

PRICE AND NON-PRICE INFLUENCES ON WATER CONSERVATION: AN ECONOMETRIC MODEL OF AGGREGATE DEMAND UNDER NONLINEAR BUDGET CONSTRAINTS

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A MODEL OF AGGREGATE WATER DEMAND

- Multi-tiered pricing schemes imply kinked budget constraints and often result in discontinuous demand functions
- We model the demand function using the piece-wise linear budget constraint model that mirrors the consumer's decision process
  - choose the utility maximizing level of consumption along each segment
  - choose the segment that maximizes overall utility
- We aggregate individual demand up to the water district

A MODEL OF AGGREGATE WATER DEMAND cont.

Quantity demanded is a function of

- "Shares" of consumers on each budget segment
- Average Marginal Price
- Average Difference Variable
- Socio-Economic Characteristics: Income & Household Size
- Climate: Temperature & Precipitation
- Conservation Programs
  - Billing information
  - Landscaping programs
  - Conservation education
  - Low-flow plumbing
  - Use restrictions

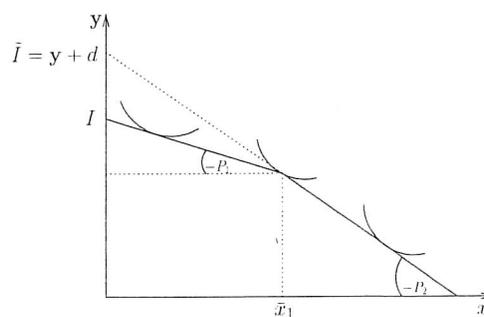
DATA AND ESTIMATION

- Data are collected from three Bay Area water districts: Great Oaks, San Leandro, and San Mateo
- Estimation follows the two-stage decision problem embodied in the piece-wise linear budget constraint model
  - estimation of fraction of consumers on each price segment using multinomial logit
  - construction of average marginal price and average difference variable using the predicted shares
  - estimation of the demand using a pooled cross-sectional and time-series estimation

INTRODUCTION

- With water, questions regarding "responsible resource use" become particularly urgent during droughts where
  - Demand increases
  - Supplies are relatively fixed in the short run
  - Stocks become depleted
  - "Stockouts" are unacceptable
- We explore the impact of pricing and non-price conservation programs on water consumption during a severe drought in the San Francisco Bay Area

BUDGET CONSTRAINT FOR A TWO TIERED PRICING SCHEME



AN EXAMPLE OF CONSERVATION DUMMY VARIABLES

Use Restrictions (UR):

- UR0: None
- UR1: Consumers are requested to reduce consumption a given percentage
- UR2: UR1 plus mandatory use restrictions
- UR3: UR2 plus enforcement of mandatory use restrictions

RESULTS

- Consumers are most responsive to pricing in non-rainy (summer) months
- Pricing for conservation is significant only during drought
- Mandatory use restrictions and landscaping audits significantly reduce water consumption

### INTRODUCTION

- Pressures on current water delivery systems have increased awareness of the need for "responsible resource use"
  - Increasing frequency of droughts
  - Increasing urban populations
  - Diminishing supplies of high quality water
  - Reduced reliability of current supplies
  
- The cost of acquiring new (reliable) supplies is increasing.