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Measuring the effectiveness of a municipal water conservation campaign: The case of Israel

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Paper

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Research article

Evaluating the effectiveness of a water conservation campaign: Combining experimental and field methods

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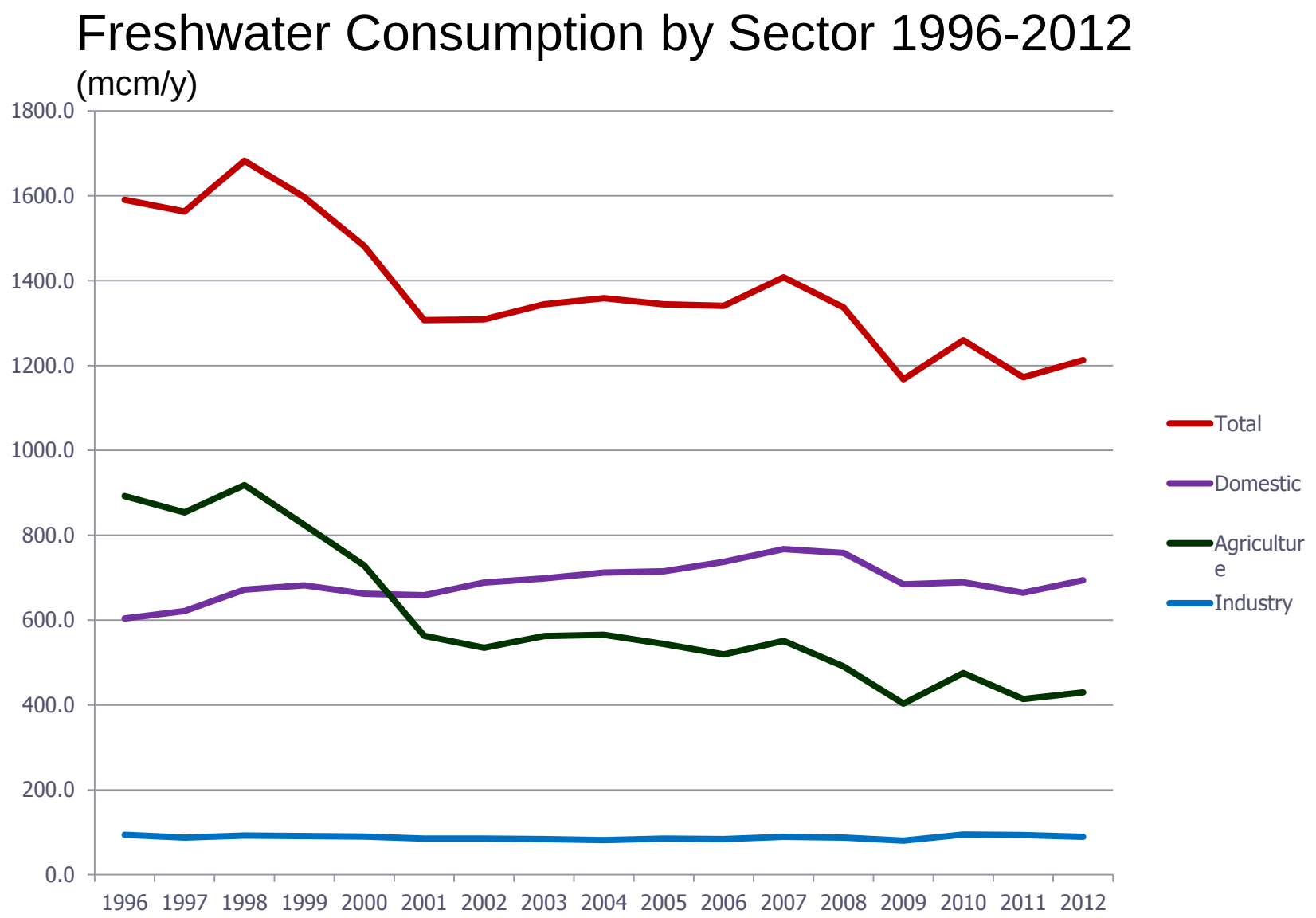
Temporary & Long Term Shortages

- Israel & neighbors suffer from chronic water scarcity
- Israel has experienced several years of drought since 2000.
- Water levels in three main reservoirs (Kinneret, Coastal Aquifer, & Mountain Aquifer) were recently at all time lows
- Long term decline in average annual rainfall (Water Authority 2010)
- Expected 13-20% decline in rainfall due to climate change, increased temperatures (and thus evaporation and demand), and longer periods between rainfall events (Alpert 2010, 2011; World Bank 2011)

CONSUMPTION BY SECTOR



Implications of Water Scarcity

- Need for either supply management (augmentation) or demand management policies in order to balance national water budget
- In short term, demand management is clearly necessary
- In order to be effective demand management must address municipal water consumption

Demand Management Tools

- **Command and Control**

  (e.g., quotas, restrictions)
- **Market Mechanisms**

  (e.g., higher water tariffs, subsidize conservation)
- **Awareness (Demarketing) Campaigns**

  (e.g., education, awareness raising, advertising)

"demarketing is the aspect of marketing that deals with discouraging customers in general or a certain class of customers in particular on either a temporary or a permanent basis." (Kotler and Levy 1971)

Command & Control

Command and Control has advantages of being certain, but may:

a. Face political backlash

b. Take a long time to implement

c. Difficult or expensive to enforce

Price Tools

Problems with implementing price increases

- Because of low elasticity, price increases would have to be significant (Hanemann 1998)
- Public opposition
- Depending on implementation, is often regressive
- Non-regressive price increases entail large information and bureaucratic costs
- Often time lag till time consumers feel the pinch
- May be high rates of non-payment among certain populations
- Lack of awareness about prices

  (77% surveyed did not know how much they paid for water (Peled 2009)

Price Tools

Municipal demand for water is inelastic

- Range: -0.3 – -0.7 (Fredricks 1993)
- Avg.: -0.51 (Espey et al 1997)
- Avg.: -0.41 (Dalhuisen et al 2003)
- Jerusalem: -0.17 (Dahan and Nisan 2009)

Conservation Campaigns

Advantages:

- Little political or public opposition
- No direct costs to consumers
- Generally has an educational aspect
- Can be implemented quickly

Disadvantages:

- Not compulsive
- Impacts difficult to quantify
- May have short-term effect
- Consumers may become indifferent if overused

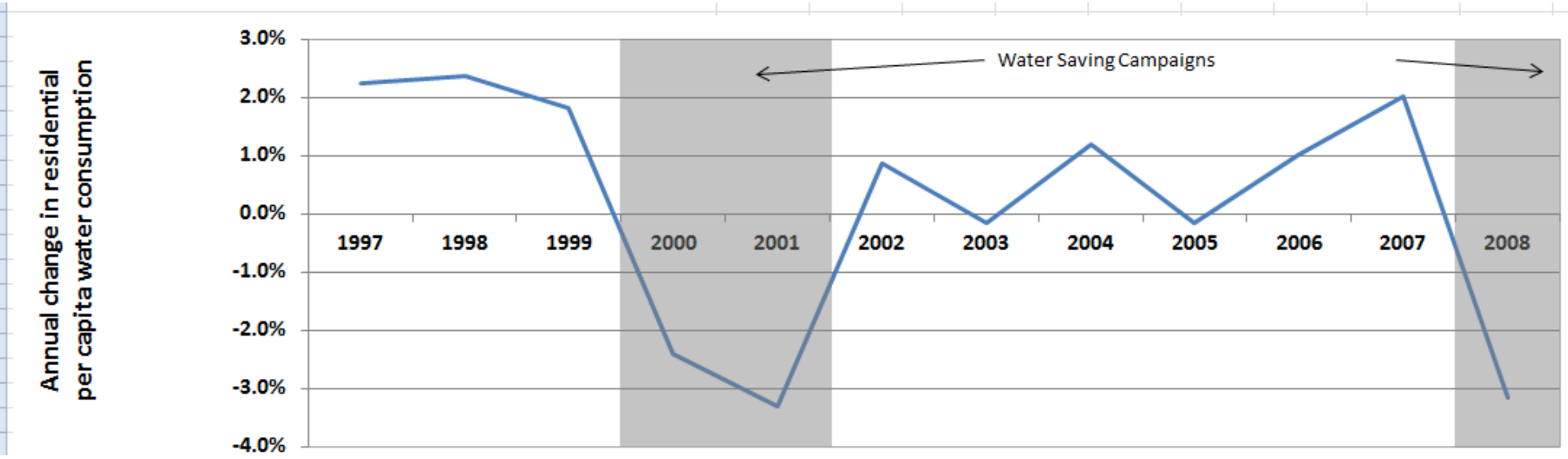
Conservation Campaign Effectiveness

Some evidence of effectiveness of conservation campaigns (Wang et al 1999; Renwick & Green 2000; Sauri 2013; Ferraro et al 2011).

Some evidence of environmental and cost effectiveness in public utilities, for both water and energy sector (Allcott and Mullainathan 2010; Allcott 2011; Ferarro and Price 2014).

Researchers in several fields addressing demarketing and other conservation type campaigns have found that positive and suggestive messages often work better than negative, fear-based, or assertive ones. (O'Neill and Nicholson-Cole 2009, Kronrod 2012).

Impact of the national water saving campaigns



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Multiple Policy Instruments

- In reality, policymakers rely on multiple policy instruments simultaneously
- Likely most effective approach, but complicates analysis of the relative effectiveness of individual measures taken

"The drought tax worked: water consumption down by 20%" *Calcalist 19.01.2010*

Research Questions

- Does a simple demarketing campaign have an effect on behavior in the context of residential water consumption?
- If so, how much?
- Is this effect sustained over time?
- Which types of campaigns have more of an effect: aggressive or suggestive ?
- How does a demarketing campaign compare in terms of cost-effectiveness with other water management options?

Study Sample

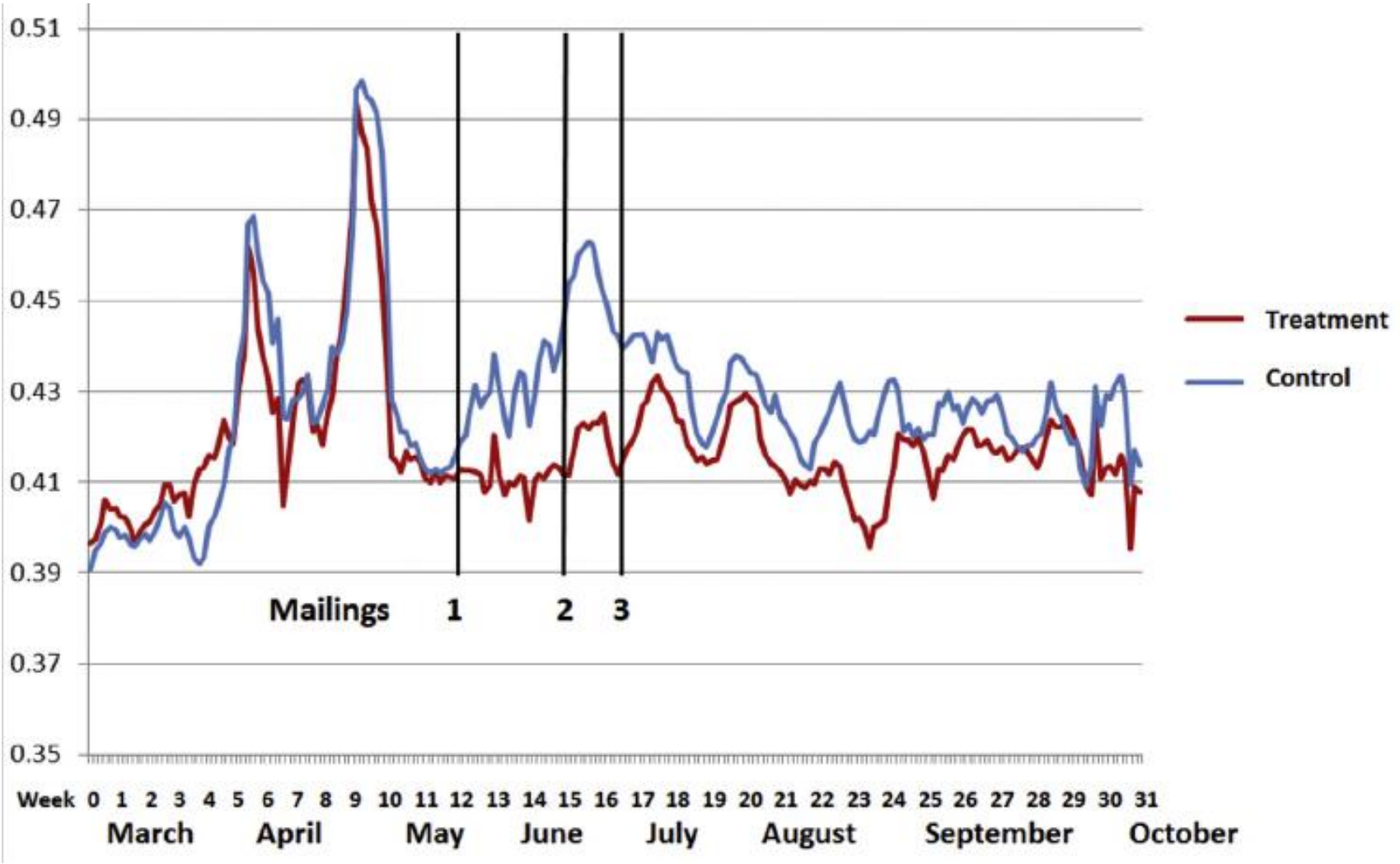
- Survey of ~3000 homes in Petah Tikva during May-October
- 1500 homes in two neighborhoods
- Divided into groups of 500 homes each (3 in each neighborhood)
- Groups were:
  - Control group
  - Assertive campaign
  - Suggestive campaign

Study Methodology

- Treatment groups were sent three messages encouraging them to conserve water
  1. A campaign message and the logo of the water supplier
  2. A campaign message with water bill
  3. Same message as first
- 1-3 week break between sending notices
- Water use was monitored daily, beginning one month prior to first notice and lasting four months after last notice (total 6 months)

Average Consumption Per Household

(7 day running average)



Regression Analysis
Fixed Effects / Difference-in-Difference Regression

$$Consumption_{it} = \beta_0 + \beta_1 Treatment_i + \sum_{t=1}^{n} \beta_{2t} Time_t + \sum_{t=1}^{n} \beta_{3t} Time_t * Treatment_i + u_{it}$$

Consumption = average daily household consumption during the period in question
Treatment = dummy variable indicating whether or not the household received the message (Control = 0. Received = 1)
Time = dummy variables indicating the time period in question
*Time*Treatment* = interaction variables for different time periods and whether or not the household received a message
β = parameters to be estimated
u = error term, *clustered by household*
i = household identifier
t = time period
n = total number of time periods

Summary Statistics
Daily Consumption (m^3)

	Mean	Std. Dev.	No. of Obs.
Overall	.442	.291	2,819
Control	.433	.305	931
Treatment (both groups)	.446	.285	1,888
Compelling	.444	.281	952
Suggestive	.449	.289	936

Fixed Effects Dif-in-Dif Regression Results

Variable Description	Variable	Coefficient	P-value
Consumption of control group during baseline period	Constant	0.399***	0.000
Time Period Dummies	week11	0.032***	0.006
	week12	0.030**	0.012
	week13	0.034***	0.003
	week14	0.039**	0.014
	week15	0.063***	0.000
	week16	0.041***	0.005
	week17	0.042***	0.009
Time Period – Treatment Interaction Dummies	week11*T	-0.012	0.334
	week12*T	-0.028**	0.044
	week13*T	-0.030**	0.037
	week14*T	-0.033**	0.035
	week15*T	-0.046**	0.012
	week16*T	-0.030*	0.064
	week17*T	-0.018	0.310

Cost Comparisons

- Average effect of the intervention was a reduction of 7.6% relative to the control groups over a period of 5 weeks.
- Avg. savings per household = 1.2 m^3 per household over the 5 week period
- Avg. cost per m^3 conserved = $0.46 (maybe even $0.23)
- Avg. cost of desal = $0.52 (with externalities >$0.585)
- Assuming elasticity of demand of -0.17 (Dahan and Nissan, 2009), price would have to have increased 44.7% on average, ($0.63 to $1.00 per m^3 based on current tariff rates).

$$\eta = \frac{\delta Q}{\delta P} \cdot \frac{P}{Q}$$

$\eta \sim= \Delta\%Q / \Delta\%P$

$-0.17 = -0.076 / \Delta\%P$

$\Delta\%P = -0.076/-0.17 = 0.447$ ➔ 44.7%

Limitations & Future Directions

Limitations:

- Don’t know why effect faded over time (end of intervention, beginning of rainy season, people became immune, etc.)
- Implementation in area already undergoing significant price changes and conservation campaigns
- Is it still true with growing desalination?

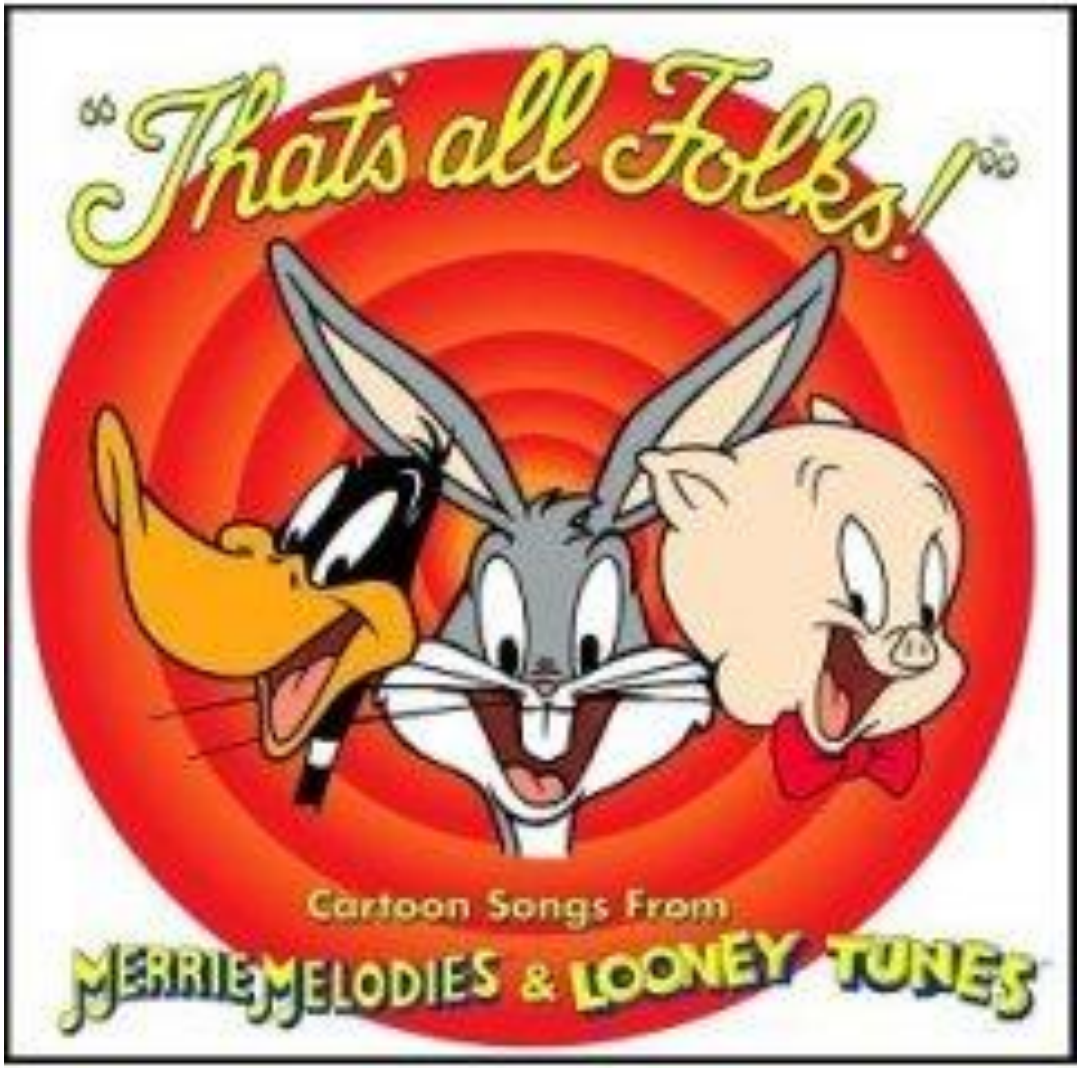
Future studies:

- Add data for household size / income
- Distinguish between uses
- More specific messages to understand better motivations
- Year-long to see if seasonality plays a function
- Energy applications

Conclusions

- The conservation campaigns were an effective tool in the short run, even with a very simple message.
- Suggestive, rather than aggressive, messages seem to be more effective
- Policymakers and social-marketers can use demarketing to complement traditional policy tools.
- Several advantages over price increases and/or supply augmentation:
  - Cheaper / more cost-effective in the short term
  - Less political resistance
  - Non-regressive
  - Can be implemented with short notice

Thank You

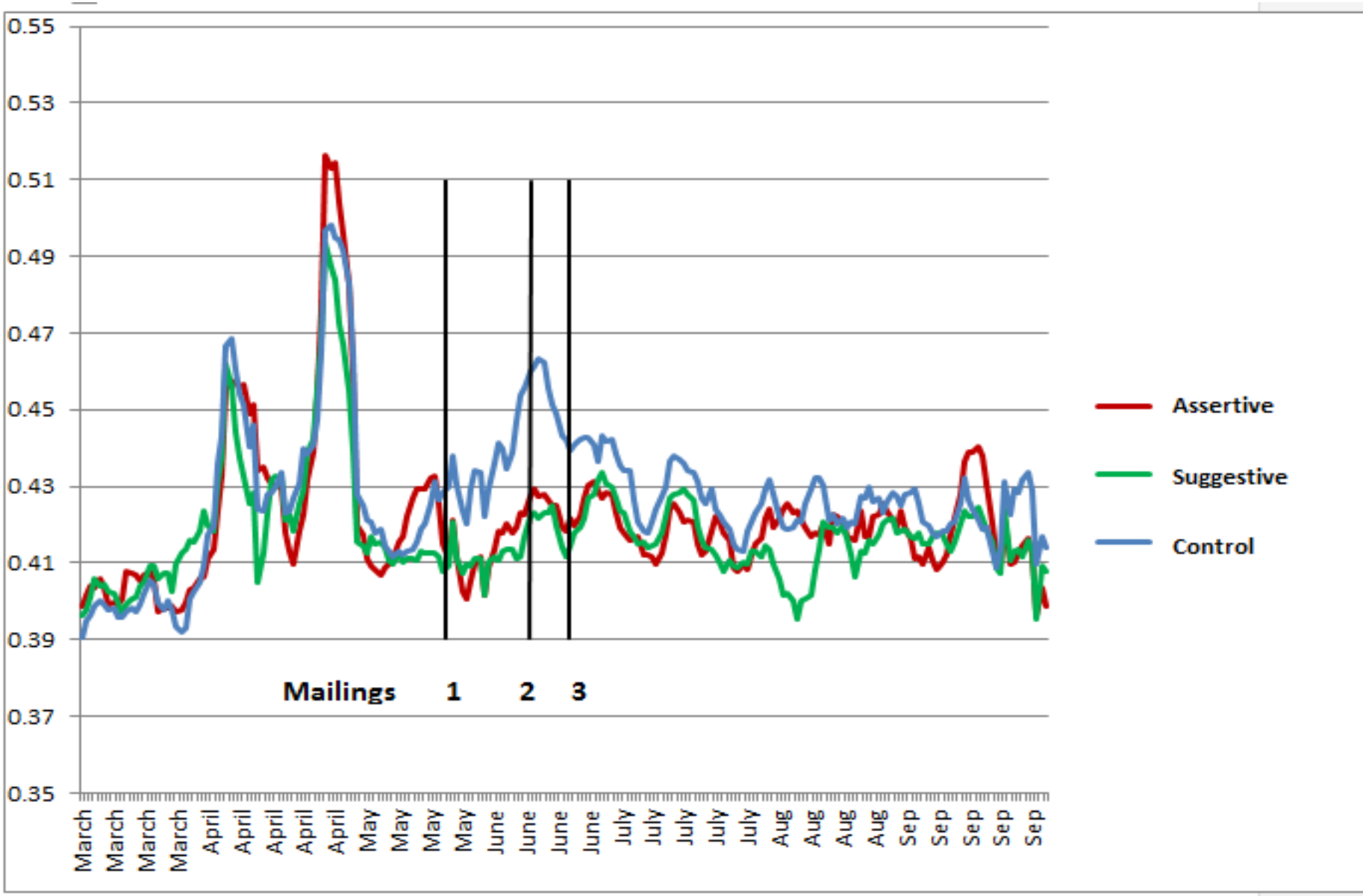

"That's all Folks!"
Cartoon Songs From
MERRIE MELODIES & LOONEY TUNES

The Demarketing Messages

Reminding you,
You Must Conserve Water !

Reminding you,
It's worth conserving water !

Average Consumption Per Household



Fixed Effects Dif-in-Dif Regression Results

	Variable	Both Treatments	Suggestive	Assertive
Additional consumption for treatment groups during baseline period	Treatment	0.006	.007	.004
Time Period – Treatment Interaction Dummies	weeks5to6*T	-0.012	-0.019*	-0.005
	weeks7to8*T	-0.005	-0.006	-0.004
	weeks9to10*T	-0.015	-0.020	-0.009
	week11*T	-0.010	-0.012	-0.010
	week12*T	-0.025*	-.028**	-0.023
	week13*T	-0.028**	-.030**	-0.026*
	week14*T	-0.029**	-.033**	-0.025
	week15*T	-0.041**	-.045**	-0.037**
	week16*T	-0.027*	-.030*	-0.025
	week17*T	-0.018	-0.018	-0.017
	weeks18to19*T	-0.014	-0.015	-0.012
	weeks20to21*T	-0.014	-0.015	-0.015
	weeks22to23*T	-0.017	-0.027*	-0.007
	weeks24to25*T	-0.012	-0.015	-0.009
	weeks26to27*T	-0.013	-0.013	-0.013
	weeks28to29*T	-0.004	-0.010	-0.002