Heterogeneity in Price Elasticities of Urban Water Demand: The Case for Albuquerque, New Mexico

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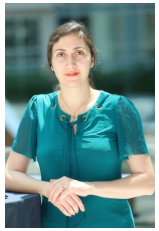
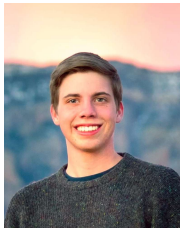
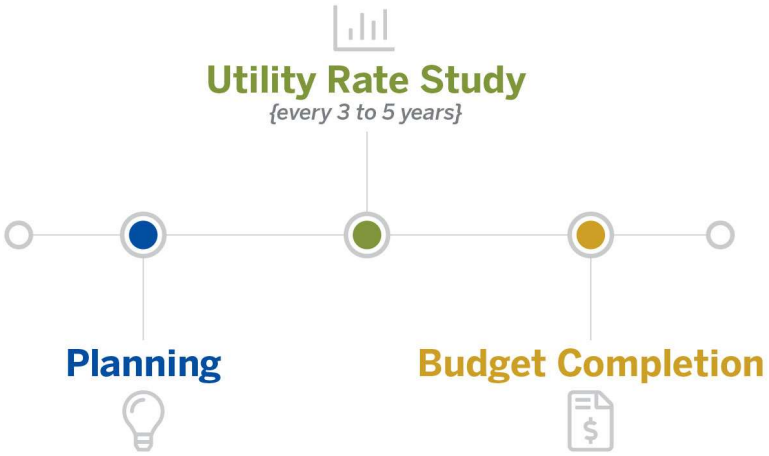




Introduction

- Water utilities
- Water users/ratepayers
- Regional water planning

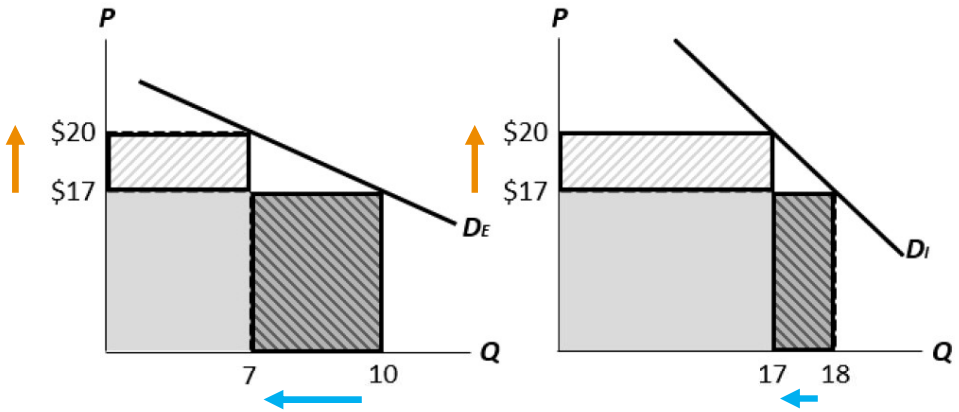


Source: https://www.sehinc.com

- Albuquerque Bernalillo County Water Utility Authority (ABCWUA)
  - 100,000 acre-feet of water annually
  - 200,000+ customer accounts
  - 600,000+ water users
  - $248,400,000 revenue
  - price elasticity estimates from the 1990s

Introduction

Price elasticity: -2.2 Price elasticity: -0.8



(a) Elastic demand (b) Inelastic demand

Figure 2. Elastic Demand vs. Inelastic Demand

Notes: Panel (a) illustrates that when demand is elastic, a price increase causes revenue to fall \$170 to \$140, because the fall in revenue from lower quantity consumed is greater than the increase in revenue from higher price. Panel (b) illustrates that when demand is inelastic, a price increase cause revenue to rise from \$306 to \$340, because the fall in revenue from lower quantity consumed is smaller than the increase in revenue from higher price.

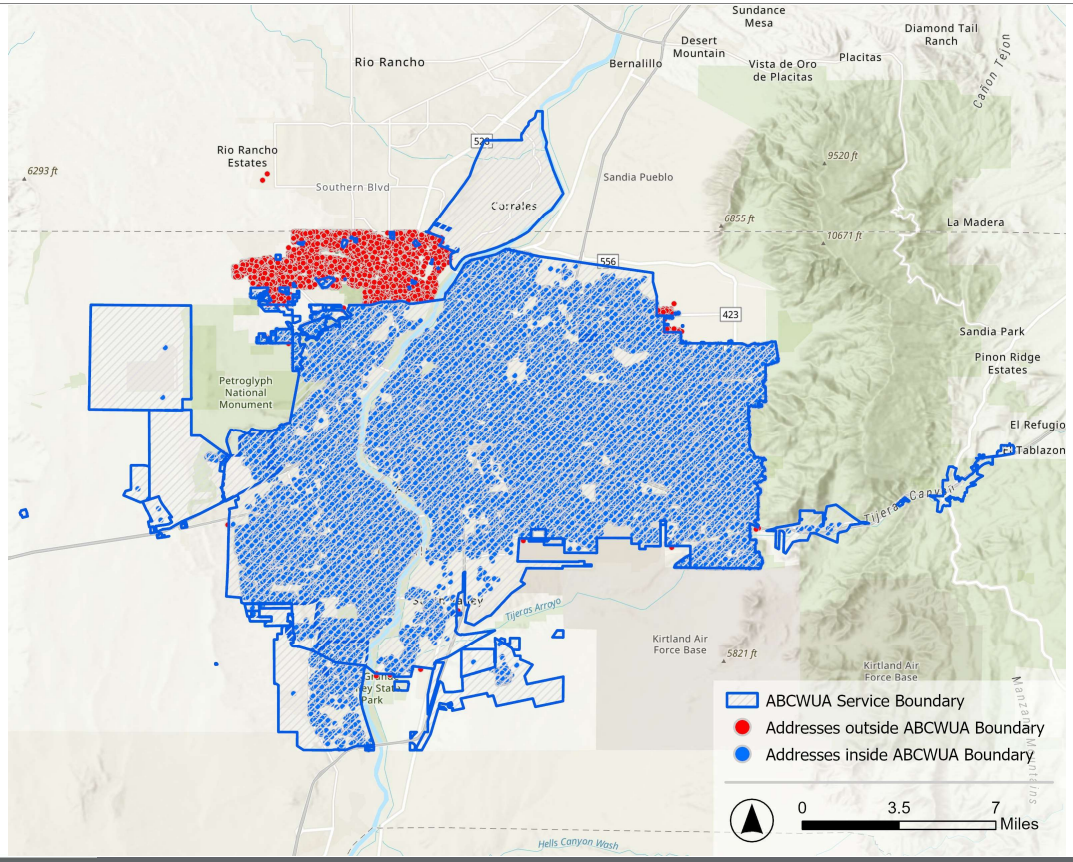
Source: Ali, M., J. Wang, H. Himmelberger, and J. Thacher, 2021. An Economic Perspective on Fiscal Sustainability of U.S. Water Utilities: What We Know and Think We Know. Water Economics and Policy, 7(1), 2150001.

Data and Methods

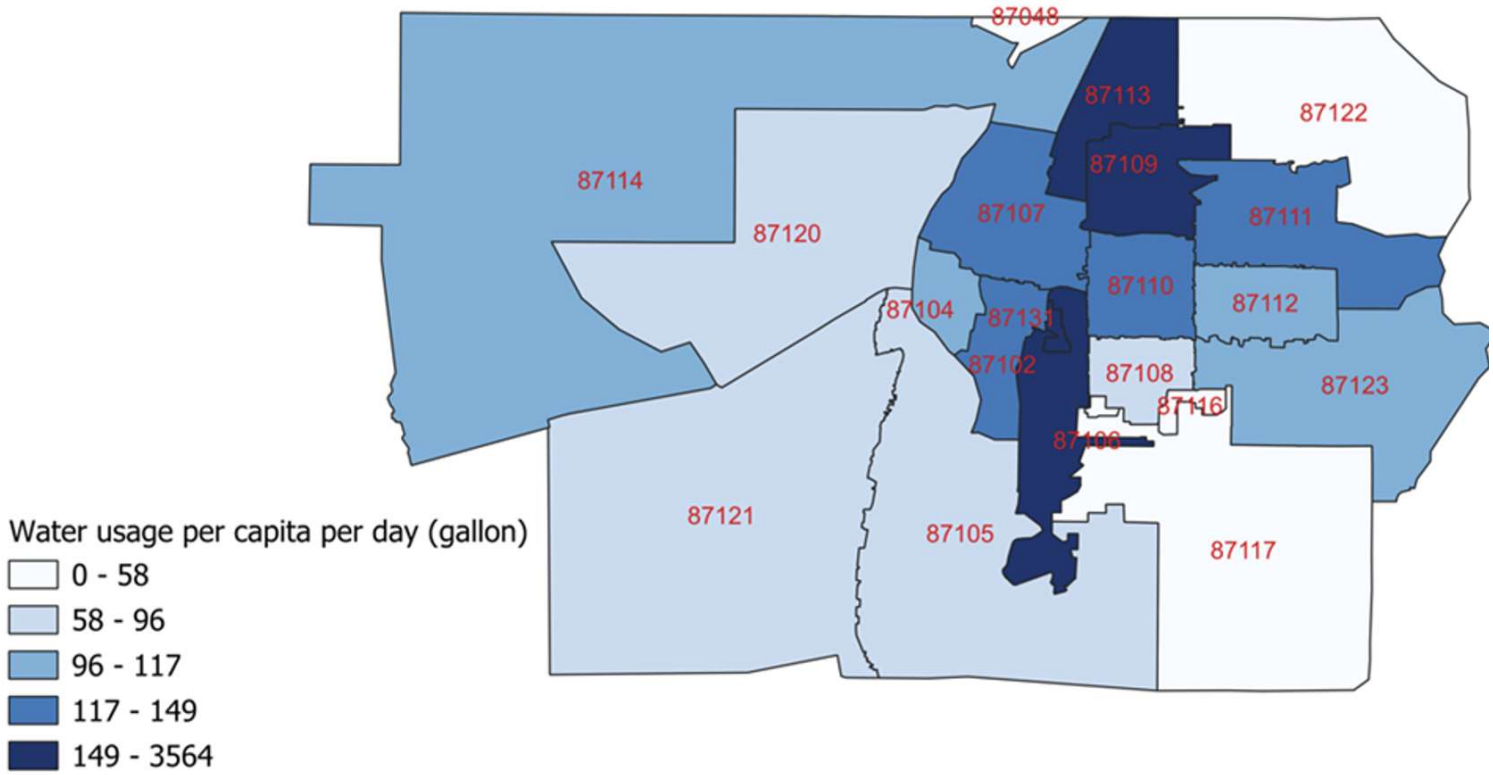
- Albuquerque Bernalillo County Water Utility Authority (ABCWUA): account-level data, sector, address, monthly water use, water bills
- National Oceanic and Atmospheric Administration (NOAA): weather variables
- U.S. Census Bureau: median household income, race/ethnicity
- 2018-2023

- Fixed-effect models: household, month, year, zip code

Data


Sundance Mesa
Diamond Tail Ranch
Desert Mountain
Rio Rancho
Bernalillo
Vista de Oro de Placitas
Placitas
Cañon Tejon
Rio Rancho Estates
6293 ft
Southern Blvd
Sandia Pueblo
9520 ft
Corrales
6855 ft
10671 ft
La Madera
556
423
Sandia Park
Pinon Ridge Estates
Petroglyph National Monument
El Refugio
Tablazon
Tijeras Arroyo
Kirtland Air Force Base
5821 ft
Kirtland Air Force Base
Hells Canyon Wash
ABCWUA Service Boundary
Addresses outside ABCWUA Boundary
Addresses inside ABCWUA Boundary
0
3.5
7
Miles

Data

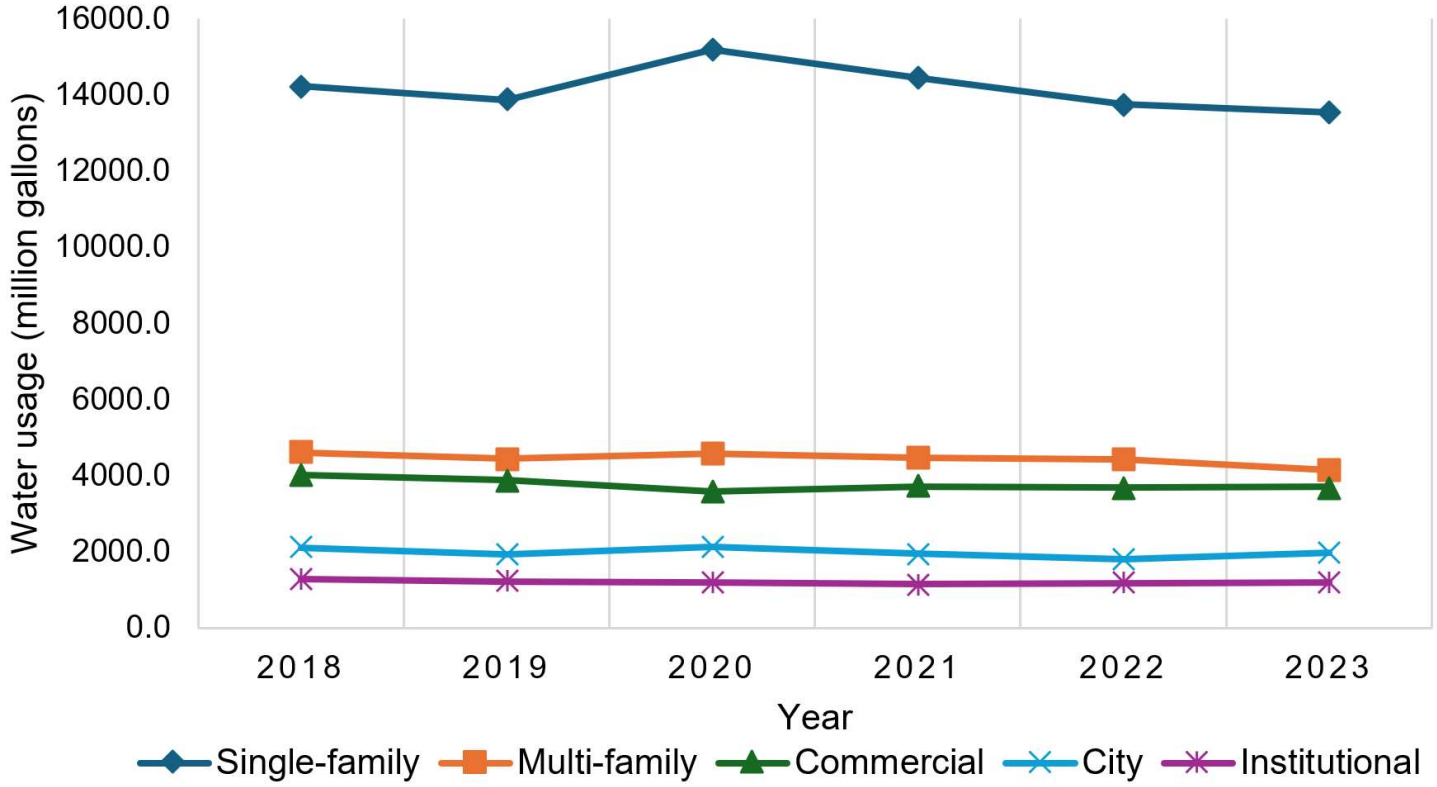

87048
87113
87122
87114
87109
87107
87111
87120
87110
87112
87104
87131
87102
87108
87123
87116
87106
87121
87105
87117
Water usage per capita per day (gallon)
0 - 58
58 - 96
96 - 117
117 - 149
149 - 3564

Data

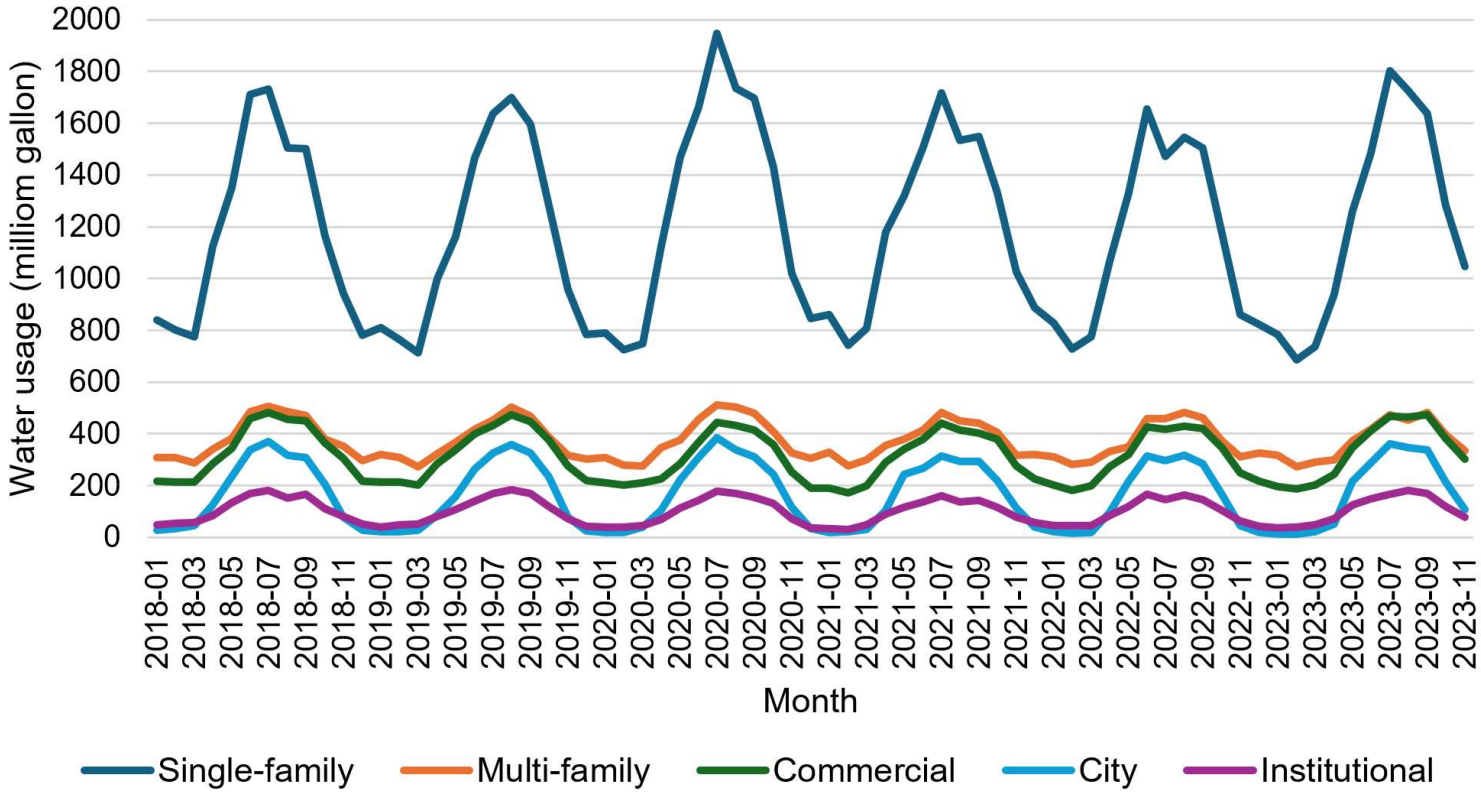
Sector	Water usage (million gallons)	Percent
Single-family Residential	13550.2	53.76
Multi-family	4138.5	16.42
Commercial	3705.9	14.70
City	1976.7	7.84
Institutional	1187.7	4.71
Industrial	344.6	1.37
Fireline	178.2	0.71
KAFB (Kirtland Airforce)	80.6	0.32
JV (Journal Voucher)	30.5	0.12
Other	12.8	0.05
Total	25205.7	100

97.43%

Data

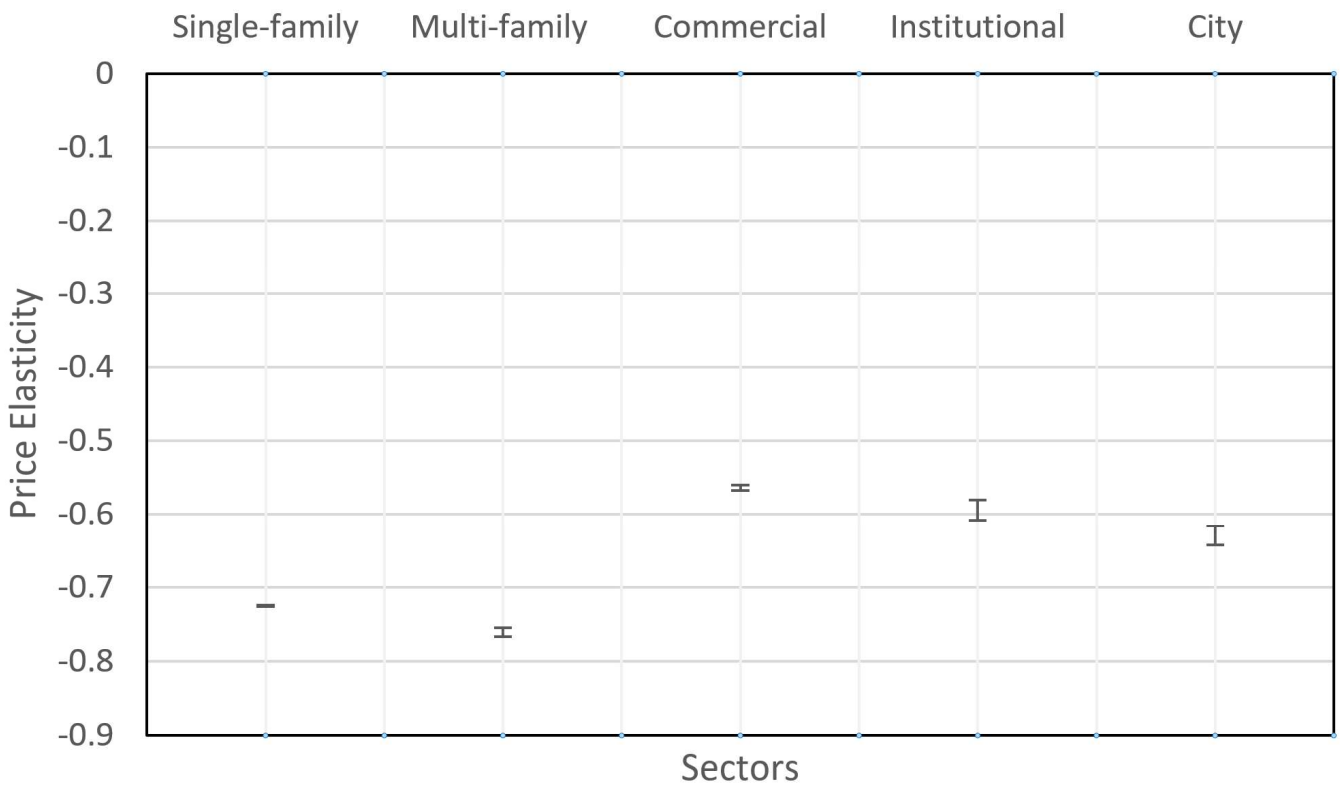

16000.0
14000.0
12000.0
10000.0
8000.0
6000.0
4000.0
2000.0
0.0
Water usage (million gallons)
2018
2019
2020
2021
2022
2023
Year
Single-family
Multi-family
Commercial
City
Institutional

Data


Water usage (milliom gallon)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2018-01
2018-03
2018-05
2018-07
2018-09
2018-11
2019-01
2019-03
2019-05
2019-07
2019-09
2019-11
2020-01
2020-03
2020-05
2020-07
2020-09
2020-11
2021-01
2021-03
2021-05
2021-07
2021-09
2021-11
2022-01
2022-03
2022-05
2022-07
2022-09
2022-11
2023-01
2023-03
2023-05
2023-07
2023-09
2023-11
Month
Single-family
Multi-family
Commercial
City
Institutional

Findings

Baseline



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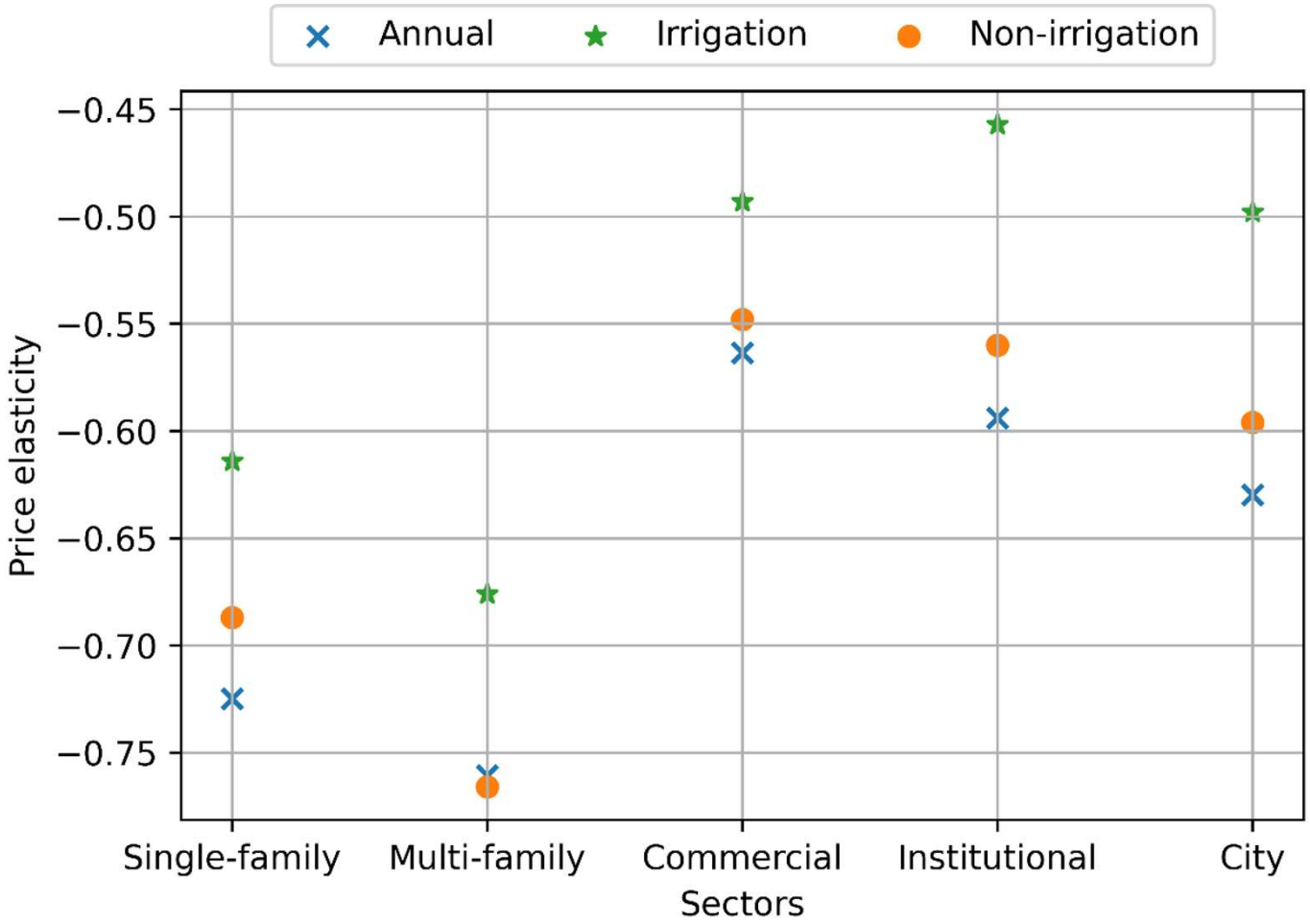
Findings

Seasonal Heterogeneity



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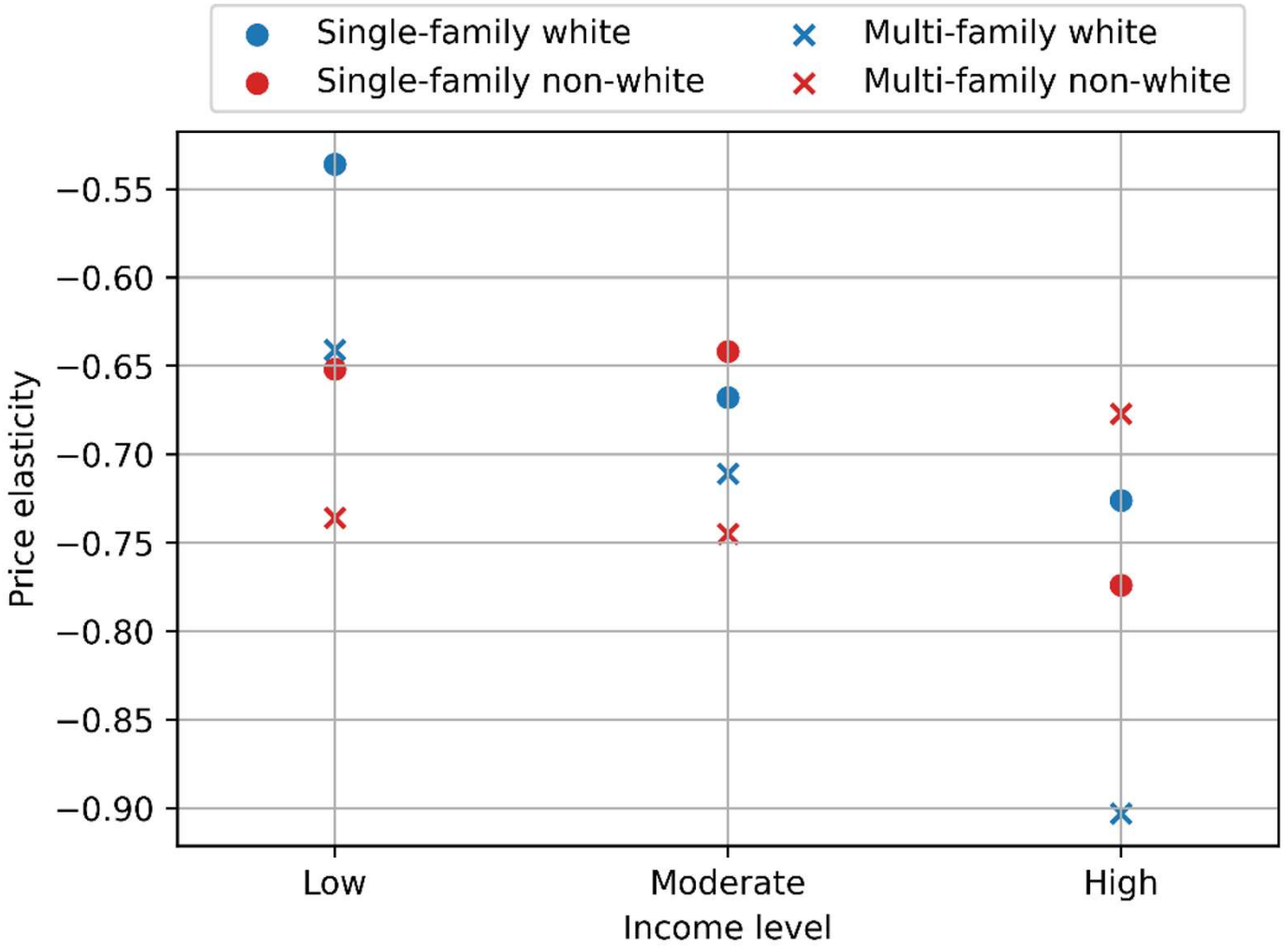
Findings

Income & Race Heterogeneity



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Conclusions & Policy Implications

Water Utilities & Policymakers

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- Sector-specific approaches in water management
- Consider income and race heterogeneity when designing water management policies
- Efficiency and equity

Conclusions & Policy Implications

New Mexico Water Data Initiative

Opportunities for collaboration among utilities and/or agencies

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Source: https://www.californiadatacollaborative.org

Thanks!

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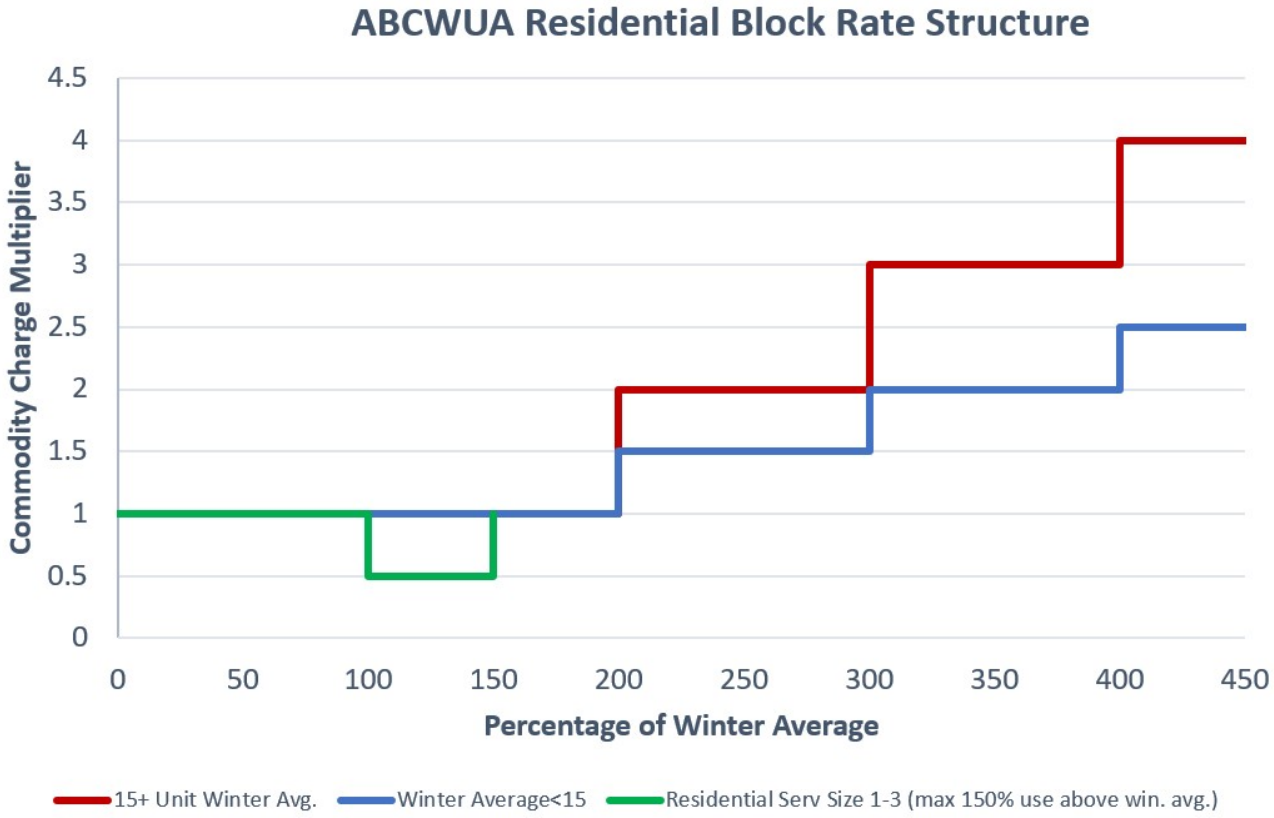
Appendix


ABCWUA Residential Block Rate Structure
Commodity Charge Multiplier
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
400
450
Percentage of Winter Average
15+ Unit Winter Avg.
Winter Average<15
Residential Serv Size 1-3 (max 150% use above win. avg.)

Appendix

Table 1 Summary statistics of the major sectors

Variable	Season	Sectors				
		RES	MF	COM	INS	CITY
Average price ($/gallon)	Annual	0.018	0.016	0.038	0.039	0.035
		(0.013)	(0.039)	(0.070)	(0.133)	(0.101)
	Irrigation	0.015	0.014	0.033	0.031	0.023
		(0.01)	(0.02)	(0.06)	(0.11)	(0.05)
	Non-irrigation	0.021	0.017	0.041	0.046	0.050
		(0.01)	(0.04)	(0.07)	(0.14)	(0.13)
Water usage (gallon/day)	Annual	279.58	1626.31	1050.31	3060.75	4952.50
		(1279.9)	(6043.4)	(6244.5)	(11960.9)	(28743.2)
	Irrigation	287.44	1927.36	1302.98	4504.71	8597.28
		(306.66)	(7159.51)	(8087.47)	(15535.46)	(39956.19)
	Non-irrigation	173.12	1401.72	799.87	1980.91	2224.29
		(190.58)	(5041.15)	(3729.89)	(8175.48)	(14545.51)
Days	Annual	30.41	30.42	30.41	30.42	30.42
		(2.17)	(2.22)	(2.17)	(2.58)	(2.09)
	Irrigation	30.70	30.78	30.72	30.68	30.68
		(1.99)	(2.12)	(2.07)	(2.98)	(1.94)
	Non-irrigation	30.21	30.15	30.18	30.23	30.22
		(2.22)	(2.26)	(2.21)	(2.21)	(2.17)
Monthly bill ($)	Annual	78.35	431.23	322.90	781.83	719.01
		(46.16)	(1292.46)	(784.61)	(1986.46)	(2544.61)
	Irrigation	87.54	471.39	362.15	968.70	1037.28
		(58.79)	(1434.24)	(925.16)	(2413.45)	(3403.56)
	Non-irrigation	70.98	401.27	298	642.07	480.78
		(31.28)	(1174.72)	(633.64)	(1579.71)	(1565.9)
Temperature (F)	Annual	58.66	58.87	58.78	58.88	58.81
		(14.95)	(15.08)	(15.01)	(15.07)	(15.03)
	Irrigation	72.84	72.94	72.88	72.86	72.80
		(6.69)	(6.97)	(6.81)	(6.82)	(6.95)
	Non-irrigation	48.04	48.38	48.23	48.20	48.32
		(9.76)	(10.17)	(9.97)	(9.97)	(10.13)
Precipitation (inch)	Annual	0.76	0.72	0.75	0.75	0.75
		(0.62)	(0.60)	(0.61)	(0.60)	(0.61)
	Irrigation	1.02	0.96	0.99	0.99	0.98
		(0.71)	(0.69)	(0.69)	(0.70)	(0.69)
	Non-irrigation	0.57	0.55	0.56	0.57	0.57
		(0.46)	(0.46)	(0.45)	(0.46)	(0.46)
N		14,355,345	589,191	804,299	85,454	88,402

Appendix

Table 2 Summary statistics of water accounts in the residential sector with monthly water data at the account level and annual socioeconomic data at the zip code level

Variable	Unit	Mean	Std. Dev.	Min	Max
Average price	Cent/gallon	1.14	1.3	0.3	3.6
Water usage	gallon/day	221.94	253.33	0	81,093.52
Billing days	day	30.42	2.14	0	62
Bill total	$	78.05	45.87	0.96	17,359.63
Temperature	Fahrenheit	58.63	14.97	34.66	85.10
Precipitation	inches	0.77	0.62	0	10.70
Income	$	59,334	16,974	28,476	160,740
Hispanic or Latino	%	44	3.1	37	52
White	%	40	5	26	51
Black or African American	%	3	1	0.06	6.4
Native American	%	5	1	0.75	10.3
Others	%	8	1	0.87	16.2