An Alternative Market Framework for Water Transfers When Third Party Externalities Dominate

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Introduction

- Last three decades have witnessed the emergence of water markets to alleviate water scarcity

- Water markets satisfy the economic principle of allocative efficiency: allocation of resource towards its highest valued use

- Yet, both transaction costs and economic and environmental externalities (third party effects) can raise the costs of water transfers and reduce their potential in allocating water efficiently across users (Young, 1986; Colby, 1990; Chong and Sunding, 2006; Garrick et al., 2013)

Objectives

- The study explicitly ties the third party impacts of binding stream flow constraints with the opportunity costs of water transfers

- Demonstrates through numerical simulations, how possible third-party externalities associated with water transfers are internalized by the marginal cost price paid by each of the participants in trading

Model

- Study utilizes a common pool market framework where a market manager coordinates all trades (Prabodanie et al, 2011; Willett et al., 2014; Raffensperger and Milke, 2017)

- Participants express their demand through the VMP of water

- Market equilibrium outcomes follow from a linear programming model maximizing aggregate gains from water transfers

- The market manager also determines net trades on the basis of each participant's initial allocation of trading permits

- Each market participant involved in the trade pays or receives a *marginal cost price* which is constructed on the basis of shadow prices from the market model constraint set

Data & Methodology

- A four firm trading model utilized with the following firm level demand functions:

Firm 1	$P_1 = 150 - 10s_1$
Firm 2	$P_2 = 80 - 2s_2$
Firm 3	$P_3 = 18 - 1.2s_3$
Firm 4	$P_4 = 20 - 2s_4$

S_i denotes a consumptive use right for water in acre foot and P_i is the price/acre foot

- Trades are assumed to take place

Results and Discussion

Model with four firms and 19 initial consumptive rights:

Firms 1 and 2 face binding constraints as reflected by the prices paid by each ($31.2/right and $48/right)

Firms 3 and 4, which do not face binding flow constraints pay the market-clearing price

The market price ranges between $14.4-$16 per consumptive use right, depending the initial allocation of rights and quantity of water rights traded in the market

Model with four firms and 22 initial consumptive rights:

Revenue/expenses from trading by 47 percent when 22 initial rights are allocated

Results and Discussion

Return flow coefficient=0.30

- With return flow coefficient=0.30, most firms face the market clearing price with no binding flow constraints

- With initial consumptive rights of 19, all firms pay the market clearing price of $48 per right

- Shadow price or marginal cost price is positive only at the point of diversion for Firm 2

Conclusions

- Common pool market trading conducted by a central market manager, utilizes a linear programming based market model, which solves for market clearing prices and quantities traded in equilibrium

- Centralized water markets can reduce some of the external economic costs of bilateral water transfers, if consumptive rights are well defined

- By incorporating opportunity costs into the prices at each round of trade which determines the direction and amount of water traded, such a market design can be successfully implemented in regions across the country where water transfers often conflict with preserving instream flows

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