The Illiquidity of Water Markets: VOX EU

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The Illiquidity of Water Markets

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Water scarcity is accelerating. In regions such as Latin America, India, and the United States,[1] this phenomenon is especially acute. Water markets are emerging as a preferred institution[2] in dry regions of the United States and Australia. However, these analyses have largely ignored institutional frictions, primarily liquidity constraints, which calls into question whether markets are the most efficient allocation mechanism for water. The nexus question is the optimal mix of markets and regulations for allocating water in a world with increasingly scarce supply.

How efficient are water markets?

Traditional theory suggests that markets increase efficiency by coordinating trade and specialization among buyers and sellers. Gains are especially large when the demand is heterogeneous; these are the instances in which a water market works well. For example, farmers often demand different quantities of water because they have systematically different crops or because their farms are located in areas with different seasonal outcomes (e.g., rainfall and precipitation). Johansson (2002) outlines the basic controversy of water markets: the presence of externalities can undermine incentive for each market participant to align social and private[3] outcomes. Since underground water is a common pool resource, and thus neighboring farmers pump water from the same water pool, farmers may realize the full benefits of pumping water (i.e., irrigating only their land), but pay only a fraction of the true costs (i.e., the increased probability of exhausting the source). Importantly, these costs affect all neighboring farmers not just the one extracting the water. The traditional notion of market with water rights will lead to overuse and exhaustion.[4]

Market efficiency and liquidity constraints

Our recent paper[5] suggests that policymakers should also be highly cognizant of another concern when considering the construction or augmentation of water markets: if farmers' demand for water is relatively homogeneous (e.g., a small area where the gains from trading are not large) and

[1] Barnett, T. P., Adam, J. C. and Lettenmaier, D. P., 2005, "Potential impacts of a warming climate on water availability in snow-dominated regions," Nature, Vol. 438, 303-09.

[2] Grafton, R. Q., Libecap, G., McGlennon, S., Landry, C. and O'Brien, B., 2011, "An Integrated Assessment of Water Markets: A Cross-Country Comparison", Review of Environmental Economics and Policy, Vol. 5, No 2, 219-239.

[3] Johansson, R. C., 2002, "Pricing Irrigation Water: A Literature Survey," The World Bank, Rural Development Department, Policy Research Working Paper 2449.

[4] Other institutional contexts may prevent an efficient solution. For example, consider the case where water is diverted from an agricultural town to a new golf course in a different town because the owners of the golf course are willing to pay more for the water. Many farmers may go out of business in the agricultural town, an "externality" that is not incurred by the owners of the golf course.

[5] Donna, J. and Espín-Sánchez, J.-A., 2014, "The Illiquidity of Water Markets," http://dx.doi.org/10.2139/ssrn.2667654.

farmers face liquidity constraints (LC), they might not have the cash to pay for water when they want to buy. In these cases, an alternate institutional setup may be more desirable. One such institution is a system of fixed quotas: each farmer periodically receives a share of the water available in proportion to the size of his plot.

When farmers are heterogeneous markets will increase efficiency, assuming liquidity constraints are not binding. Farmers will trade freely to improve water allocation. The advantage of quotas arises from the fact that, since farming is a seasonal activity, farmers need the cash to buy water before the harvest season yet, a standard market mechanism only provides them with cash after the harvest season. Due to weather uncertainty and without perfect financial markets, poor farmers will be liquidity constrained precisely at the time of the year when they need the water the most. On the contrary, a system of fixed quotas ensures that each farmer has access to water during the harvest season.

What types of weather shocks? Idiosyncratic vs. aggregate shocks

An important detail is whether farmers' water demand differs for permanent or temporal causes. Permanent differences could be included in the quotas system: farmers will have more or less water depending on their crops. Temporal differences are harder to contract *ex ante* and, hence, will only be solved by the market or *ex post* bargaining.

It is also important to stress the differences between idiosyncratic and aggregate rain volatility. High idiosyncratic volatility means that neighboring farmers will have very different levels of rain within the same year. High aggregate volatility means that the average rain for all farmers will be very different between years. High idiosyncratic volatility means that demand is heterogeneous and markets are good. High aggregate volatility means the price of water during dry years will be very high, thus LC are important, and quotas perform well.

From a theoretical perspective, whether quotas outperform markets depends on the extent to which liquidity constraints are binding for farmers (i.e., they experience them) versus the dispersion of heterogeneity in demand. For example, if heterogeneity in demand is large and liquidity constraints do not play a major role, markets will tend to outperform quotas; if not, the opposite is true.

The challenge with empirically answering which of the two is larger comes from the fact that water markets throughout the world are heavily regulated. These regulations and the overlap of public and private water rights imply that undistorted water markets prices are never observed; instead, we observe the distorted prices, which are insufficient for estimating water demand. While there are econometric techniques for addressing this, since even distorted price differences signal gains from trade, these comparisons still provide ambiguous results if there are barriers across districts and different regulatory framework.[6] The presence of LC complicates these issues even further: their presence will lead an analyst to systematically underestimate demand if they are not taken into account.

[6] Libecap, G. D., 2011, "Institutional Path Dependence in Adaptation to Climate: Coman's "Some Unsettled Problems of Irrigation," American Economic Review, Vol. 101, No. 1, 64-80.

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Concluding remarks from a case study in Spain

In our paper, we look at a centralized free market for water that was in place for over 700 years. By focusing on farmers who only grow apricot trees, we concentrate only on temporal, rather than permanent, differences in demand. All farmers' plots are located within a small area. This ensures that the idiosyncratic volatility is small. The area under study, southeastern Spain, is the driest region in Europe: aggregate rain volatility is high. We estimate water demand and financial constraints in this setting. We use our estimates to compute counterfactual revenue and compare the revenue that the farmers would obtain under two institutions: auctions and quotas. We found that quotas outperform markets by 8%.

Our results show that implementing water markets might be counterproductive in certain cases. In particular, introducing markets might reduce efficiency relative to quotas in areas where: i) aggregate rain volatility is large relative to idiosyncratic rain volatility; ii) the market serves a small area; and iii) LC are a concern. Recent attempts to introduce water markets in India might be counterproductive due to the likely presence of LC among the farmers.

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