WATER AUCTIONS
WITHIN THE AGRICULTURAL SECTOR:
CONDUCT AND PERFORMANCE IN ISRAEL

Dafna M. DiSegni
School of Management, University of Haifa, Israel

Amity Feder
Graduate School of Mathematical Sciences, Tel Aviv
University, Israel

Zvika Neeman
School of Economics, Tel Aviv University, Israel

Authors are listed in alphabetical order.
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Introduction

Economists have argued for years that using markets for water would increase both efficiency and social welfare. However, the extend and limitations to which such an increase in efficiency and welfare can take place is vague. Who will benefit from a reallocation of water using a market mechanism? What are the differences in performance of distinct water-market mechanisms?

In this study we simulate the performance of three multi-unit auction schemes: the discriminatory, uniform and Vickrey auctions. Results are compared to common alternative pricing policies: the marginal pricing and the three block pricing systems. We also compare the implications of multi-regional auctions vs. one state auction.

The state of Israel exemplifies a classical example where water is scarce and inefficiencies in water use within the agricultural sector are primarily attributed to the criteria of water allocation and price. Water is allocated according to water usage in the 1980s and priced at 3 tier increasing prices (first 50% of the quota at price $p_i$, additional 30% at price $p_i$, last 20% at price $p_i$).

Micro-level data on water pricing, water quotas and water use within the agricultural sector in Israel was used to generate a set of 6,170 demand equations, representing farmers' marginal benefit from water use for irrigation and for simulating the reallocation of water and payments under each of the schemes under focus. Performance of the schemes is compared at the individual and social level.

### Simulation: Water auction within the Israeli Agricultural Sector

- **Number of bidders**: 6,170 (all farmers, or farm colectives)
- **Water types**: water is available at different qualities. We normalize all water types to fresh water using the water equivalent factor used by the Israeli Farmers Federation:
  - Bidding function (demand) is simulated with a random draw of parameters $\alpha^* = B^* \gamma^*$ from a uniform distribution [0.002, 0.008].
  - Demand takes the simplified function $\alpha^* = B^* \gamma^* \sigma^*$ and accordingly $P_{w,bid} = \alpha^* - B^* \gamma^* \sigma^*$.

The uniform and Vickrey auctions perform equally and result consistent with theoretical analysis presented by Swwider (2001, 2006) and Krishna (2002). Both are truth telling (bidding strategy and allocation equal). Total bidder payments are slightly higher under the uniform auction, and accordingly, average bidder payment is lower. Payments under discriminatory auction are slightly lower than the optimal (Vickrey) payments.

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**Table 1: Water allocation under tire pricing (1000m³) - proportional to farmer's land area (3 tiers)**

<table>
<thead>
<tr>
<th>Region</th>
<th>1st tier</th>
<th>2nd tier</th>
<th>3rd tier</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>35.5%</td>
<td>22.8%</td>
<td>12.0%</td>
<td>43.9%</td>
</tr>
<tr>
<td>South</td>
<td>41.7%</td>
<td>36.0%</td>
<td>11.3%</td>
<td>58.7%</td>
</tr>
<tr>
<td>North Valley</td>
<td>17.4%</td>
<td>10.9%</td>
<td>7.7%</td>
<td>35.7%</td>
</tr>
<tr>
<td>Central</td>
<td>27.7%</td>
<td>23.4%</td>
<td>13.7%</td>
<td>56.4%</td>
</tr>
<tr>
<td>South</td>
<td>27.4%</td>
<td>18.9%</td>
<td>14.2%</td>
<td>59.5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>38.4%</td>
<td>25.5%</td>
<td>16.0%</td>
<td>54.8%</td>
</tr>
</tbody>
</table>

**Water allocation under tire pricing (1000m³) - proportional to farmer's land area**

- **Social Value per unit**: 0.949
- **Average welfare water allocation unit**: 0.972

**Result 1: Auction Performance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Uniform</th>
<th>Vickrey</th>
<th>Discriminatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption (K CM)</td>
<td>857.145</td>
<td>857.145</td>
<td>857.192</td>
</tr>
<tr>
<td>Total social welfare (K NIS)</td>
<td>2,076,140</td>
<td>2,076,190</td>
<td>2,076,207</td>
</tr>
<tr>
<td>Total bidders' payments (K NIS)</td>
<td>1,704,316</td>
<td>1,704,349</td>
<td>1,704,176</td>
</tr>
<tr>
<td>Total bidders' revenue (K NIS)</td>
<td>311,730</td>
<td>311,771</td>
<td>312,011</td>
</tr>
<tr>
<td>Average social benefit (NIS/CM)</td>
<td>3.35713</td>
<td>3.35713</td>
<td>3.35712</td>
</tr>
<tr>
<td>Average bidder's profit (NIS/CM)</td>
<td>0.308015</td>
<td>0.308214</td>
<td>0.368243</td>
</tr>
</tbody>
</table>

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**Result 2: Auction (uniform) vs. block pricing allocations - simulation**

- **Consumption under block pricing (1000m³)**: $\rho = 0.936$
- **Consumption under uniform auction**: $\rho = 0.978$

**Water allocation under tire pricing (1000m³) - proportional to farmer's land area**

- **Social Value per unit**: 0.572
- **Average welfare water allocation unit**: 0.971

**Result 3: State Auction (uniform) vs. Regional Auctions**

- **Adoption of the auction trade mechanism for allocating water to agricultural usage is shown to improve social welfare, but unequally improve farmers' welfare. A regional auction favors the peripheries. The Northern and South Jordan districts receive the highest benefit from the regional auction (rather than state level auction); the bidders in these regions receive 13% more units while the average bidders' payment decreases by 0.8% and 1.5% respectively. Contrarily, the central district receives 2.8% less units and the average payment decreases by 0.5%. In sum, the bidders average payment decreases by 0.5% under multi regional auctions, their average profit will increase by 2.7% and the total social welfare will decrease by 0.05%, which makes the multi regional auction a legitimate mechanism to allocate water resource in Israel.**