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Environmental Water Rights Transfers in a Nonprofit Institutional Structure

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Abstract:
Increased demand for diminishing water resources has created the need for creative water management strategies. One technique perused in the western United States is the purchase of water rights by non-profit organizations for environmental in-stream uses. This paper looks at the Columbia Basin as a case study of the motivations of non-profit organizations. It shows how the institutional structure reduces transaction costs associated with water rights transfers and how non-profit organizations can incentivize water conservation in the western United States.

Water is the basis of life on earth. The efficient management of this precious resource is one of the most pressing environmental and social questions of this generation. Water is used for irrigation, household consumption, and industrial production. The western United States has been managing a diminishing water supply with increasing demand. Now many rivers are running low, creating problems for wildlife and endangering the continued use of a valuable resource. The Columbia River is the fourth largest river in the United States. The Columbia Basin incorporates many tributaries flowing through Idaho, Montana, Oregon and Washington, before emptying into the Pacific Ocean. In the Columbia River basin one effort for increasing in-stream water flows has been the creation of a water rights transfer market, using environmental nonprofit organizations with the mission to restore rivers and riparian habitats.

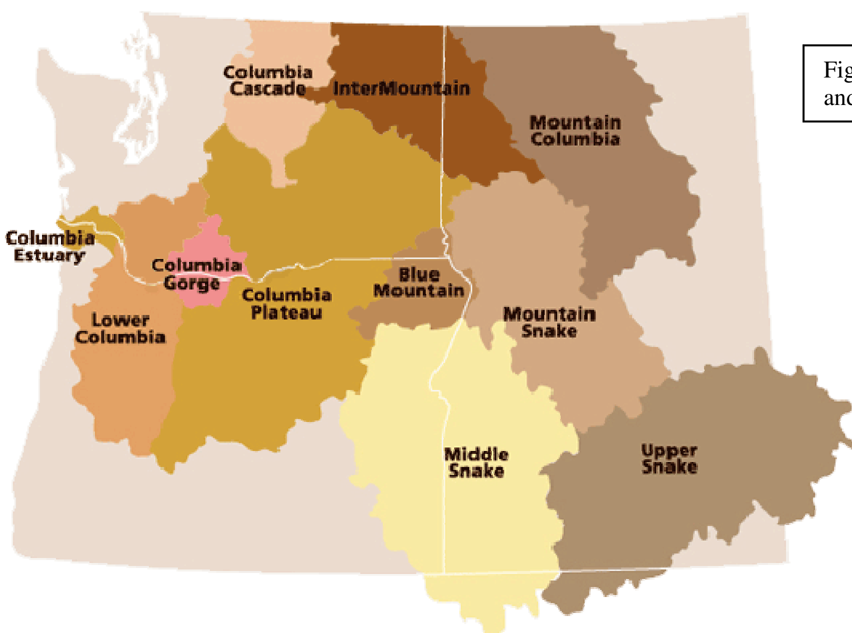

Figure 1: The Columbia River Basin and 11 sub basins. Source: CBWTP

Using the Columbia River basin as a case study, this study will look at the different factors that impact the quantity and price of water transferred in environmental transactions to increase in-stream flows, and how the structure of the various nonprofit organizations contribute to the facilitation of the market.

The Structure of Western Water

Water law in the western United States is dominated by two fundamental concepts. First is the prior appropriation of rights defined by Wyoming v. Colorado, 259 U.S. 419 (1922), known as the *first in time*, *first in right* doctrine. This stipulates that the land owner in a basin with the longest standing right to land in the area, regardless of geographical location, gets first allocation of water, and often, the largest quantity. The remaining water rights are structured hierarchally based on the age of the associated land right. Howe and Goemans (2003) showed that water rights with seniority have a higher price than those who don't, but have little effect on quantity. The law creates unequal value of water within a basin. Not only does the senior right holder have the lowest risk associated with drought years but he/she is guaranteed his/her allotment regardless of the flow of water across years. The increased value of senior water is represented within transactions.

The second related legal directive for western United States water law is the beneficial use, known as *use it or loses it* doctrine. Rights holders are required to use the complete state government allocated quota of water (stipulated by prior appropriations) for active "beneficial use," or they are subject to forfeiture or abandonment of unused water in future water rights. The doctrine was instituted to prevent speculation and attempt to maximize the use of a scarce resource (Neuman, 1998). Similar to the rules implemented by Idaho, Montana and Washington, under Oregon's Administrative Rules for water quality, beneficial uses include:

- domestic water supply
- fishing
- industrial water supply
- irrigation
- water contact recreation
- livestock watering
- aesthetic quality
- fish and aquatic life
- hydropower
- commercial navigation and transportation

Proving that an in-stream use of water is beneficial is often expensive. Many government issued permits and forms are required, as well as an administrative hearing (Jackson, 2009). Most irrigators do not want to spend the time or money to conserve water and avoid abandonment. The system has very little incentive for land owners to conserve water for ecosystem services, because of the risk of losing their current allocation of water.

Therefore, there has been a move by the environmental community to increase the in-stream flow of water by purchasing water rights from users for in-stream use, but often a lack of institutional support makes it difficult to have buyers find sellers. The difficulties associated with water markets create problems of asymmetric information. Combined with the stipulations of the prior appropriation doctrine there is little incentive for water conservation.

The Bonneville Power Administration (BPA) is the federal government agency that is responsible for operating the system of federally owned hydropower plants (dams) within the Columbia River Basin. The agency generates power for the region, and sells it at cost. Due to proven adverse effects of dams the BPA is required to donate money (about $4 million annually) for environmental reconstruction in the area. BPA choose to fulfill this requirement by funding environmental water transfers within the basin. The BPA gave the National Fish and Wildlife Foundation administrative power of their mitigation funds. The BPA and the NFWF created a joint venture called the Columbia Basin Water Transactions Program (CBWTP) to facilitate funding of 10 “qualified local entities” (QLEs) , who negotiate voluntary water transfers in Oregon, Washington, Idaho and Montana and to assist landowners who wish to restore flows to existing habitat.

Environmental water rights transfers usually take one of two forms: leases and sales. A lease is a temporary transfer of water. They specify quantities of water for certain durations of time to be kept in-stream, and do not involve the sale of a water right. Sales are permanent transfers of whole or partial rights to water, where the new right holder has access to the specified quantity of water in perpetuity. Technically, under CBWTP there are no sales.

Review of Literature

Until recently, environmental values of water have been unresearched and unobservable (Loomis et. al. 2003). Economic analyses have tended to focus on the multiple off-stream uses such as irrigation and urban and industrial uses (Lund and Israel, 2005). The only in-stream use that has been extensively researched is hydropower (Førsund 2007). Brewer et al. (2007) found that water rights prices in the western United States are higher for agriculture-to-urban trades relative to within-agriculture trades. This shows that if water was being allocated efficiently in the west, most water would be flowing into cities, not being used for agriculture. Young (1986) explores, within the conventional neoclassical framework, “Why are there so few transactions among water users?” He notes all of the reasons that water markets have unique characteristics and presents a simple model to explain the barriers to trade. He found the willingness to pay for water is not high at the margin, and that high transaction costs to negotiate purchase contracts and the interdependence of water users within a basin make it a hard commodity to trade in the open market.

Within the context of water rights transactions, there has been work concerning the determination of the value of in-stream flows. Griffin and Hsu (1993) show under frameworks that decrease the transaction costs and acknowledge the existence of low flow externalities, there are efficiency gains when in-stream flows have value. They conclude that giving in-stream users and environmental groups the ability to purchases in-stream rights will help reach a socially efficient level of in-stream flows. Current water management neglects the importance of preserving in-stream flows. Livingston and Miller (1986) acknowledge a fundamental equity issue concerning valued in-stream flows. They contend that within water markets there is a conflict of interest between those who transfer for agricultural economic reasons and transfers for in-stream use. They say that increasing the choice domain of one group, limits the choices of the alternative group.

The institution of economic incentives for land conservation has been discussed throughout economic literature (e.g. Boyd, 2000), but analyses of incentives for water conservation have been a new development. Loomis (1987), one of the first scholars to attempt to determine the value of in-stream flows, found that marginal values of in-stream flows vary significantly with level of stream flow. Specifically he reported extreme values of $0.50 to $74 per acre foot. His work has shown that in-stream uses of water do have value for wildlife, recreation, water quality, decreased risk of drought conditions and aesthetics. Loomis et al. (2003) showed that over $100 million of water was traded for a variety of environmental reasons from 1998-2003.

Another challenge concerning water transactions is the relationship with the value of the adjacent land. Giving water value in a separate market apart from land will decrease the value of land for all the farmers in the area. The value of land, due to the prior appropriations law, is tied to water rights. Separating the water right from the land could cause secondary costs due to the loss of capital (the water) on the land (Dinar et al., 1997). Water rights holders will not sell their water for environmental reasons unless they can at least cover the lost capital value of their land. Occasionally, water rights transfers include a transfer of land rights as well.

Garrick et al. (2009) argue that for water transfer markets to be successful there needs to be an institutional structure that can establish credible baselines, facilitate procedures and rules, and create successful monitoring and compliance regimes. Neuman (2004) argues that the use of non-profits to restore in-stream flows is a "fair, effective, and efficient approach." By examining their legal and institutional structure, King (2004) discusses how water trust non-profits fit into the conservation field, and argues that the legal nuances of western water law have created unique entities. He argues that compared to land conservation non-profits, the legal structure of water law have led non-profits to prefer temporary leases over permanent acquisitions, and to partner with public agencies. Findings that are evident in the structure and actions of nonprofits in the Columbia River Basin.

Theory

Theories of conservation have changed over the last 50 years. Conservation theory originated with Arthur Cecil Pigou, an English economist who first realized the economics of conservation in 1957. Pigou was interested in question of the optimal intertemporal utilization of the fixed natural resource stocks. Now questions have turned to providing unspoiled natural environments for future generations (Krutilla, 1967).

There are multiple negative externalities related to allowing river basins to operate with low flows of water. Many studies have shown that over use of water supplies can have intertemporal effects (e.g. Zeitouni, Dinar, 1997; Chandrakanth, Alemu, Bhat, 2004), for example, lower flows in following years and inter-basin effects. Some negative environmental externalities include: harmful impacts to marine species, riparian vegetation loss and decreases in water quality. River basins with higher costs of low water flows are more valuable for conservation. For example the Washington State Department of Ecology has listed 16 river basins where low flows are a known limiting factor to salmon populations[1] and the Oregon State Water Resources Department has declared 7 critical groundwater areas[2].

The economic benefits of water conservation are represented in different ways. Daubert and Young, (1981) and Loomis and Creel (1992) showed that water level is an important determinant in the value of water related recreational activities. Increased water flows can also help to mitigate the negative effects that drought years may have on a basin (Ward and Michelsen, 2002). Keeping a water right in-stream provides a public good for the basin by adding insurance against dry conditions (Smith and Lenhart, 1996).

Irrigated land with a scarce or diminishing supply of water has large potential economic efficiency gains from conservation and the reallocation of water among users (Easter et.al, 1998). Economists (e.g. Burness and Quirk, 1980, Johansson 2000) argue that giving water a price can have the market reflect scarcity. This has been difficult to accomplish in the Western United States due to political pressure from agricultural communities. The solution was to create a market for water rights transfers, therefore changing the incentives and hopefully encouraging conservation.

These markets are difficult to implement due to high transaction costs. Transactions costs are factors that prevent markets from operating efficiently (Coase 1960). Water markets in the western United States are characterized by transaction costs sustained by searching for trading partners, characterizing water commodities, price negotiations and legal fees associated with the transfer (Colby 1990). High transaction costs lower the quantity and increase the price of

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[1] The critical basins are: Lower Yakima, Methow, Middle Snake, Naches, Okanogan, Upper Yakima, Walla Walla, WenatcheeCedar-Sammamish, Chambers-Clover, Elwha-Dungeness, Green-Duwamish, Nooksack, Puyallup-White, Quilcene-Snow and Snohomish. Source: www.ecy.wa.gov.

[2] The critical areas are Cow Valley near Vale; The Dalles in Wasco County; Cooper Mountain-Bull Mountain southwest of Beaverton and Tigard; and the Butter Creek, Ordnance (alluvial and basalt) and Stage Gulch areas in Morrow and Umatilla Counties. Source: www.oregon.gov

transfers. In the Columbia River Basin, open market water transfers are legal, but because of transaction costs they don't often occur. The institutional structure created by CBWTP allows non-profit organizations to lower transaction costs for environmental water transfers for in-stream use.

Agricultural irrigation, urban consumption and industrial production are the three primary uses of water in the United States (Lund and Israel, 2005). Irrigation withdrawals represent 40 percent of total freshwater withdrawals and 65 percent of total freshwater withdrawals for all categories excluding thermoelectric power. Urban and industrial uses of water are about 18 percent of total freshwater withdrawals and nearly 30 percent of total freshwater withdrawals for all categories excluding thermoelectric power[3]. There is an assumed positive relationship between population and water consumption for both domestic urban uses and industrial (Algharian et al. 1955). Prior appropriation legally ties water rights to land. Therefore, an opportunity cost associated with selling a water right is selling the land and water rights together in a land market. Market land prices have a positive relationship with the prices in the water rights market (Crouter, 1987).

Water rights transfers have occurred in the Columbia River Basin for other than environmental motivations. This indicates that in some cases transaction costs are low enough to facilitate market action. Furthermore this could signify that selling water to environmental non-profits may indicate some value in the transaction for environmental factors. Loomis and White (1996) found that Americans have an annual willingness to pay of $88 to protect pacific salmon and steelhead, an endangered species in the Columbia River basin. Sellers who consider their value for conservation transact higher quantities and prices over the purely economically rational sellers (Colby 1990).

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[3] USGS estimation of water use in the United States

Data

The basis of the data on individual environmental water transfers came from the CBWTP directly. Their website (www.cbwtp.org) allows access to their database of all transactions since the inception of the program in 2002. The data includes the specifications of the transactions, basin and watershed features and individual seller characteristics. The data is aggregated from transaction proposal forms submitted to the program by QLEs as a request for funds. These proposal forms are usually between 15 and 20 pages long and contain all (and more) the information found on the database.

The data acquired from CBWTP incorporated information on 255 transactions conducted in Idaho, Montana, Oregon and Washington. The data include 8 QLEs: Clark Fork Coalition (CFC), Deschutes River Conservancy (DRC), Idaho Department of Water Resources (IDWR), The Freshwater Trust (TFT), Trout Unlimited - Washington Water Project (TU-WWP), Trout Unlimited-MT Water Project (TU-MWP), Walla Walla Watershed Alliance (WWWA), and Washington Water Trust (WWT). It should be noted that IDWR is not a non-profit institution but a state government agency and although there is some deviation from the averages, under CBWTP, they are treated the same as the rest of the QLEs and are included in the analysis for robustness (see appendix 1). The transactions by QLEs ranged from 1 transaction conducted by WWWA to 55 conducted by WWT. Table 1 shows the number of transactions across entities.

Table 1: Transactions across QLEs

QLE	# of Transactions
Clark Fork Coalition	34
Deschutes River Conservancy	35
Idaho Department of Water Resources	51
The Freshwater Trust	44
Trout Unlimited - Washington Water Project	20
Trout Unlimited-MT Water Project	14
Walla Walla Watershed Alliance	1
Washington Water Trust	55
Total	255

Source: CBWTP

Data for the population variable was from the U.S. Census Bureau county population estimates. The values were determined by finding the average population of all the counties for which the transaction's sub-basin flowed through. These quantities reflect the population in the year in which the transaction was proposed.

The Census of Agriculture was the source for the market yield and land value variables. Data for 2002 and 2007 were collected. Therefore, for all the transactions that were proposed between 2002 and 2006 we used data from the 2002 census, and for all the transactions between 2007 and 2010 we used data from the 2007 census.

<u>Evidence</u>

For this study uses two, two stage least squares regressions to determine the effects of independent variables on the water quantity and prices involved in transactions conducted and funded by CBWTP. Both of the dependent variables are endogenous. The first dependent variable, ACFT, is the average total in-stream acre feet per transaction. An identical independent variable appears in the price model. The second dependent variable is COST. COST is the total cost incurred by the QLE for the transaction. This is the price of the water right minus funds given to the QLE by CBWTP for the transaction. An identical independent variable appears in the quantity model.

Quantity model:

$$ACFT_i = \beta_1 + \beta_2 COST_{+\beta_9 POP+\beta_{10} YLD+\beta_{11} LAND+\beta_{12} CONV+\beta_{13} EC\backslash CO+\beta_{14} LAW)}^{(INST:\beta_3 TERM+\beta_4 IRR+\beta_5 THREAT+\beta_6 ENDANG+\beta_7 ACAP+\beta_8 SNR} + \beta_3 TERM + \beta_4 IRR + \beta_5 THREAT + \beta_6 ENDANG + \beta_7 SNR + \beta_8 POP + \beta_9 YLD + \beta_{10} LAND + \beta_{11} CONV + \beta_{12} EC\backslash CO + \beta_{13} LAW + \beta_{14} STREAMFLOW + \beta_{15} LOWFLOW + e$$

Price model:

$$COST_i = \beta_1 + \beta_2 ACFT_{+\beta_{10} LAND+\beta_{11} CONV+\beta_{12} EC\backslash CO+\beta_{13} LAW+\beta_{14} STREAMFLOW+\beta_{15} LOWFLOW)}^{(INST:\beta_3 TERM+\beta_4 IRR+\beta_5 THREAT+\beta_6 ENDANG+\beta_7 SNR+\beta_8 POP+\beta_9 YLD} + \beta_3 TERM + \beta_4 IRR + \beta_5 THREAT + \beta_6 ENDANG + \beta_7 ACAP + \beta_8 SNR + \beta_9 POP + \beta_{10} YLD + \beta_{11} LAND + \beta_{12} CONV + \beta_{13} EC\backslash CO + \beta_{14} LAW + e$$

Variables

The variable YLD attempts to proxy the opportunity cost value of irrigation water. Empirically it is the average market value of agricultural products sold per farm in the sub-basin. The farmers who cite irrigation as their primary water use is represented by the dummy variable IRR, which is 1 if irrigation was the primary use and 0 if it is not. The YLD value differentiates sub basins in which either irrigators have, lower marginal costs for growing crops, or higher marginal revenue for agricultural products. This variable encompasses factors such as: soil quality, government regulations, climate, biodiversity, and regional price differences.

Urban and industrial uses of water are incorporated into the POP variable. POP is the average population in the sub basin. Population is a proxy for different urban and industrial uses across sub-basins.

LAND and is the estimated market value of land and buildings per farm for each transaction. LAND represents the value of the benefits forgone by the sellers if they were to sell their water right on the open market. Due to a lack of a consistent water market with reliable prices, the land market is the best alternative. The value of the water right is incorporated into the land price because they are usually sold together.

The dummy variables THREAT and ENDANG are equal to 1 if the water transaction affected a stream in which a threatened or endangered, respectively, lives. Otherwise the value of the variable is 0. These two variables try to proxy the importance of environmentalism in determining the quantity of water involved in the transaction.

Within the proposals submitted to CBWTP QLEs were asked to specify the right seller's primary rationale for transferring their water. Four different designations were determined for the purposes of this study[4]: (1) economic, (2) conservation, (3) a combination of economic and conservation, and (4) legal, reasons. CONV, EC\CO and LAW are dummy variables whose value is 1 if the respective variable is the motivation in the transaction by the seller. CONV is if the seller reported acting for conservation reasons, EC\CO is if the seller is acting for economic reasons combined with conservation reasons and LAW is if the seller is acting for a legal reason, for example avoid beneficial use requirement violations. These variables are all relative to sellers who report acting in transactions for economic reasons.

Based on the prior appropriations doctrine water rights are valued differently based on the time of their right. The dummy variable SNR is a 1 if the right is the most senior water right on the stream and a 0 if it is not. This variable will describe the influence of the prior appropriation doctrine. TERM is a variable that designates the years of the lease agreement (from 1-100).

The instrumental variables for the quantity model are STREAMFLOW and LOWFLOW. STREAMFLOW is the average cubic feet per second of the stream for which the transaction

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[4] The proposal form's responses for this data were free response. The values for this characterization where done by the researcher as objectively as possible by reading the responses and attempting to determine the intent of the seller. In some cases the responses were very straight forward and obvious which did not require and subjective decisions.

benefited for the 5 years prior to the lease. LOWFLOW is a dummy variable for which the value is 1 if the flow is 10 cfs or lower and 0 if it is above. These variables are valid instrumental values because of the assumed motivations of the non-profits operating under CBWTP. QLEs are first and foremost attempting to raise water levels by purchasing rights and keeping the water in-stream. Secondly they also have benchmark water levels that are scientifically established water level goals that are required for stream well being. This implies that changes in stream flow will affect the quantity variable and not the price variable. Changes in stream flow will not affect price because the QLEs value increased stream flow over price, due to their motivations, non-profit status and funding from CBWTP[5].

The instrumental variable for the price model is ACAP. In some of the transactions studied, there was land also transferred to the non-profits with the water rights. Land sold with water transactions is referred to as appurtenant land. ACAP is a variable incorporating the quantity of the acres of land, if any, acquired appurtenant to the water transaction. This variable is a viable instrument because having land sold with the water increases the price, but shouldn't affect the quantity. The reasoning is similar to the quantity instruments. QLEs are concerned with increasing the quantity of water to meet environmental benchmarks. Because of outside funding, from CBWTP, price is a less important determinant of the QLEs behavior.

[5] The search for an instrumental variable for the quantity model resulted in very few valid options. I chose my instrumental variables because they had the strongest theoretical argument to back them up. It is worth noting that although neither STREAMFLOW nor LOWFLOW are statistically significant in the results of the quantity model.

Quantity Model:

Table 2: Regression Results for Quantity Model

Quantity Model	*Coefficients*	*Standard Error*	*z-Stat*	*P-value*
Intercept	285751.7	24237.54	11.79	0
COST	0.147003	0.091408	1.61	0.108
TERM	-64.5354	123.3777	-0.52	0.601
IRR	-280599	22489.34	-12.48	0
THREAT	2640.454	10998.25	0.24	0.81
ENDANG	34491.71	14764.03	2.34	0.019
SNR	-10895	9859.618	-1.11	0.269
POP	0.001956	0.013817	0.14	0.887
YLD	0.006447	0.071284	0.09	0.928
LAND	-2.87705	4.799335	-0.6	0.549
CONV	-97.2532	9471.413	-0.01	0.992
EC\CO	3209.924	16551.58	0.19	0.846
LAW	(omitted)			
STREAMFLOW	0.195031	3.075456	0.06	0.949
LOWFLOW	3218.644	11367.43	0.28	0.777

Price Model:

Table 3: Regression Results for Price Model

Price Model	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	(omitted)			
ACFT	0.59222	0.213885	2.77	0.006
TERM	579.5803	286.9427	2.02	0.043
IRR	24393.77	27819.49	0.88	0.381
THREAT	55164.87	23848.54	2.31	0.021
ENDANG	25574.96	35994.09	0.71	0.477
ACAP	-1.03232	3.926861	-0.26	0.793
SNR	22827.2	23932.77	0.95	0.34
POP	0.098591	0.03091	3.19	0.001
YLD	-0.30418	0.175774	-1.73	0.084
LAND	-25.1697	12.82343	-1.96	0.05
CONV	30176.91	23442.16	1.29	0.198
EC\CO	-7489.62	40671.36	-0.18	0.854
LAW	175359.2	63687	2.75	0.006

Results

The value reported for COST in the quantity model is barley insignificant at the 10% level with a z-statistic of 1.61. However, if you consider the one-sided test of significance, the value is statistically significant at the 10% level when the t-statistic is above a value of 1.28. Originally there was suspected correlation problems, however this turned out to be insignificant. This implies an unexplained force that may be pushing up the standard error[6].

The value for ACFT in an OLS regression[7] reported a coefficient of 1.09. This value is twice as much as the two-stage regression. This implies an upward bias in the coefficient based on the endogeneity of the two variables across both regressions. Otherwise the minute changes in coefficients imply that the endogeneity problem does not extend to other variables.

The regressional analysis returned results which are to be expected from a working market. First, there is a relationship between quantity and price for which an increase in quantity increases the price of the transaction, and an increase in price increases the quantity. This shows that the structure established by CBWTP and the QLEs has adequately lowered the transaction costs associated with water transactions in the western United States. Normal market responses of quantity and price show that with lower transaction costs water markets have the potential to operate efficiently.

Another result of the analysis concerns the protection of public goods. Endangered and threatened species have many values: (1) use value, such as viewing animals or fishing (Loomis and White,1996), (2) existence value, or the satisfaction gain from knowing that a particular species has a healthy existence (Loomis and White, 1996), and (3) because extinction irreversibly narrows the reservoir of potential resources (Bishop, 1978). The regressional

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[6] See appendix 3
[7] See appendix 2

analysis indicates significant environmental factors of quantity and price. The quantity model shows streams with endangered species have a significant higher quantity of water transacted than those that don't. Environmentalism is also evident in the price model. Transactions on streams that contain threatened species will have a higher price than those that don't by about $50,000.

Endangered species are considered a public good, in need of protection (Coursey, 2001). The analysis confirms Loomis and White's (1996) conclusion that water rights holders have a value for endangered species. Second, it could indicate that QLEs are successfully fulfilling their mission statements by focusing their informational resources on sub-basins that require the most protection. Consequently, higher prices indicate that the non-profit institutions have a higher willingness to pay for water that helps threatened species. This confirms that the QLEs involved in CBWTP are attempting to restore more critical river ecosystems and providing the function of protecting endangered species.

The theory suggests that opportunity costs (represented by POP, YLD and LAND) should be important factors of quantity and price. This is partially confirmed by the empirical analysis. The variables POP, YLD and LAND were all significant in the price model and not the quantity model.

POP represents the opportunity costs of domestic urban and industrial uses of water and so the positive relationship is expected (Algharian et al. 1955). County populations in the Columbia River Basin span from Multnomah County, OR, with over 700,000 residents, to Clark County, ID, with less than 1000. This population disparity says that transactions in Multnomah County will be $69,000 more, than in Clark County. This is another indication that the market is working under normal conditions and opportunity costs are affecting market actions.

For YLD, the model gave a negative coefficient. One possible explanation for this value is that as the productivity of land goes up the need for water goes down. The soil is more efficient, so less additional irrigation is needed with higher yielding land. Another explanation could be in the different water needs of high yield crops in each sub-basin in different years.

LAND also reported a negative coefficient. This value could be explained by land speculation. As cities continue to grow there will be an increasing demand for land to contribute to urbanization. More developers will buy agricultural land for speculative purposes. Therefore as land prices in a sub basin increase there could be a decrease in the associated water right. This would be because the land owners are not currently using the land and lease out the unused water right.

The lack of significance in the variables on the quantity side could be explained by the leasing mechanisms utilized under the current framework. The average lease length, excluding 100 year terms, is about 4.5 years. Because sellers are not relinquishing water for long periods of time, the opportunity costs are not fully actuated.

Non-profits

Weisbrod (1986) first suggested that non-profits serve as private producers of public goods. He argued that the government, with a re-election constraint, will never provide the efficient amount of public good production. Non-profits also can be less bureaucratic and less costly than a similar government program or agency (Hansmann, 1987).

In this case study there are two layers of nonprofits. First, following the Hansmann argument, the BPA is ill equipped and too big, operating 31 hydro electric dams in the basin, to efficiently allocate funds. Therefore, they partnered with NFWF to cut down on transaction costs associated with funding water transfer projects in the basin. Secondly, the CBWTP created a system to allocate funds, rather than distributing themselves. Delegation could be for regional bureaucratic efficiency. Each non-profit operates in specific regions, overlapping very little. The non-profits may also have preexisting positive relationships with the community, or a better understanding of local hydrology.

The BPA and CBWTP have constructed a system in which they limit their funding to 10 QLEs to insure the fulfillment of their mission to "support innovative, voluntary, grassroots, water transactions that improve flows to tributary streams and rivers in the communities of the Columbia Basin."

This system is set up to insure that water transactions occur at the lowest cost to BPA. Only about 14% of transactions are fully funded by CBWTP. The majority of transactions are supplemented with funds from the QLEs. For-profit institutions have little incentive to act in a market with non-profits who get contributions from private donations and corporate sponsorship. Because of the high transaction costs associated with water market trades (Colby, 1990) for profit firms have little incentives to enter this market, even if they were allowed.

Secondly, non-profits signal to farmers that they are not being taken advantage of. In the western United States agricultural communities are very skeptical of reallocation of water. There are two major fears associated with water transactions. First, it is possible that with fewer actors in the local agricultural economy the costs associated with public operating and maintenance, for example the up keep of communal canals, with fall more heavily on those remaining. Secondly, there is a fear that in-stream transfers in particular could lower the number of farmers and cause water to flow to urban areas, which could affect the viability of the local agricultural economy (Jaeger, 2004).

Conclusion

This analysis returned two important results. First, the superstructure of non-profit organizations in the Columbia River Basin has adequately lowered transaction costs to facilitate market transactions. Furthermore, the involvement of non-profit organizations in the market gives in-stream flows value and funding from CBWTP creates an incentive for water conservation. Although this study does well at showing market action and seller motivations, there is little explanation of decision making by non-profit organizations. Water markets are complex entities that are hard to quantify. More work is needed to refine valuation methods and create tools and incentives to increase water conservation through economic methods.

The data indicates an ability of non-profit organizations to lower transaction costs in water rights markets. Therefore a possible policy consideration is the creation of an auction system for tradable water rights. Auctions can mitigate problems with inefficiently distributed rights and can direct revenues toward economically desirable outcomes (Conner, Ward, and Bryan, 2008). However auctions are costly to design and administer (Libecap, 2009). Non-profit organizations could lower the costs for design, operation, administration, funding and evaluation. They could also insure that conservation is accounted for. A significant decrease in the associated cost would make auctions a feasible policy option for Western States. An auction system would require a redistribution of existing water rights. This would be a very unpopular procedure originally; however there has been success with such policies in both Australia (Garrick et. al., 2009) and Chile (Alevy, Cristi, and Melo, 2010). Non-profit organizations as administrators of conservation programs can be a cost efficient way to find socially economic equilibriums.

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Appendix 1

Table 4: Comparison of IDWR data

Average water cost (per acre ft)		Average quantity	Percent of 100 year leases
IDWR	20.95544	6599.962	13.70%
total	30.96774	19885.19	19.20%

Appendix 2: OLS Regressions

Quantity Model (OLS)	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	277393.4	28975.78	9.57	0
COST	0.190727	0.02413	7.9	0
TERM	-99.5063	118.1284	-0.84	0.4
IRR	-270764	26067.07	-10.39	0
THREAT	-967.634	9689.805	-0.1	0.921
ENDANG	31401.02	14190.19	2.21	0.028
ACAP	1.524714	1.601328	0.95	0.342
SNR	-13100.4	9887.368	-1.32	0.186
POP	-0.00158	0.013131	-0.12	0.905
YLD	0.013503	0.07301	0.18	0.853
LAND	-1.83964	5.440932	-0.34	0.736
CONV	-976.364	9628.799	-0.1	0.919
EC\CO	3811.292	16674.26	0.23	0.819
LAW	-8458.75	26603.4	-0.32	0.751
STREAMFLOW	-0.77858	2.424139	-0.32	0.748
LOWFLOW	1907.831	11699.45	0.16	0.871

Price Model (OLS)	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	-194663	80545.23	-2.42	0.016
ACFT	1.090127	0.137921	7.9	0
TERM	487.5056	281.0644	1.73	0.084
IRR	186445.7	74150.71	2.51	0.013
THREAT	52139.49	22918.46	2.27	0.024
ENDANG	19632.44	34248.69	0.57	0.567
ACAP	-0.92086	3.835184	-0.24	0.81
SNR	29542.86	23647.77	1.25	0.213
POP	0.078288	0.030981	2.53	0.012
YLD	-0.29736	0.173493	-1.71	0.088
LAND	-17.8491	12.95945	-1.38	0.17
CONV	32149.87	22925.96	1.4	0.162
EC\CO	-17056.6	39852.91	-0.43	0.669
LAW	162970.4	62732.17	2.6	0.01
STREAMFLOW	19.39842	5.658729	3.43	0.001
LOWFLOW	-92.9575	27971.93	0	0.997

Appendix 3: Correlation Test

	ACFT	COST	TERM	IRR	THREAT	ENDANG	ACAP	SNR	POP	YLD	LAND	CONV	EC\CO	LAW	STREAMFL	LOWFLOW
ACFT	1															
COST	0.4408	1														
TERM	-0.0171	0.1111	1													
IRR	-0.5476	-0.0942	0.0349	1												
THREAT	-0.0027	0.1108	-0.0824	0.0273	1											
ENDANG	0.1261	0.0577	0.0282	0.0047	-0.3401	1										
ACAP	0.0809	0.0188	0.1162	-0.0782	0.0715	-0.0177	1									
SNR	-0.0024	0.0871	0.1015	-0.0139	-0.0241	0.1341	0.1405	1								
POP	0.0163	0.136	0.0061	0.0416	-0.0018	0.0373	-0.0291	-0.058	1							
YLD	-0.0681	-0.0316	-0.0254	0.1142	0.0329	-0.0997	0.0695	-0.1516	0.3601	1						
LAND	0.0041	0.0504	0.0772	0.0008	0.0301	0.0198	0.0236	0.1645	0.6971	0.1228	1					
CONV	0.0308	0.0564	0.0565	-0.0258	-0.0105	-0.0138	-0.06	0.0016	-0.1322	0.0036	-0.1608	1				
EC\CO	-0.0306	-0.0247	-0.094	0.0559	0.0771	-0.0435	-0.0022	-0.0518	0.2077	-0.0122	0.1797	-0.2736	1			
LAW	0.0108	0.1327	0.0614	0.0346	-0.0075	-0.0128	-0.0085	-0.0471	0.1623	0.143	0.3251	-0.1662	-0.0605	1		
STREAMFL	0.0089	0.217	0.0627	0.0871	0.0231	-0.1206	-0.0479	-0.0267	0.1013	0.0916	0.0345	-0.0565	0.085	-0.008	1	
LOWFLOW	-0.0696	-0.0692	-0.0419	-0.0085	0.1566	-0.0509	0.068	0.1338	-0.1028	-0.0854	-0.0646	0.1286	-0.0537	-0.0123	-0.5154	1

Appendix 4: Descriptive Statistics

ACFT		*COST*		*TERM*		*IRR*	
Mean	19885.19	Mean	53709.82	Mean	23.48425	Mean	0.968504
Standard Error	5878.362	Standard Error	12523.77	Standard Error	2.433477	Standard Error	0.01098
Median	916.825	Median	625	Median	3	Median	1
Mode	91	Mode	0	Mode	1	Mode	1
Standard Deviation	93685.68	Standard Deviation	199596	Standard Deviation	38.78324	Standard Deviation	0.174999
Range	1000000	Range	2187924	Range	99	Range	1
Minimum	0	Minimum	-3896	Minimum	1	Minimum	0
Maximum	1000000	Maximum	2184028	Maximum	100	Maximum	1
Sum	5050839	Sum	13642295	Sum	5965	Sum	246
Count	254	Count	254	Count	254	Count	254

THREAT		*ENDANG*		*ACAP*		*SNR*	
Mean	0.574803	Mean	0.133858	Mean	444.7151	Mean	0.338583
Standard Error	0.031081	Standard Error	0.021407	Standard Error	179.9266	Standard Error	0.029752
Median	1	Median	0	Median	11.5	Median	0
Mode	1	Mode	0	Mode	0	Mode	0
Standard Deviation	0.495349	Standard Deviation	0.341172	Standard Deviation	2867.558	Standard Deviation	0.474162
Range	1	Range	1	Range	43945	Range	1
Minimum	0	Minimum	0	Minimum	0	Minimum	0
Maximum	1	Maximum	1	Maximum	43945	Maximum	1
Sum	146	Sum	34	Sum	112957.6	Sum	86
Count	254	Count	254	Count	254	Count	254

POP		*YLD*		*LAND*		*CONV*	
Mean	262592.2	Mean	116229.6	Mean	1837.372	Mean	0.429134
Standard Error	33734.46	Standard Error	4396.803	Standard Error	79.49079	Standard Error	0.031117
Median	140617	Median	103349	Median	1623.75	Median	0
Mode	140617	Mode	80430.2	Mode	1623.75	Mode	0
Standard Deviation	537638.9	Standard Deviation	70073.5	Standard Deviation	1266.875	Standard Deviation	0.49593
Range	2969003	Range	272492.5	Range	8828.2	Range	1
Minimum	11469	Minimum	9623	Minimum	386.8	Minimum	0
Maximum	2980472	Maximum	282115.5	Maximum	9215	Maximum	1
Sum	66698411	Sum	29522329	Sum	466692.6	Sum	109
Count	254	Count	254	Count	254	Count	254
EC\CO		*LAW*		*STREAMFLOW*		*LOWFLOW*	
Mean	0.090551	Mean	0.035433	Mean	1096.64	Mean	0.200787
Standard Error	0.018042	Standard Error	0.011623	Standard Error	125.5347	Standard Error	0.025185
Median	0	Median	0	Median	130.1333	Median	0
Mode	0	Mode	0	Mode	5533.1	Mode	0
Standard Deviation	0.287536	Standard Deviation	0.185237	Standard Deviation	2000.694	Standard Deviation	0.40138
Range	1	Range	1	Range	10081.3	Range	1
Minimum	0	Minimum	0	Minimum	0	Minimum	0
Maximum	1	Maximum	1	Maximum	10081.3	Maximum	1
Sum	23	Sum	9	Sum	278546.6	Sum	51
Count	254	Count	254	Count	254	Count	254

Appendix 5: Explanation of Variables

Variable	Explanation
ACFT	Average total in-stream acre feet per transaction
COST	Total cost incurred by the QLE for the transaction
TERM	Term of the transaction in years
IRR	1 if irrigation was the primary use and 0 if it is not
THREAT	1 if stream has threatened species and 0 if it is not
ENDANG	1 if stream has endangered species and 0 if it is not
ACAP	quantity of the acres of land, if any, acquired appurtenant to the water transaction
SNR	1 if the right is the most senior in the primary reach and 0 if it is not
POP	Average population in the sub basin
YLD	Average market value of agricultural products sold per farm in the sub-basin
LAND	Estimated market value of land and buildings per farm for each transaction
CONV	1 if seller cited conservation as motivation and 0 if it is not
EC\CO	1 if seller cited economic reasons mixed with conservation as motivation and 0 if it is not
LAW	1 if seller cited legal requirements as motivation and 0 if it is not