Hedging Irrigation Risk through Water Markets: Trends and Opportunities

Ereney Hadjigeorgalis[1]

Introduction

Risk and agriculture go hand in hand. As the uncertainties of agricultural production cause farm incomes to be substantially volatile, farmers will attempt to hedge or manage their risk through various instruments. Although there exist a number of risk management tools, most are geared towards managing non-irrigation-related production risks. These include yield and revenue insurance, futures and options, contracting sales and purchases, enterprise diversification, debt-level management, credit availability, and off-farm employment (USDA – RMA). Multiple peril crop insurance provides coverage in the event of drought losses, but it does not give farmers the necessary tools to prevent these losses in the first place. This paper describes how and why water markets may provide a workable mechanism to manage irrigation risk by allowing farmers to hedge, spread and share their individual risks through water rights transactions and temporary water rentals.

Documentation of the use of economic instruments to manage irrigation risk abound in the literature (Campos and Studart 2006; Keplinger et al. 1998; Lund and Reed 1995; Gomez, Tirado and Rey-Maquieira 2004; Iglesias, Garrido and Gomez-Ramos 2003; Booker, Michelsen and Ward 2005), but there has been relatively little discussion of the role of water markets as a means of managing the risk of variable water supplies that are implied by recurrent drought (Characklis et al. 2006; Calatrava and Garrido 2005a, 2005b; Beare, Bell and Fisher 1998; Howitt 1998). The inevitability and recurrence of drought, however, spurs the need to develop innovative approaches to irrigation risk management (Pirie, de Loe and Kreutzwiser 2004; Ross, Cancelliere and Guiliano 2005; Wilhite 1997). As we begin to see drought more as a manageable risk, and less as an unpredictable natural disaster (Higgins 2001), we can begin to explore water markets as a viable risk management tool at the individual user level.

Irrigation risk is defined here as the risk of receiving less than the full allocation of water in a growing season. While the irrigation risk may be the same for all farmers in a basin, depending on whether they operate under a priority or correlative system, the relative costs associated with that risk will differ widely among farmers. This is due to a number of factors, which include the debt position of the farmer, the crop mix and its sensitivity to variations in water supply. Some farmers may face higher relative risk costs because of large fixed costs that need to be covered during the growing season or substantial investments made in permanent plantations.

Farmers with higher relative drought costs would also be those that do not have other irrigation risk management options. Cummins and Thompson (2002) identify four main options for managing irrigation risk. Farmers can (1) attempt to more accurately predict shortfalls using available information, (2) improve on-farm water use efficiency, which will free up additional resources, (3) use alternative water sources such as groundwater and on-farm storage or (4) trade water. Our ability to accurately predict shortfalls is admittedly limited. For those farmers that are unable to improve their irrigation efficiency or who do not have access to alternative

[1] The author is Assistant Professor, Department of Agricultural Economics and Agricultural Business, New Mexico State University.

water supplies, water markets may provide an efficient vehicle for spreading, hedging or sharing irrigation risk.

In addition to differences in relative risk costs, some farmers are more risk averse than other farmers. Risk aversion is an intrinsic quality that is not a simple function of crop mix, debt position or other external factors. Some farmers are simply not willing to take on as much unprotected risk as others based on their personal preferences. When these farmers are faced with limited irrigation risk management options, they will seek out instruments in the water market to ensure that they have an adequate water supply.

How can farmers ensure that they have an adequate water supply, even in times of unexpected shortages, given that water is in fixed supply and cannot be produced? One approach is for the farmer to hold a reserve of water rights that go unused in years of normal or abundant water supply. Alternatively, he may be interested in markets that would provide him water on an as-needed basis. In order for these markets to work, however, there must be a parallel group of farmers who are willing to supply water in times of shortages or relinquish rights to water in the long term. These farmers would either face lower relative drought costs or be less risk averse. This is the basis for risk sharing.

Different types of water market arrangements could provide different risk sharing opportunities. Farmers would be attracted to these arrangements to the extent that they addressed their individual risk management needs. Some farmers will seek instruments that will grant them greater security and eliminate more uncertainty whereas others will be satisfied with instruments that reduce some, if not all, of their risk. This demand for differing degrees of risk management could be accommodated by various forms of market transfers.

Water Rights Purchases

At one end of the continuum is the purchase of additional permanent water rights. Supplementary water rights purchases allow a farmer to mitigate the risk of drought as if he were purchasing an insurance policy. The opportunity cost of those unused rights in normal to abundant water years can be viewed as the premium paid to avert catastrophic loss in drought years. However, whereas an insurance policy would compensate the farmer for his loss, the purchase of additional water rights helps the farmer avert the loss altogether

In a correlative system, holding supplementary water rights would guarantee the farmer a higher water supply in times of drought, since water allocations are based on the number of rights held. In a priority system, the purchase of senior rights would serve the same end. The higher a farmer's relative drought costs, or the more risk averse he is, the more water rights he would purchase. These rights would be a reserve that could be drawn on in times of low water supply, but would go unused in times of normal to abundant water supply.

While this approach has worked well for farmers in Chile and Australia where there is no expropriation based on non-use (Hadjigeorgalis and Lillywhite 2004; Hadjigeorgalis 2004, 2000; Chatterton and Chatterton 2001; Bjornlund and McKay 2002; Bjornlund 2003); it would be difficult to maintain in the current institutional framework of Western water rights, which are subject to use-it-or-lose it principles. While forfeiture principles may have been designed to ensure beneficial use of all water under the original institutional framework of water allocation, they may impede efficient risk sharing among farmers in the current water market environment.

Spot Water Purchases

Holding additional water rights that are only exercised in drought may not be the most efficient form of risk sharing afforded by water markets. Although maintaining reserves may work well for those farmers who face the greatest relative drought costs or who are extremely risk averse, there will be other farmers who will prefer instruments that do not necessitate the lost opportunity cost of unused water rights over time. These farmers may rely on spot markets to purchase water from other farmers during drought.

Relying on temporal purchases of water is a riskier approach to obtaining additional supplies than outright water rights purchases. By relying on this market, farmers would be exposing themselves to two additional risks that do not exist in the water rights market: price risk and availability risk. In one sense, while spot water may be available in a drought, its price is likely to be high and uncertain over time. A farmer may find that while water is available, it may not be available at a price that would make it more economical than a drought loss. Other farmers, who may be willing to pay a very high price for water, may find that there is not a sufficient supply or that they will need to purchase from several farmers, thus increasing their transactions costs.

Water Banks

Many states have avoided the inherent riskiness of spot water markets by establishing either temporary or permanent water banks. Two prominent examples are the permanent Idaho water bank and the California drought water bank. In Idaho, water is leased through several different water banks including a state water bank, three local rental pools, and the Shoshone-Bannock Tribal Water Supply. The California Drought Water Bank is an intermittent temporary water bank that only comes into operation in cases of drought. California first instituted a drought water bank in 1991, but by that time the drought had already lasted five years in the state. Subsequent drought water banks were established in 1992 and 1994.

Water banks are excellent risk sharing mechanisms. The water price is fixed and there is sufficient supply at these prices. In this sense, both price and availability risk are eliminated as well as the opportunity cost of holding water rights that will go unused in most years. Water banks that are permanent institutions, such as the Idaho water bank, are preferred to temporary institutions that are only instituted in case of drought, since whether and when a drought water bank will be established introduces another aspect of uncertainty into farmers' decision-making.

Water Derivatives

The next frontier for risk management in water markets would be the establishment of water derivatives such as futures and options. These derivative instruments could serve to reduce the risk inherent in pure spot markets for water while avoiding the need to invest in additional water rights that may go unused in most years. They also would allow for market-determined prices in contrast to the fixed prices afforded by water banks. While derivatives do not remove the risk that accompanies uncertain water supply, they can determine who takes on the speculation and who avoids it (Cummins and Thompson 2002).

A futures market in water would be a set of contracts that promised to deliver specified amounts of water at a future date at a pre-arranged price. This arrangement would obligate the buyer to purchase the water regardless of prevailing water supply conditions at the delivery date. The

seller in this arrangement bears the brunt of the price risk in the event that water supplies become scarcer than anticipated at the time of the contract.

In an options market, on the other hand, a farmer could purchase an option to buy (call) a certain amount of water at a pre-arranged price. Unlike futures contracts, the buyer is not obligated to honor the contract. He could let the option expire by failing to exercise it by its delivery date, and the seller would retain the option premium paid. Options are attractive because they protect against insufficient water supplies, but do not require the buyer to purchase water should precipitation increase substantially over the contract period.

California experimented with these kinds of instruments in its 1995 water bank program. In anticipation of a potentially dry year in 1995, the Department of Water Resources (DWR) purchased water supply options from willing sellers for water bank members. In the case of insufficient water supplies, the DWR could exercise these options to meet water supply needs. In the end, DWR bought options on 29,000 acre-feet of water at $3.50 per acre-foot. The negotiated exercise price on these options varied between $36.50 and $41.50 per acre-foot. Abundant rainfall in 1995 negated the need to exercise the options, which expired in May 1995. The sellers retained the original option price paid, which totaled $101,500. DWR attempted to sell the options to a third party, but could not find sufficiently interested parties (Jercich 1997). Options markets such as these have immense potential to help producers manage the risks of cyclical droughts in the Western United States and in drought-prone regions of the world.

Contingent Water Markets

An alternative mechanism that functions similarly to options markets is a contingent or interruptible water market. Rather than a source of water supply for farmers during drought, this mechanism provides farmers with a market for water they wish to sell. Contingent water markets have been proposed as a means of securing water supplies during drought for urban centers, hydropower or environmental concerns (Michelsen 1988; Hamilton, Whittlesey and Halverson 1989; Huffaker, Whittlesey and Wandschneider 1993). Since the value of water in non-agricultural sectors tends to be higher, irrigators could be compensated for their agricultural production loss and associated transactions costs through various payment schemes.

Contingent water markets generally involve long-term leases. Over the lease period, farmers maintain control and use of their water during most years. When trigger conditions emerge, such as low in-stream flows or increased urban demand, farmers relinquish their water temporarily in exchange for just compensation. These markets may provide an income safety net for irrigators who have the flexibility to fallow their land or reduce their acreage significantly during drought. For farmers with less flexibility, such as those that grow permanent crops, other types of markets would be more advantageous.

Policy Challenges for Risk Management Through Water Markets

What are some of the challenges to using water markets as efficient mechanisms to hedge irrigation risk? In the Western United States, holding water rights as reserves is discouraged by the use-it-or-lose-it clause, which does not recognize the risk hedging value of holding additional water rights that are only exercised in times of drought. Under this current institutional structure, farmers risk the loss of their rights for a behavior that may be deemed economically efficient.

Other challenges to risk management through water markets are the immaturity of the markets themselves and institutional frameworks that place significant barriers on the further deepening of these markets. Spot water markets and water derivatives, in particular, demand a more developed framework where information is not costly and transactions can be regularly conducted.

Despite these challenges, water marketing may prove to be the best way to effectively manage irrigation risk in agriculture in the face of increasing uncertainty over future water supplies. As water becomes scarcer in coming years water markets are likely to rise to these challenges despite their criticism in many circles. As they do, researchers and applied economists will pay greater attention to all of the potential roles that these markets can fill – and most importantly how they can help farmers reduce their losses from cyclical water shortages.

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