THE USE OF ADVERTISING TO ENCOURAGE WATER CONSERVATION: THEORY AND EMPIRICAL EVIDENCE

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INTRODUCTION

A growing demand for water in the industrial and residential sectors and increased concerns for environmental quality combined with limited water supply augmentation have raised water scarcity issues and led policymakers to consider policies that enhance water use efficiency. Most water reforms aim to reduce the demand of the agricultural sector, which is the largest user. These efforts include water pricing (see Tsur & Dinar, 1997; Boggess, Lacewell, & Zilberman, 1993); water markets (see Kaiser & McFarl, 1997, for a survey); and trade mechanisms (Brill, Hochman, & Zilberman, 1997). Strong political lobbying and the need to maintain independent domestic food production have led policymakers to direct conservational efforts in the urban residential sector. The capacity to conserve water by raising residential water prices is limited as urban water prices are already high and the elasticity of demand is low. Thus, there is a need to increase voluntary water conservation through education. Educational efforts may include a campaign to encourage installation of water conservation devices and more responsible use of water in gardening, washing, and other activities.

Reported residential water savings attributed to past conservation campaigns fall in the range of one to five percent. Michelsen, McGuckin, and Stumpf (1999) report a one to four percent saving in 12 cities in the United States, and the Israeli Water Authority reported a one to five percent saving in 1997 to 2000. Although these numbers are substantial, little is known about the extent that education can further reduce water usage, which affects public campaigns aimed at "de-marketing" or "un-selling" a product.

This paper aims to analyze the motivation for choosing advertising as a tool to reduce household consumption of water and to empirically document its effect based on a survey conducted in Israel.

To understand voluntary conservation, we use theories that address issues of fairness and labor effort allocation within groups. We incorporate these theories and marketing theories to develop a model to explain water conservation. We empirically test the framework using a survey done in Israel. Major findings are that, on average, the stated willingness to conserve was about 15 percent and that the fairness theorem holds; i.e., individuals' willingness to voluntarily conserve water decreases with economic incentives taken by the government.

CONCEPTUAL FRAMEWORK

Water is one of the market goods used to produce household commodities and it is also consumed as a final commodity. Consumers need a minimum quantity of water. It is common to model the demand for water using the Stone-Geary utility function in either the Cobb-Douglas, linear, or log-log forms (see, for example, Hanemann, 1997; Becker, Zeitouni, & Zilberman, 2000). This form of demand ignores education and conservation activities. A key factor in modeling water conservation activities is that the consumer needs to care about the community; i.e., he or she gains from the benefits of the community. The issue of low participation in public projects (Dawes & Thaler, 1988) is a focal element in education strategy.

The act of giving up your own benefit to help others is usually referred as to altruism or pro-social behavior (Schwartz, 1997; Baston & Shaw, 1991; Price, Feick, & Guskey, 1995). (The translation of social responsibility to economic behavior is done by adding the attitude toward the policy or the community to the utility function (Train, McFadden, & Goett, 1987; Rabin, 1993)). Rabin argued that his fairness model applies to altruism and labor efforts.

Labor economists analyzed situations where the individual's efforts contribute to the collective but incur personal cost. The motivation to cooperate comes from adding a share of the collective earnings to the personal income. A worker needs to allocate his efforts between his own business (farm) and working for the collective. The collective member's evaluation of others' efforts

affects his own contribution to the collective efforts (Bonin, 1977; Parliament, Tsur, & Zilberman, 1989). There is some tradeoff between water and time in the production of commodities. For example, a car can be washed using an irrigation pipe, which wastes much water but is done easily and quickly; or water can be supplied in buckets, which conserves water but is costly in terms of time.

Schwartz (1977) and Osterhus (1997) argue that consumer choice is moderated by social norms and the individual's need to meet those norms. Schwartz's (1977) altruism model addresses both social and personal norms, where the personal (subjective) norms affect the influence of the social norms on the individual's behavior. Osterhus (1997) models strategies that are used to induce contribution to the others, and he uses the term pro-social activity. He distinguishes between economic incentives (prices and rewards), normative influence (social and individual norm and their interaction), and structural factors (mediators of the interaction between social and personal norms, such as visibility). Osterhus (1997) found that the effect of social norms on consumption is mediated by factors such as responsibility and trust. A low feeling of responsibility and low trust in the actions of the advertiser may cause a weak linkage between social normative behavior and individual consumption. Visibility of personal actions is a key structural factor mediating the translation of social norms to personal behavior. Environmentalism and in-house water-conservation behavior are by definition almost invisible; thus, social norms should be operationalized by generating a high sense of personal responsibility and involvement, and by demonstrating the consequences of non-social behavior.

The above discussion suggests that water conservation norm is a translation of social and personal norms. It is a function of the gap between the two and the price of behaving differently from others, and it increases with levels of observability and responsibility. Suppose that there are *j* individuals in a certain society. Let S represent the personal water conservation norm, $\bar{S} = \sum_j S_j$ is the society's norm, r is the marginal price of deviation from social norms, and level of observability and responsibility are k_1 and k_2, respectively. Personal social norm before advertisement is:

$$S_0 = f(k_1, k_2, r, \bar{S}) \qquad (1)$$

Social norms are updated by education (advertisement), A, and comparing one's actions to the actions of others. The latter may operate the social justice adjustment mechanism; i.e., one's feeling that the burden is allocated fairly and that others contribute their share. This is often a moderate factor in multi-player cooperative decisions and outcome (see Akelof, 1982; Thaler, 1985; Kahneman, Knetsch, & Thaler, 1986; & Rabin, 1993). Advertising is used in this case to educate; i.e., change social norms. This suggests that initial perception of social norms is updated by educational advertisement activities and observing the behavior of others:

$$S = S_0 + g(A) + k_{1j} \sum S_j ;. \qquad (2)$$

Personal responsibility decreases if an individual feels that his/her actions will not affect the outcome. Thus, if one thinks that the government will do the job, he/she will probably be more passive. The fairness model suggests that if the government will reduce public water consumption then consumers may feel that it is only fair to contribute their share;

$\frac{\partial k_2}{\partial G} > 0$ (G is government action).

If water prices increase, then consumers may think that they are already doing their share.

Incorporating the concept of fairness or benefit from others utility, family production function framework into the individual's utility, yields the consumer's maximization problem:

$$Max_{S_W} U(Q_i, t_0, S) \qquad (3)$$

subject to:

$$Q_i = f(Y_i, t_i, W_i)$$

$$P_w W + P_y Y \le I + z t_w$$

$$t_0 + t_w + t_s \le T$$

where S_W is the intensity of water conservation, $0 \le S_W < 1$, S is social norms, W is defined as the quantity of water consumed, Y is other market goods, t_0 is leisure time; z is the hourly wage, t_0 is leisure, t_w is time spent on work, and t_s is the leisure time spent to save water. I is the initial endowment, P_w is the price of one unit of water, P_y is the price of other market goods, and T is the effective time constraint.

Solution of the consumer's maximization problem yields that the optimal saving is:

$$U_{t_0}\left[1-\frac{\partial t_0}{\partial W}\frac{\partial W}{\partial S_W}\frac{\partial S_W}{\partial S}\right]=U_Y\frac{P_W}{P_Y}\left[1-\frac{\partial S_W}{\partial S}\right]+U_S$$

The left-hand side is the marginal loss from reduction of leisure time as water consumption increases and the right-hand side is the increase in marginal utility from consumption of other products (as consumers save water) plus the increase in social benefit.

The desired reduction in household water consumption can be achieved by increasing the price of the water, P_w or increasing both social norms and responsibility. The relative effectiveness of price and manipulation of personal norms is determined by the ratio between r and d. Key factors in voluntary conservation are those variables that affect the formation of personal norms and its translation to conservation.

Our model assumes that personal responsibility will decrease if it appears that somebody else (government) will do the job, or if price increases and administrative measures have already been imposed on the individual or consumers think they should be imposed. As already mentioned, social justice (i.e., ones feeling that the burden has been fairly allocated) is often a moderating factor in multi-player cooperative decisions and outcome. Thus, it is expected that consumers who support water price increases to other sectors will be more willing to voluntarily save water.

H1: The consumer's willingness to save water (via active measures) increases with his/her feelings that other sectors will also engage in water-conserving activities.

The translation of social norm to personal responsibility is mediated by personal characteristics. Women have been found to care more about the environment than men (Ottman, 1993). Since water conservation has many similar aspects with environmentalism, women are expected to show higher willingness to save water. Age was found to have a positive impact on conservation (Neiswiadany, 1992).

H2: Women's willingness to conserve water will be higher than men's.
H3: Willingness to save increases with age.

BACKGROUND: ISRAEL'S WATER CRISES

In 1999, after a very arid winter, the Israeli Water Authority decreased the quantity of water allocated for agricultural usage by 250 million m^3 (a reduction of 40 percent from 1998). The Ministry of Agriculture (1999) allocated the quantity that needed to be saved among the different crops using a lexicographic decision rule; i.e., first minimizing long-term damage to the produce and then allocating based on the marginal value of production. For example, water allocation for cotton and wheat irrigation was reduced by 100 percent; for vegetables, including potatoes, by 30 percent; and for fruits, including citrus, by 20 percent. The Ministry of Agriculture demanded that farmers be compensated for the reduction in water usage by 1 NIS (about \$0.25) per m^3. The political instability that characterized the Israeli Parliament and a lack of agreement between the Treasury and the Agricultural Ministry led to delays in announcing the new water quotas. These went into effect in May 1999 and by then it was too late for many farmers to follow the official guidelines. Thus, the actual agricultural sector reduced the amount of water used by only 29 percent.

The Ministry of Agriculture conditioned its future agreement for further reductions in water supply by applying similar water-saving steps to both the industrial and private sectors (household consumption)[1]. One of the demands imposed by the Ministry was to increase the price of water supplied to municipal authorities, the suppliers of water to the urban sector. Increasing the price to households may have a "positive" moral effect on feelings of social justice, but its effect on reducing demand is very low as households price elasticity is stiff. The period between 2000 and the beginning of 2001 did not improve the water balance situation in Israel. In January 2001, only 30 million m^3 of water had been added to Lake Kinneret (the only water reservoir in Israel) instead of the 80 average million m^3. It is anticipated that by the end of 2001, the water level in Lake Kinneret will continue to decline to –214.3[2], below the red line level set at –213 m (the red line designates the lowest level of water the reservoir can hold; thus, water should instead be pumped from other, as yet unavailable, resources).

WATER RESOURCES IN ISRAEL: TRENDS AND POLICIES

The demand for water in Israel has increased due to the sharp rise in population caused by immigration[3] and a natural growth; that is why the supply has never caught up. Water supply in Israel depends solely on rain.

Sequential dry years and over-pumping further accelerated the existing water crisis. If and when a peace agreement is signed among Israel, Lebanon, and the Palestinians, water scarcity is expected to dramatically increase.[4] In 1998, the demand for water was higher than its supply by 212 million m^3, in 1999 the excess demand had increased to 317 million m^3; and in 2000 ground water was overexploited by 350 million m^3.

REGULATIONS, PRICES, AND ADVERTISEMENT

Water quantities and usage are determined by administrative allocations and processes, both monitored by the water director with the authority of the 1959 water law. Each year the Water Authority determines water allocation to the different sectors (agricultural, industrial, and municipal) for the coming year. Water suppliers are constrained to these allocations in their extraction permits (Kislev & Rosental, 1999).

The price of water for the farmer does not depend on his/her location, although production prices depend on distance from the water source. However, it does vary as a function of usage. Farmers pay about \$0.18 per m^3 for the first 50 percent of their water allocation, \$0.22 for the next 30 percent, and \$0.29 for the last 20 percent. Industries pay about \$0.22-\$0.25, and individuals pay on average \$1.00 per cubic foot. The price of water for agriculture has not changed much since the year of Israel's independence (1948) until the mid-1970s. In 1973 the price of water to agriculture was raised by about 5 percent, and in 1976 prices were raised by an additional 26 percent, a price level that stayed fixed until 1980. At that point, prices rose again by about 20 percent, and then decreased to their former level until 1986 when the water allocation for agricultural usage was reduced by 10 percent. In 1990 prices rose to high levels, and in 1991 the price of water for agricultural usage increased again by about 24 percent.

The price of water allocated to agriculture increased in 1986, and the reduction in quantity decreased the agricultural sector demand by 28 percent (16.4 percent in addition to the administrative steps). Concomitant to the pricing and administrative measures, the Water Authority launched an advertising campaign aimed at encouraging water conservation. The public response to the 1986 campaign was minor, and household consumption went down only 6 percent (Kislev & Vacsin, 1997). In 1991, the agricultural sector's demand decreased by 23 percent, and the households' response to the advertisements was 5 percent. The public response to the 2000 campaign was an estimated 10 percent saving (Mkorot Spokesperson).

In 2001, the Water Authority, the Treasury, and the Agricultural Ministry agreed that the quantity allocated to agricultural usage from the available drinking-quality water would be reduced by 50 percent (available quantity of 450-490 million m^3, down from the long-term average of 980-1000 million m^3). A paper presented in September 2000 by the R&D authority forecasted that in a steady state the water supply would stand at around 530 million m^3. The direct annual damage to the economy from cutting back the water supply to agricultural usage is anticipated to be about 2.0 billion NIS (\$0.5 billion US). In 2000, there were 0.2 million irrigated hectares; after implementation of the new policy, the Israeli agricultural sector will lose 0.05 million hectares,[5] 9,000 hectares of orchards will be uprooted, and 15,800 employees will be out of work.[6]

In addition to these administrative steps, the Water Authority decided to launch an advertising campaign aimed at educating and encouraging water conservation in December 2000. The slogan of the campaign was: "Don't let the winter 'fool' you; there is a still a water shortage—please conserve." The television ads showed everyday scenes where a parent wasted water (not turning off the faucet while shaving, watering the garden in the middle of the day, or answering the phone while running the water in the kitchen), and a child preaching to his parents about wasting water and reminding them to turn off the faucet when not in use. These types of ads showed individuals different ways to save water and stressed their personal responsibility to help ease the water shortage. The previous year's campaign, which was less effective, used a "sad baby" concept showing various scenes of an arid, dried-up environment.

EMPIRICAL EVIDENCE

The Survey

In January 2001 we surveyed 197 Israelis. Respondents consisted of 140 undergraduate economic students from two universities (Haifa University and the Hebrew University of Jerusalem) and 57 employees of the Hebrew University. This was a nonrepresentative survey; however, since it was aimed at measuring the effect of the advertising campaign and using gender and the tradeoff between active and passive measures to explain the magnitude of the conservation, sample

choice is not expected to harm the validity of the results.[7] Respondents were asked whether or not they remembered the latest water conservation campaign. They were asked whether or not the ads encouraged them to save water and then to estimate how much they actually saved (in percent). The final question was: What policy was the most effective in inducing water conservation (increase price for household, increase price for agriculture, stop watering public gardens, use social advertising, or increase supply)?

Survey Results

Most of the 197 respondents (93.91 percent) remembered the water conservation campaign. In general, most of the Israelis (72.59 percent) complied with the challenge of saving more water, whereas only 25 percent (3) of those who did not see the campaign thought they would save water; 75.6 percent (143 responders) were willing to save water after being exposed to the campaign. Thus, in this instance, the pro-social advertising campaign achieved its purpose. The average saving was 15 percent. The declared figures are to be treated with caution, as there is always a gap between declared willingness to pay (act) and the actual one (see Berk et al., 1993).

Most of the respondents (60 percent) thought that conservation should be undertaken by others; i.e., increase the price of water used in agriculture, stop watering public gardens, or use advertising. However, the fact that 40 percent agreed to an increase in the price of water for household usage supports the government's policy.

We estimated the effect of personal variables and fairness measures using the following estimation:

$$S_w = a + b_1 Age + b_2 Gender + b_3 Income + b_4 fairenessindex$$

Where S_w is the declared intensity of savings. Fairness is measured by an individual's acceptance of a certain policy measure:

1. Increase household price
2. Increase agricultural price
3. Stop watering public gardens
4. Advertise
5. Augment water supply.

Since the government is asking the public to save water, then it is expected that willingness to save increases with policies number 3 and 5 and decreases relative to the other policies. The results of the empirical model are given in Table 1 below.

Table 1: Estimating Main and Cross Effects of Age, Gender, Income, and Preferred Policy on the Intensity of Conservation.

Parameter	B	Std. Error	t	Sig.
Intercept	73.6477064	14.85507	4.95775	2.07E-06
Intercept	-0.281396	0.175342	-1.60484	0.110831
AGE	**-64.92443**	21.31845	-3.04546	0.002787
Man	**-51.79651**	17.23077	-3.00605	0.003149
INCOME=Low	**-57.196977**	14.41215	-3.96866	0.000116
INCOME=Medium	**54.8667493**	25.58474	2.144511	0.033757
Recommended Policy:				
Increase household price	**-54.743794**	15.76996	-3.4714	0.000693
Increase price for agriculture	19.5671339	12.59201	1.553933	0.122508
Stop watering public gardens	**-45.281396**	17.22608	-2.62865	0.009551
Use advertisement	**-35.712339**	14.84468	-2.40573	0.017475
Increase Supply of water	**0**			

R^2 square = 0.248

These results suggest that:

1. Women responded better to the campaign than men; i.e., their willingness to save water after the campaign was significantly higher than the men's. Women increased the probability of saving by 58 percent.
2. Younger individuals responded better to the conservation campaign. Each additional year showed a decrease of 0.3 percent in water conservation.
3. Individuals with high incomes are willing to save more than low- or medium-income individuals.
4. The theories of fairness and effort allocation within groups, which argue that personal efforts are affected by others' action, were strongly supported. The willingness to save sharply declines when economic incentives are used. It increases when the public sector does voluntary water-saving activities such as no watering of public gardens.
5. There is a tradeoff between a price increase and voluntary conservation.

Long-Term Effects

Long-term commitment was measured as the percent of respondents who would continue to save water after the advertising campaign ends. Only 38.1 percent of the respondents thought that they would continue to save water. There were no significant relationships between long-term commitment and any of the socio-demographic explanatory variables; however, a higher intensity of saving during the campaign was a good indictor of long-term commitment.

CONCLUSIONS

Advertisements can be an effective way to encourage water conservation. The average declared willingness to save is 15 percent. This is higher than the targeted 10 percent that the household sector was expected to reach after imposing many unpleasant measures, including doubling the price of water, mandatory installation of water-saving instruments, and issuing fines to anyone caught watering his/her garden during the day. Without knowing how long their willingness to conserve would last, it is impossible to estimate its efficiency relative to other measures taking into account that its cost was about $2.5 million.

We show empirically that advertisement works and that the feelings of responsibility that mediate the advertising's effect are a function of passive versus active action and the feeling of social justice. In particular, we found that the willingness to save increases with governmental conservation efforts and supply augmentation, and decreases with a price increase.

Our study found that women were found to be more responsive to the advertisement campaign, wealthier individuals cared more about the environment than others, and mature respondents showed a higher willingness to save. This may suggest that advertisements should be targeted more towards women by appealing to their sense of responsibility.

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End Notes:

[1] "Water Usage in Agriculture and the Rural Sector," a special economic report on the situation of the agricultural and the rural sectors. Prepared by the Department of Research Development, the Ministry of Agriculture, July 1999, Ch 2.2.6.

[2] See Rinat (2001).

[3] More than 1 million Russian Jewish immigrants during the 80s (20 percent increase in the population in three years) and a steady immigration rate of 60,000 (1 percent) per year in the following years.

[4] In his book "Rivers of Fire: The Conflict of Water in the Middle East," Arnon Sofer (1992) argues that the water shortage in the Middle East will cause a war between Arabs and Israelis.

[5] One of the informal benefits of agriculture is that it occupies and signal rights on land. Given that a final agreement about the borders of and ownership rights between Israel and the Palestinians hasn't yet been signed, stopping to farmland could have a serious political impact.

[6] The R&D department (September 20, 2000) report submitted to the general manager of the Agricultural Ministry.

[7] We compared results from the student group with those obtained from the university employees, a more representative group, and found no significant differences in any of our analyses.