The Cost of Shortage in Urban Water Systems

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Importance of reliability

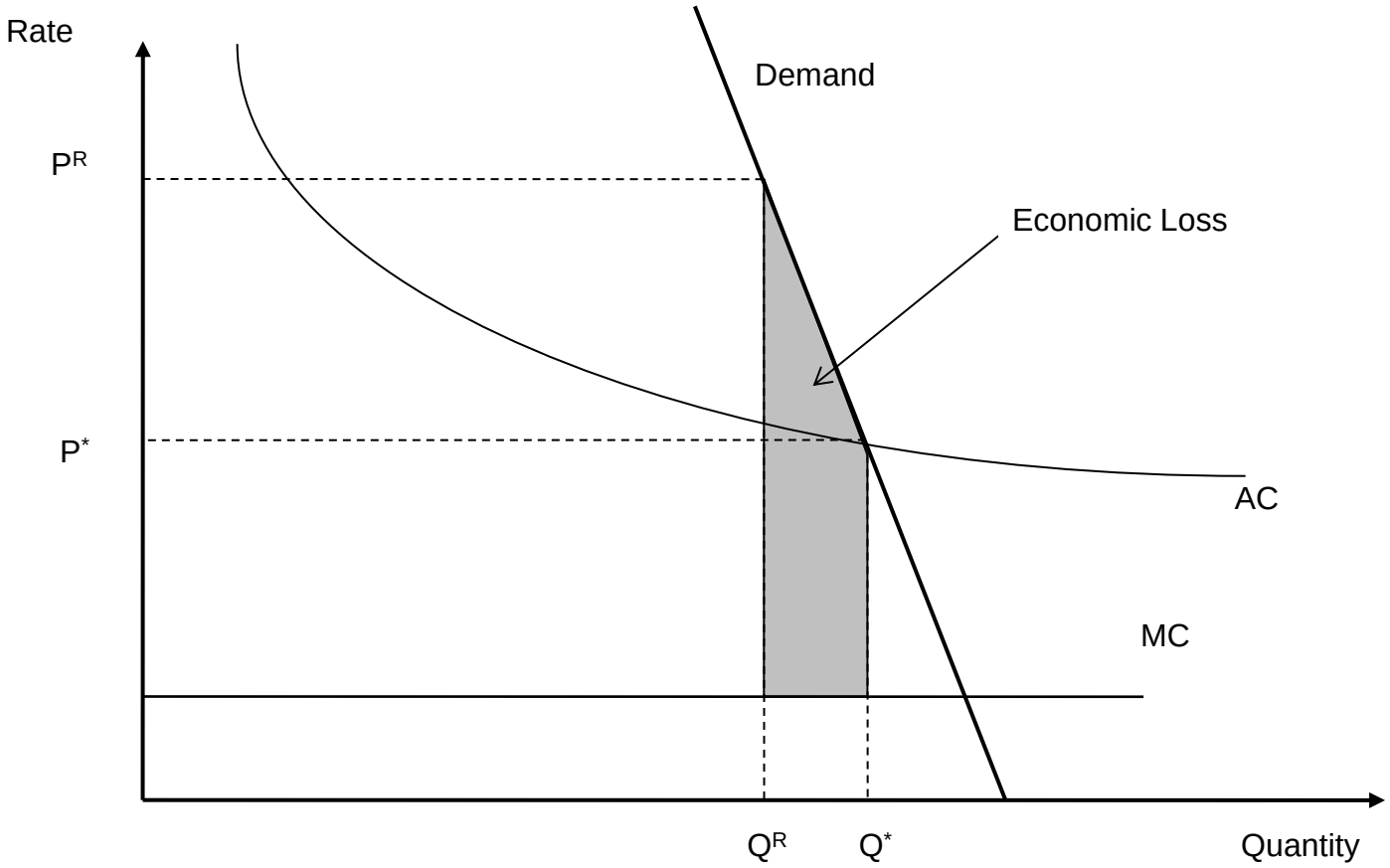
- Capital budgeting and the water supply portfolio
  - Imported water vs. recycling or desalination
  - $1,000/af with risk vs. certain $1,500/af
- Value of storage
- Impact of natural hazards on water systems
  - Drought
  - Earthquakes
  - High water events
  - Infrastructure failures

Shortage losses

Willingness to pay to avoid a given shortage is determined by

- Consumer preferences
  - —Underlying valuation of water
  - —Traditionally, economists have emphasized this factor
- Utility's rate structure and how it covers costs
  - —Large variation across agencies
- Source of unreliability
  - —Which part of the portfolio is being disrupted?

Simple graphic of losses



Financing public water systems

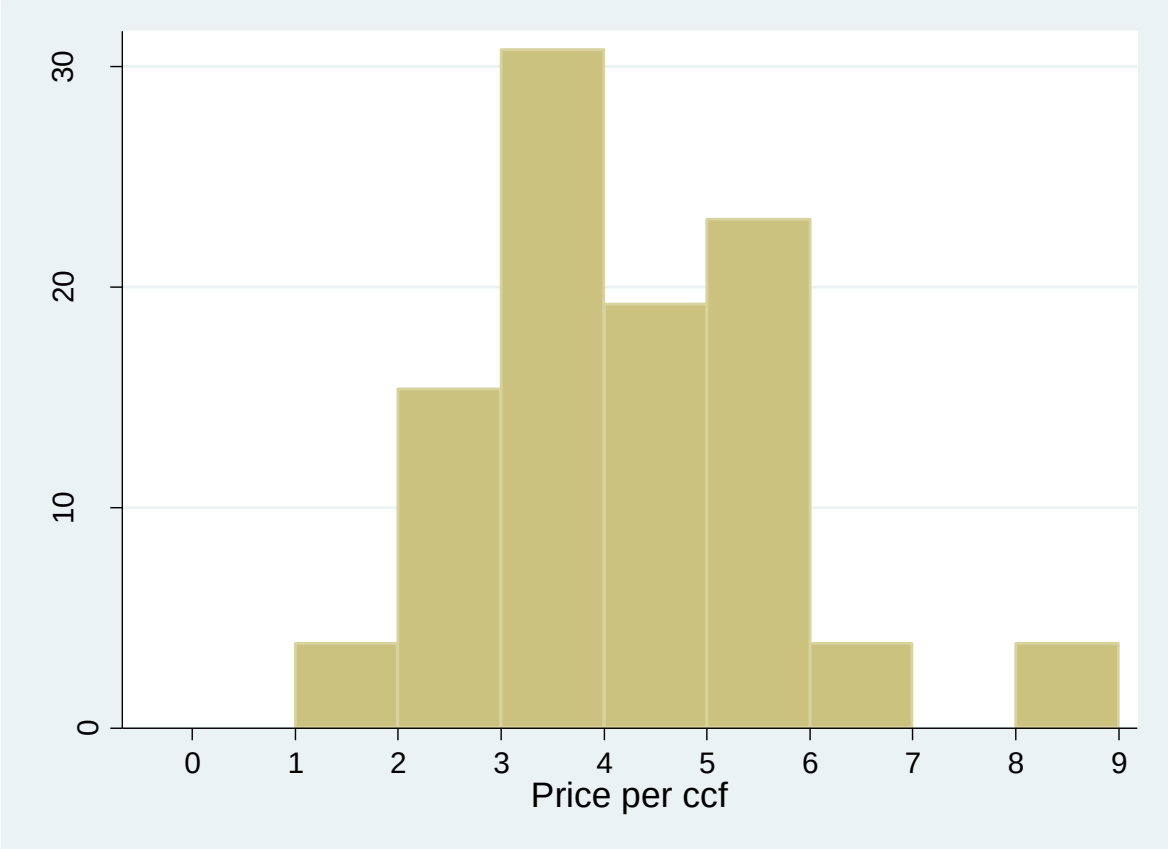
- About 85 percent of all urban water connections are served by a public agency
  - Not regulated by state PUCs
  - "Regulated" by voters and free to set prices
- High levels of fixed costs relative to other utilities
  - Storage, treatment, pipelines, etc.
- Common use of average cost pricing

Financing public water systems

- Water rates in public systems are in part political choices and not often based on efficiency considerations
- Frequent use of subsidies, especially to offset capital expenses
- Lack of efficiency in pricing distorts consumer decisions and makes capital budgeting difficult
- Large variation in prices, even among agencies with similar marginal costs of service

Distribution of 2010 SFR Prices

SF Bay Area

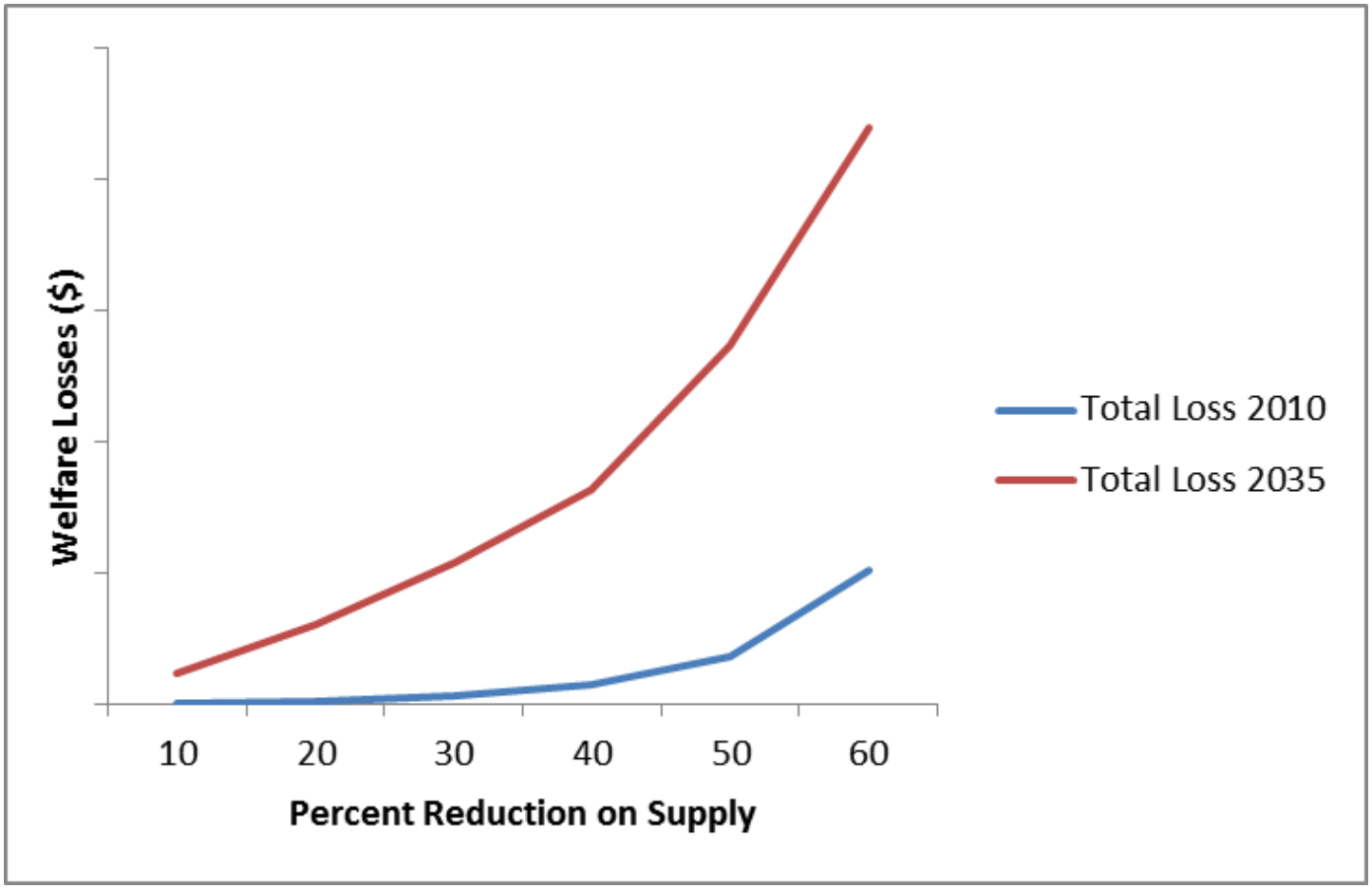


N = 26

How customer losses vary with price elasticity and rates

		Percent reduction of baseline water demand in FY2010-11					
Agency	Assumptions	10	20	30	40	50	60
Representative agency (avg. elasticity and SFR price)	Elasticity: -0.25 Price: $1,677	$1,836	$2,436	$3,370	$4,933	$7,823	$13,985
Agency A	Elasticity: -0.32 Price: $1,295	$1,283.10	$1,608.95	$2,074.70	$2,779.16	$3,929.17	$6,022.29
Agency B	Elasticity: -0.28 Price: $1,749	$1,867.92	$2,389.44	$1,665	$2,892	$5,012	$9,158
Agency C	Elasticity: -0.19 Price: $1,795	$595	$1,559	$4,743.61	$7,999.09	$15,186.75	$34,380.22
Agency D	Elasticity: -0.17 Price: $2,085	$2,608.17	$3,913.97	$6,316.00	$11,251.60	$23,019.44	$57,665.32

Characterizing the customer losses under increasing levels of shortage



Customer losses relative to income for a representative agency

Representative Agency			Median income (real 2010):	$112,174
(a)	(b)	(c)	(d)	(e)
% Shortage on Baseline Demand	Monthly ccf/hh	Avg. lost consumer surplus (CS) per ccf	Monthly lost consumer surplus per hh = (a) x (b) x (c)	Percentage of monthly hh income = 100% x (d) / (median income / 12)
10	10.57	$0.94	$1	0.0%
20	10.57	$2.32	$5	0.1%
30	10.57	$4.46	$14	0.2%
40	10.57	$8.05	$34	0.4%
50	10.57	$14.68	$78	0.8%
60	10.57	$28.83	$183	2.0%

Remark: Although welfare losses are large in aggregate, they represent a small share of household income on average.

Modeling job losses

- Employment data is based figures used to calculate price elasticities
- Multipliers from sector-specific surveys vary by size of shortage (MHB Consultants)
- Each multiplier is based on the mix of NAICS subsectors
- Pattern of losses similar to welfare losses

Industry-specific employment elasticities

NAICS Code	SIC Code	Description	Employment Output Multiplier for 0 - 15% Water Reduction	Employment Output Multiplier for 15 - 30% Water Reduction
Industrial Sector				
311	200-209	Food and Kindred Products	0.46	1.88
327	320-329	Stone, Clay, Glass, and Concrete Products	0.75	0.67
333, 334	350-359	Computer Equipment and Industrial Machinery	0	0
334	367	Electronic Components and Accessories	0.17	1.14
333, 334, 335	366, 369	Communication and Other Electronic Equipment	0.19	0.48
336	370-379	Aerospace and Transportation Equipment	0	0.67
334, 339	380-389	Measuring and Controlling Equipment	0	0
(31 - 33)		All Other Manufacturing Industries	0.15	0.33
Commercial Sector				
445, 452	541	Grocery Stores	0	0.44
722	581	Eating and Drinking Places	0	1.61
53	650-659	Real Estate Developers, Operators and Lessors	0	0.13
721	701	Hotels and Motels	0.09	1.58
812	721	Laundry and Garment Services	1.5	2.33
622	806	Hospitals	0.04	1.05
(42 - 81)		All Other Commercial Industries	0	0.17

Source: MHB Consultants, Inc., "The Economic Impact of Water Delivery Reductions on the San Francisco Water Department's Commercial and Manufacturing Customers," 1994. Tables 13 and 14 (pp. 48, 50)

Modeling business revenue losses

- Sector-specific sales data is collected from the US Census Bureau, County and Zip Business Patterns 2007
- Multipliers from sector-specific surveys vary by size of shortage (MHB Consultants)
- Each multiplier is based on the mix of NAICS subsectors
- Pattern of losses similar to welfare losses

Industry-specific output elasticities

NAICS Code	SIC Code	Description	Output Multiplier for 0 - 15% Water Reduction	Output Multiplier for 15 - 30% Water Reduction
Industrial Sector				
311	200-209	Food and Kindred Products	0.46	2.04
327	320-329	Stone, Clay, Glass, and Concrete Products	0.67	0.58
333, 334	350-359	Computer Equipment and Industrial Machinery	0.04	0.04
334	367	Electronic Components and Accessories	0.19	1.35
333, 334, 335	366, 369	Communication and Other Electronic Equipment	0.19	0.48
336	370-379	Aerospace and Transportation Equipment	0	0.67
334, 339	380-389	Measuring and Controlling Equipment	0	0
(31 - 33)		All Other Manufacturing Industries	0.12	0.38
Commercial Sector				
445, 452	541	Grocery Stores	0	0.44
722	581	Eating and Drinking Places	0	1.56
53	650-659	Real Estate Developers, Operators and Lessors	0.04	0.3
721	701	Hotels and Motels	0.15	1.52
812	721	Laundry and Garment Services	0.92	2.58
622	806	Hospitals	0.06	1.04
(42 - 81)		All Other Commercial Industries	0.03	0.32

Source: MHB Consultants, Inc., "The Economic Impact of Water Delivery Reductions on the San Francisco Water Department's Commercial and Manufacturing Customers," 1994. Tables 13 and 14 (pp. 48, 50)

Conclusions

- Urban losses from shortage can be large on a unit basis
- These losses can be included in reliability planning and when making investment decisions
- Losses can vary widely among agencies depending on rates, demand characteristics, and the cost of the unreliable supply