to prevent state or federal actions such as this that GFWD is preparing a local plan."*[45]

In this statement, Gravelly Ford seemed almost more intent on reassuring its members that they need not worry about any sort of limitations on groundwater pumping, and that the only reason they were engaging in the planning exercise was to make sure such restrictions were not imposed from outside.[46]

Regarding taxes or fees on groundwater pumping: as we have seen, AB 3030 empowered local districts to levy pumping fees or taxes, but required any such measures to be approved by a majority vote of local landowners. Most GMP's contained no explicit provisions for the imposition of any sort of taxes or fees on groundwater pumping, and some that did again specified that they would be imposed only as a last resort. For example, the 2010 GMP of the Tulare Irrigation District, after declaring that the district was empowered to impose such taxes or fees, went on:

> *"such taxing ability cannot be imposed unless brought to a landowner vote. Like extraction restrictions, this step is to be considered only as a last resort in the overall management of groundwater in the District."*[47]

In general, local districts in the sample were highly reluctant not only to directly interfere with private pumping in any way, but even to provide financial disincentives to discourage pumping.

In terms of encouraging water conservation, far more common were provisions aimed at improving water use efficiency, such as technical assistance in adopting improved water application techniques; provision of information on crop water use, workshops and newsletters;

or direct subsidies such as through low-interest loans. A few districts mentioned maintenance of the district surface water distribution system to reduce conveyance losses. The conclusion seems to be that in considering demand management measures, the only ones that were evidently feasible to set in place were ones that asked local farmers to make few if any sacrifices.

c. Conjunctive management

A related issue has to do with so-called conjunctive management of surface water and groundwater. Existing groundwater legislation promotes, and most GMP's contain, measures for conjunctive management. For years, economists have been calling for greater emphasis on conjunctive management in order to rationalize the use of water supplies. There is no doubt that greater reliance on conjunctive management has been a positive development. The evidence from the voluntary GMP's, however, has shown that there is a logical consequence of local users being encouraged by law to focus on maintenance of groundwater supplies. Namely, when it is difficult to mandate demand-side management through efforts to encourage conservation, local agencies will turn to the supply side. There are several implications of this, one that we have already seen: the interest in protecting groundwater supplies locally through restrictions on exports. Another has to do with the use of pricing, in the form of fees and prices charged for surface water, by local agencies to manage groundwater use.

Despite some differences in quality, surface water and groundwater are close substitutes in crop production. This means that when surface water is also locally available, the pricing of surface water may influence how much groundwater is used. A number of GMPs contain provisions that explicitly refer to the use of surface water pricing as a way to manage groundwater use. For example, the GMP of the Semitropic Water Storage District speaks of setting surface water rates low enough to encourage the use of surface water instead of groundwater[48]. This

means, of course, that reductions in groundwater use may be coming at the expense of increasing surface water use. In the short-term, such pricing policies may have little or no effect on ground-water use, depending upon whether local surface water supplies are being quantity-rationed[49]. However, the longer-term response may well be increasing pressures for importations in order to augment local surface water supplies. This is thus another potential consequence of recent emphases on maintaining local control over groundwater supplies.

d. Local control

Another theme revealed in these GMP's is a strong, commonly-expressed desire for groundwater management to be under the control of local residents and not implemented at higher levels of jurisdiction. Figure 2 reports that 69 GMP's – over half – contained specific statements regarding the importance of local control of groundwater management. These were commonly variants of the following statement by the Madera ID, which stated among its primary goals to: "maintain local control of groundwater resources within the District."[50] Occasionally, the GMP's exhibited awareness that maintaining local control might call for them to actively participate in the political sphere. For example, Delano-Earlimart ID stated that it would "take an active role" in opposing legislation "detrimental to local groundwater management efforts."[51] The strong and abiding desire for local control exhibited here suggests a concern that outside control could lead to unwanted outcomes with regard to groundwater management. As rural localities are well aware of the keen interest in urban areas in their water, it should not be surprising that they would oppose control of their water supplies being in any other hands.

What do we make of these GMP provisions overall? The general message is one of keen reluctance to embrace any sort of reductions in water use, along with a strong preference both to add water supplies and to prevent any groundwater from being exported from the locality. This

is not out of opposition to water transfers in principle: transfers occur as a matter of course within most localities. But the possibility of water going elsewhere is viewed differently, even when there is the potential for a mutually-beneficial exchange. It is of course possible that prohibitions on groundwater exports are a means of trying to preempt free-riding by locals, who might try to export groundwater at the expense of other local residents. Whether this is a compelling alternative explanation depends upon how easy it is for the local district to monitor such actions and to take steps to counter them. For example, if exports had to go through the district's distribution system, it should in principle be possible for the district to impose an export tax that could be used to compensate other district members for any third-party impacts imposed on them. From the viewpoint of district rent-maximization, such an arrangement would be preferable to an export prohibition, and it is striking that no district in our sample has instituted anything like this.

VII. Conclusions

In recent years, economists have been making increasingly urgent entreaties for greater reliance on water markets in order to rationalize water allocation, not only in California but throughout the arid West. For many, this has been a surprisingly tough sell, and it is incumbent on economists to understand why. Historically, non-economic arguments have been invoked for why these entreaties commonly fell on deaf ears, including the influential notion that somehow, "water is different."[Young(1986)] However, even as more and more people have come around to the notion that economic principles can and should apply to water, we continue to observe staunch resistance in many quarters to transferring water, via markets or otherwise, from traditional to emerging uses.

This paper has offered a possible explanation for this continued resistance, based upon recent developments in behavioral economics, that water in traditional uses may be subject to an

endowment effect, and that traditional users may experience loss aversion regarding the amenities associated with their uses of water. On a general level, this provides an explanation for efforts by rural communities to ensure that water will not exit the communities. Our findings suggest, however, that whether these efforts are successful depends upon various factors that determine their political influence at the local level. These factors include the stakes of members of these localities in retaining water locally, as well as the transaction costs of organizing to impose these provisions. Furthermore, these results control for local water conditions, which should influence the intensity of efforts to maintain local supplies.

The explanation offered here does not deny other sources of transaction costs, nor is it inconsistent with the fact that some water transfers are in fact occurring. But it does argue that we should not be overly surprised when potential sellers resist water markets, in which voluntary participation could presumably only benefit them. Nor should we be surprised when localities tie their own hands by refusing to consider any groundwater exports that result in reduced net local supplies. This has, of course, implications for the desired locus of control over local supplies, by accentuating the tradeoff between improved local management based on better information on local conditions on the one hand, and broader state interests in allocating water to its highest value uses on the other hand. Thus, we may be ambivalent about the recent general trends toward local control, to the extent that they make it more challenging to transfer water to its highest-valued uses, which may be emerging, not traditional, uses.

Figure 1: Utility function in the presence of loss aversion

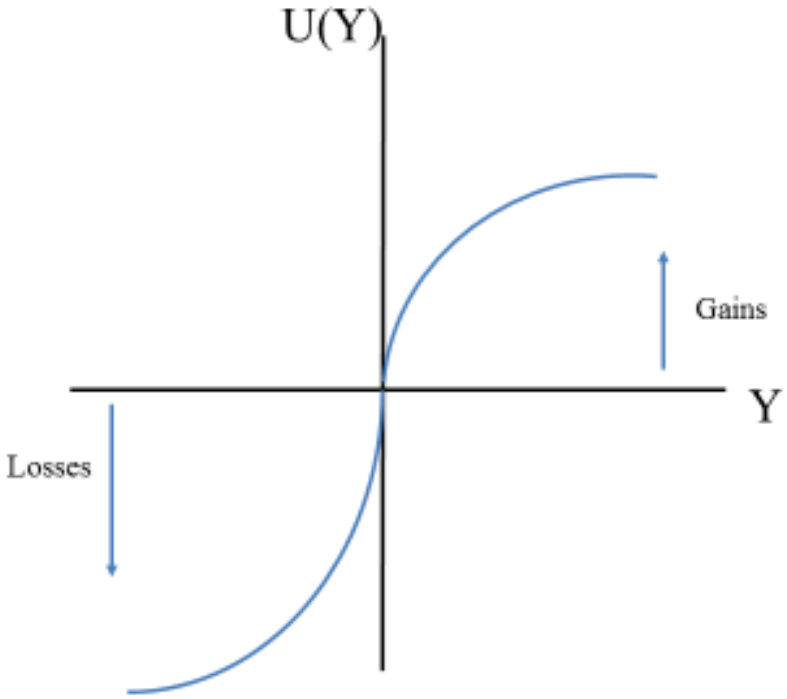
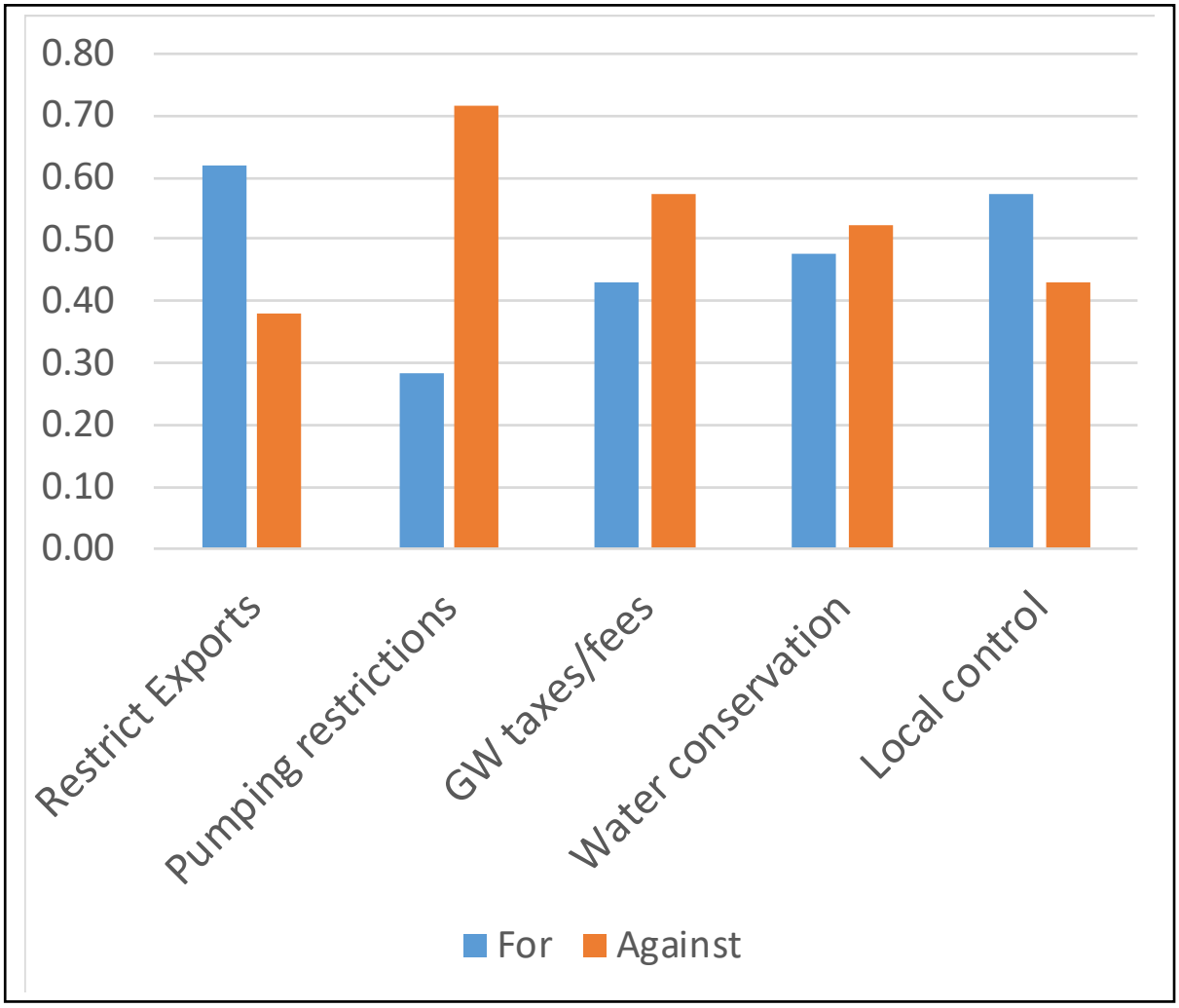


Figure 2: Selected voluntary provisions in the groundwater management plans



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[40] See also, for example, Westlands WD GMP(1996), p. 27; Tulare ID GMP(2010), p. 44; Madera ID GMP(1999), p. 4; Delano-Earlimart ID GMP(2007), pp. 29-30; Kaweah Delta WCD GMP(2006), p. 47.

[41] The Tulare ID, for example, requires a four to one payback of water exported during dry years. See Tulare ID GMP(2010), p. 45. See also Westlands WD GMP(1996), p. 27.

[42] Shafter-Wasco ID GMP(2008), p. 5-11]

[43] Alta ID GMP(2010), p. 14.

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[45] Gravelly Ford GMP(2000), p. 29]

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[47] Tulare ID GMP(2010), p. 45.

[48] Semitropic WSD GMP, p. 19.

[49] Kanazawa(1993, 1994).

[50] Madera ID GMP(1999), p. 2. See also Westlands WD GMP(1996), p. 5; Cawelo WD GMP(2007), p. 1-6; Gravelly Ford WD GMP(2000), p. 2; Delano-Earlimart IC GMP, p. 3; Riverdale ID GMP(1995), App. A.

[51] Delano-Earlimart ID GMP(2007), p. 3. See also Tulare ID GMP(2010), p. 5.