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.

Poster prepared for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington,
August 12-14, 2012.

WATER AUCTIONS WITHIN THE AGRICULTURAL SECTOR:

CONDUCT AND PERFORMANCE IN ISRAEL

Dafna M. DiSegni, Amity Feder, Zvika Neeman

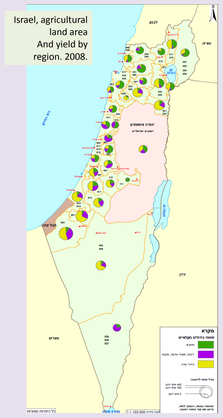
Introduction

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 pricing. 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_1, additional 30% at price p_2, last 20% at price p_3).

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.



Tier-pricing in Israel in 2008

	1st tier		2nd tier		3ed tier		total	
Region	% users	% water	% users	% water	% users	% water	# of users	Total water used million m³
Northern Districts	35.11	2.18	12.39	14.2	52.5	83.62	920	128.564
Galilean Valleys	41.32	0.70	9.14	5.51	49.54	93.78	755	184.608
Central districts	27.55	3.61	12.75	9.71	59.7	86.68	2,886	135.758
Coastal plain	17.45	1.91	7.94	6.73	74.61	91.36	831	85.302
Southern district	27.27	2.33	7.94	12	64.79	85.68	693	225.868
Jordan Valley districts	36.47	6.49	10.59	10.02	52.94	83.49	85	39.285
TOTAL							6,170	799.385

Simulation:
Water auction within the Israeli Agricultural Sector

Number of bidders: N=6,170 (all farmers, or farm-collectives)

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:

$$w_{treated} = 2w_f$$
$$w_{DanEff} = 1.6w_f$$
$$w_{saline} = 1.45w_f$$

Total water supplied to the agricultural sector in 2008: 1121.4 Million C³ (630.7 MMC fresh water, 490.7 MMC secondary water , i.e., about 65%). Normalized quantity: 799.4 Million C³

- Bidding function (demand) is simulated with a random draw of parameters (slop B^n) from a uniform distribution [0.002, 0.008].
- Demand takes the simplifies function $\alpha^n = P_{last} + B^n x$

and accordingly, $P_{last} = \alpha^n - B^n x^n$.

Result 1: Auction Performance

Parameter	Uniform	Vickrey	Discriminatory
Consumption (K CM)	857,148	857,148	857,172
Total social welfare (K NIS)	2,016,160	2,016,160	2,016,207
Total bidders' payments (K NIS)	1,704,456	1,704,388	1,704,176
Total bidders' profits (K NIS)	311,703	311,771	312,031
Average social benefit (NIS/CM)	2.352173	2.352173	2.352162
Average bidder's profit (NIS/CM)	0.3636518	0.3637314	0.3640243

The Uniform and Vickrey auctions perform equally (A result consistent with theoretical analysis presented by Swinkler (2001, 2006) and Krishna (2002). Both are truth telling thus bidding strategy and allocation equals; 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.

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

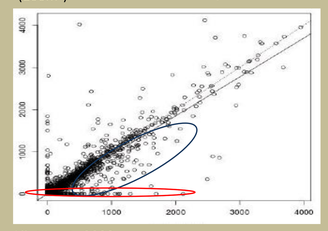
Parameter	block price mechanism	Uniform auction	Difference Auction Vs Block price
Consumption (Thousand cm)	799,508	857,148	7.21%
Total social welfare (T Sh)	1,869,478	2,016,160	7.85%
Total bidders payment (T Sh)	1,224,787	1,704,456	39.16%
Total bidder welfare (T Sh)	644,690	311,703	-51.65%
Average Social benefit (Sh/cm)	2.338	2.352	0.60%
Average Bidder benefit (Sh/cm)	0.806	0.363	-54.96%

Auction increases social welfare by 7.85%. The uniform market clearing price is 1.996 which is 52% higher than the first block price P1 (1.302) and 31% higher than the average allotment price (1.534). In the allotment system most bidders (50.5%) payment per unit is lower than the average price since they purchase less then their given allotment.

Result 2: Auction (uniform) vs. block pricing allotments

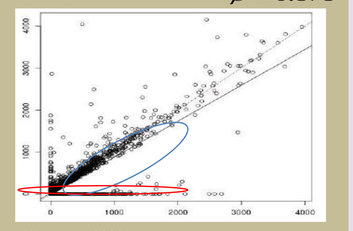
We find that under auction pricing (a) medium size farmers increase their water consumption, relative to their consumption under the allotment system; (b) number of bidders with zero consumption increased. Under the allotment system only 24% of the bidders did not consumed their quotas. Under auction, almost 40% of the bidders did not win any units.

Consumption under Block pricing ($100m^3$) $\rho = 0.936$



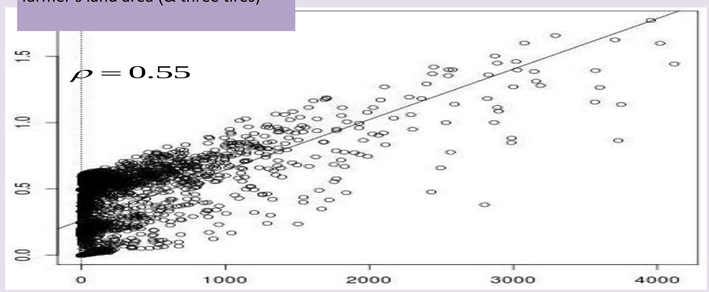
Allotments 2008

Consumption under Uniform auction ($100m^3$) $\rho = 0.878$



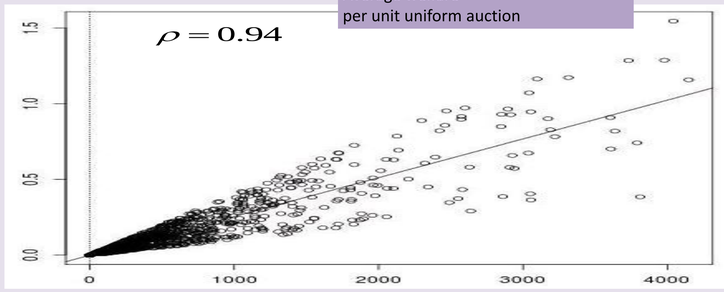
Allotments 2008

Average welfare
Water allocation proportional to farmer's land area (& three tires)



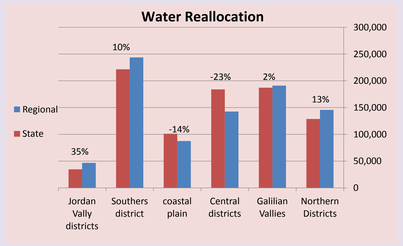
Water allocation under tire pricing ($1000m^3$) - proportional to farmer's land area

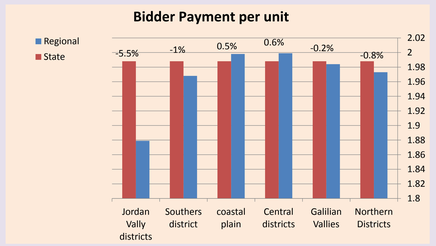
Average welfare
per unit uniform auction

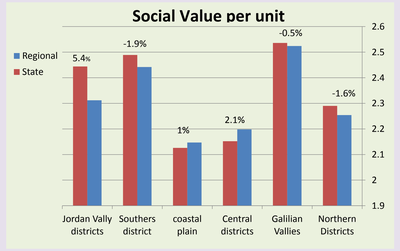


Water allocation under tire pricing ($1000m^3$) - proportional to farmer's land area

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 23% 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.