Re-Designing Natural Gas Tariffs to Increase Efficiency and Help Low-Income Households

Energy Policy Conference

November 14, 2012

Presenter: Lucas Davis, UC Berkeley and Energy Institute at Haas

Discussants: Christopher Danforth, Division of Ratepayer Advocates
Noah Long, Natural Resources Defense Council
Amrit Singh, PG&E

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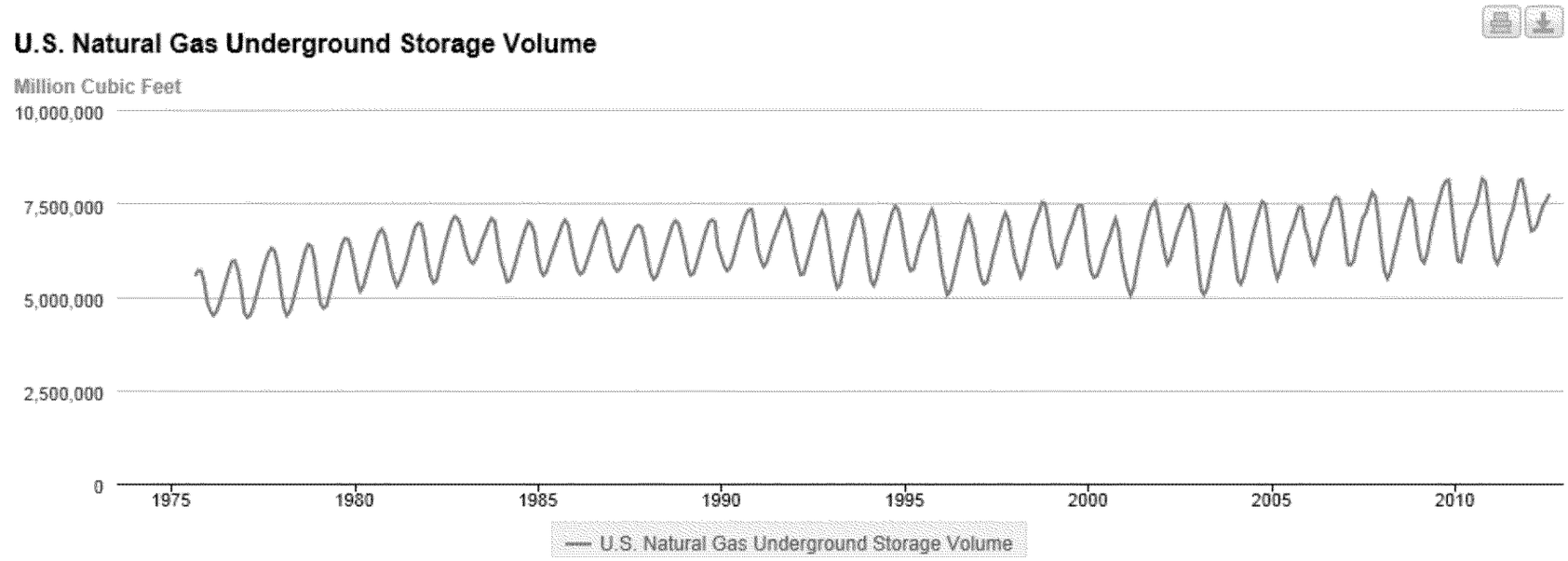
Storage



eia Source: U.S. Energy Information Administration

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Typical Bill

PSE&G

Winter Month 2009 — Page 3 of 4
Account number 12 345 678 90 Invoice number: 012345678901
24-hour customer service and emergencies 1 800 436-PSEG (7734)

PSE&G Gas

Usage	Meter 1111111
Estimated reading March 4	8900
Actual reading Feb 3	8709
Conversion to CCF	x 1.0120
CCF total	193.292
Conversion to therms	x 1.035
Total therms	**200**

Charges	PoD ID: PG000000441520494521	Rate - RSGH
Delivery (1)		
Service charge (2)		$5.96
Distribution charge (3)	200 therms @ $0.351250	70.25
Balancing charge (4)	162 therms @ $0.095988	15.55
Total Delivery		**$91.76**
Supply* (5)		
BGSS Commodity (6)	200 therms @ $0.990650	198.13
Total Supply		**$198.13**
Total Gas Charges		**$289.89**

(7) *The total supply amount ($198.13 or $0.990650 per therm) reflects your Price to Compare for this month should you choose another gas supplier for these services. Your monthly Price to Compare may vary each month depending on your usage pattern.*

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Relevant Studies from EI@Haas

"The Equity and efficiency of two-Part Tariffs in U.S. Natural Gas Markets", by Severin Borenstein and Lucas Davis

http://ei.haas.berkeley.edu/pdf/working_papers/WP213.pdf

"Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing, by Lucas Davis and Erich Muehlegger

http://www.ucei.berkeley.edu/PDF/csemwp194.pdf

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Overview

- Natural gas companies in the United States collect the vast majority of total revenues from the volumetric charge.
- Why? There is a widespread perception that current rate schedules have desirable distributional consequences.
- We evaluate this claim empirically using nationally-representative household-level data.
- We show that the correlation between household income and natural gas consumption is indeed positive, but surprisingly weak, so current rate schedules are only mildly progressive.

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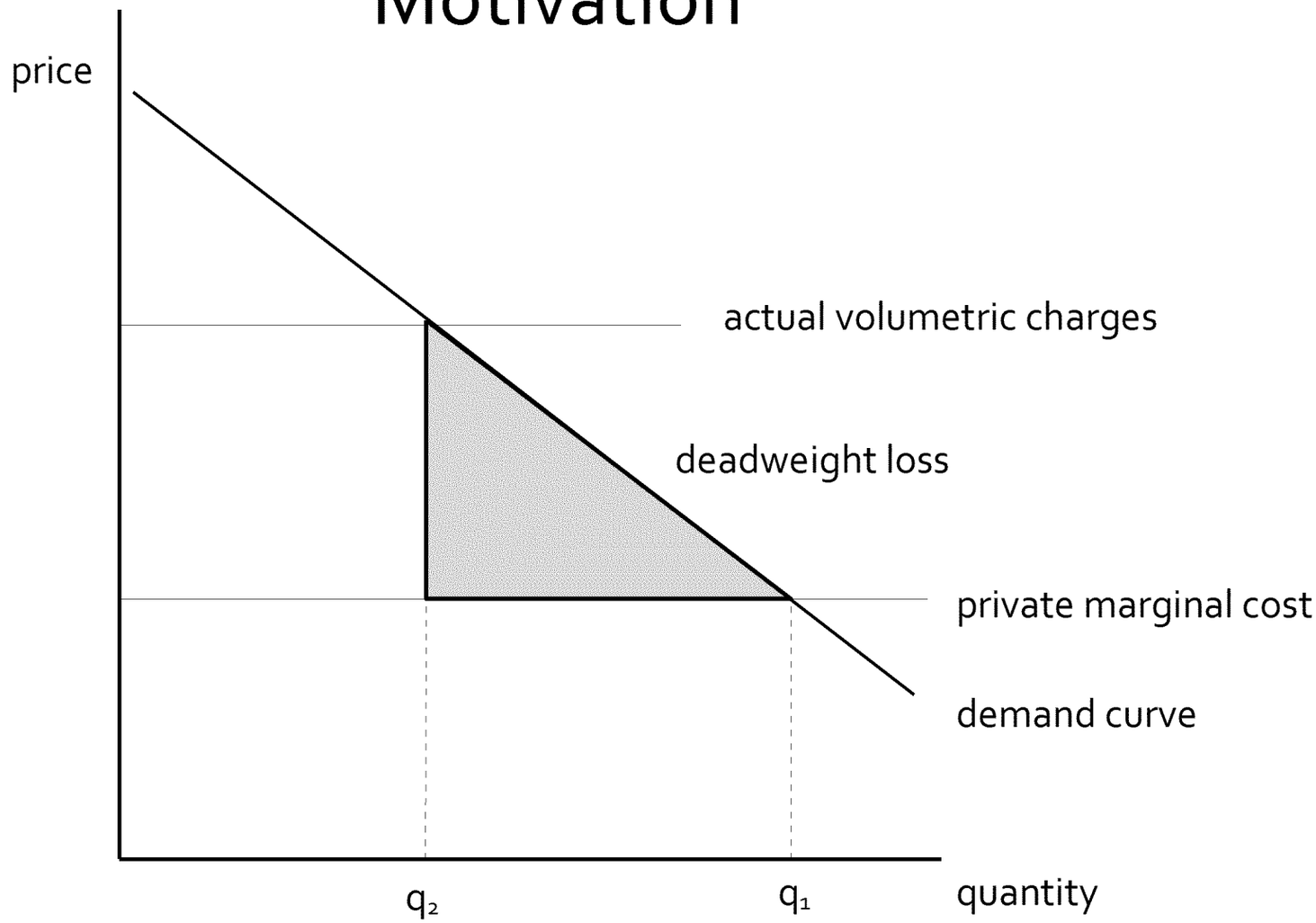
Motivation



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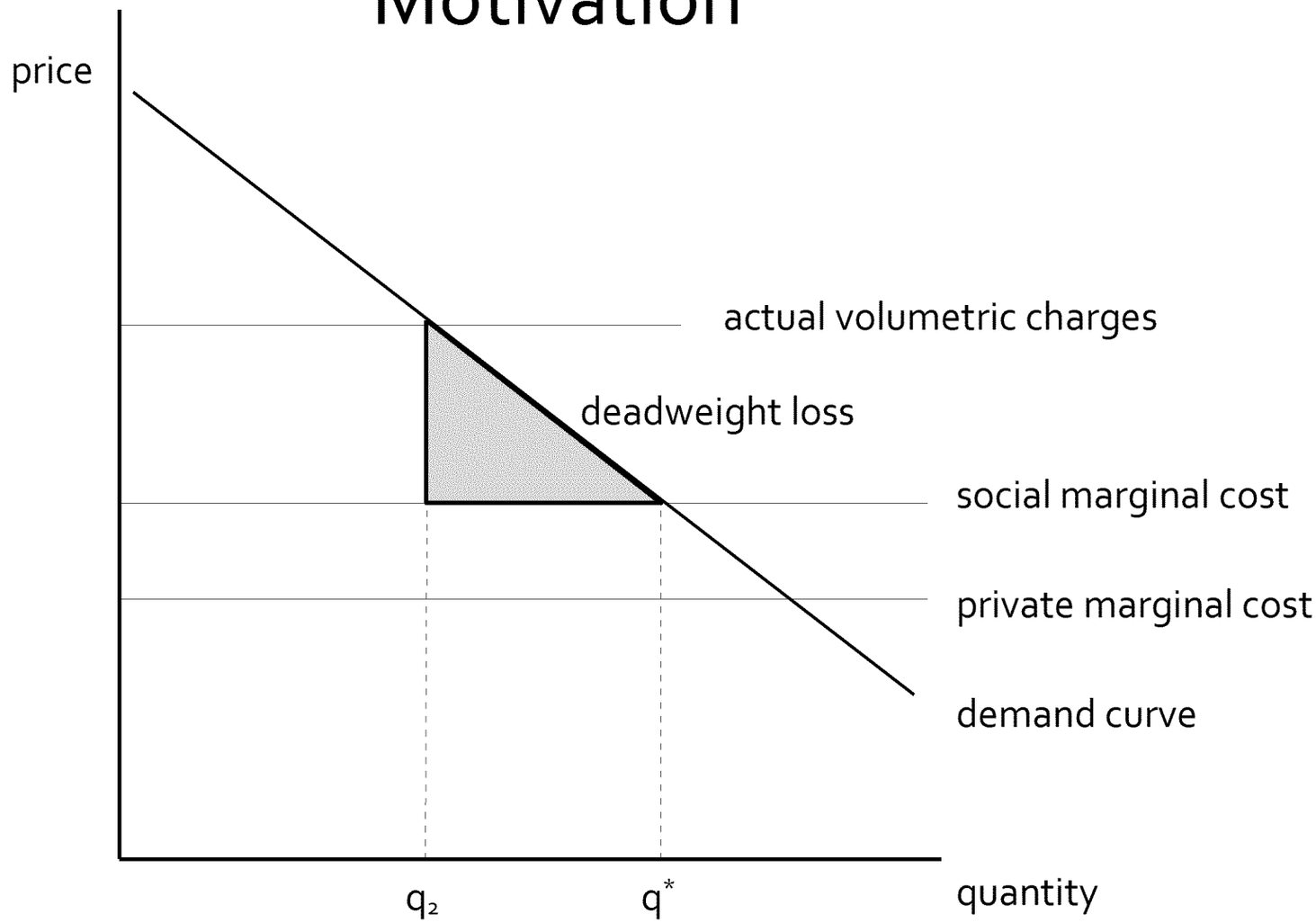
Motivation



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Implications for Revenue Volatility

- This emphasis on volumetric charges means that revenues are highly volatile, within and across years.
- LDCs collecting a large share of their total annual net revenue during cold, high-demand winter months.
- Marginal cost pricing of gas with higher fixed monthly charge would reduce this volatility.
- Instead, many LDCs have adopted "decoupling" mechanisms in which the volumetric charge is continuously adjusted.

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Residential Market

- 60% of all households in the U.S. use natural gas
- Total expenditure $50 billion annually
- LDCs use about $30 billion to buy natural gas
- The other $20 billion goes for LDC costs
- LDCs regulated by state regulatory commissions using rate-of-return regulation.

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"Non-Commodity" Costs for LDCs

- Installation and Maintenance of Network
  - "Trunk lines" that carry gas from the interconnection with large pipelines to the local distribution lines
  - Local distribution lines in neighborhoods and to individual houses
- Installation and Maintenance of Meters
- Processing bills, customer service

These costs are mostly fixed with respect to the volume of natural gas that is consumed.

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Related Literature

- Coase (1946) was among the first to describe what efficient pricing would look like in such markets:
  - Volumetric charge set equal to marginal cost
  - Fixed monthly fee set equal to share of fixed costs.
- Optimal Two-Part Tariffs.
  - Baumol and Bradford (AER, 1970), Feldstein (QJE, 1972), Ng and Weisser (ReStud 1974), Sherman and Visscher (QJE 1982)
- Efficiency of Utility Pricing.
  - Naughton (ReStat 1982), Knittel (JIE 2003), Ito (EI@Haas 2010)

Data Sources

- Residential Energy Consumption Survey (RECS)
  - Nationally representative data from 2005
  - Includes 4,000 households
  - Linked to utility-provided billing data
- Residential Appliance Saturation Survey (RASS)
  - California only; from 2003
  - Includes 11,700 households
  - We focus on PG&E, SDG&E, and SCG (97% of CA customers)
- Wholesale Natural Gas Prices from Platts

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Table 1: Descriptive Statistics by Needs-Adjusted Household Income Quintiles

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
A. Household Economic and Demographic Characteristics					
Percent of Poverty Line	<148%	148-235%	235-334%	334-514%	>514%
Mean Annual Household Income (1000s)	$16.5	$32.3	$46.7	$65.3	$129.8
	(8.9)	(12.0)	(15.8)	(20.8)	(44.1)
Number of Household Members	2.75	2.86	2.71	2.50	2.47
	(1.92)	(1.61)	(1.51)	(1.32)	(1.17)
Number of Children	0.94	0.85	0.78	0.61	0.52
	(1.38)	(1.14)	(1.08)	(0.97)	(0.92)
Proportion Homeowner	0.49	0.66	0.77	0.85	0.91
	(0.50)	(0.47)	(0.42)	(0.36)	(0.29)
Proportion Receives Energy Assistance	0.18	0.06	0.0	0.0	0.0
	(0.38)	(0.24)	(0)	(0)	(0)

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Table 1: Descriptive Statistics by Needs-Adjusted Household Income Quintiles

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
B. Natural Gas Consumption and Expenditure					
Mean Annual Consumption (cubic feet, 1000s)	61.1 (47.8)	68.2 (44.1)	66.7 (40.7)	67.9 (41.6)	80.9 (47.9)
Mean Annual Expenditure	$743 (588)	$823 (533)	$807 (476)	$854 (550)	$993 (586)
Expenditure as a Fraction of Income	0.06 (0.09)	0.03 (0.02)	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)

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Figure 1: Natural Gas Consumption and Household Income

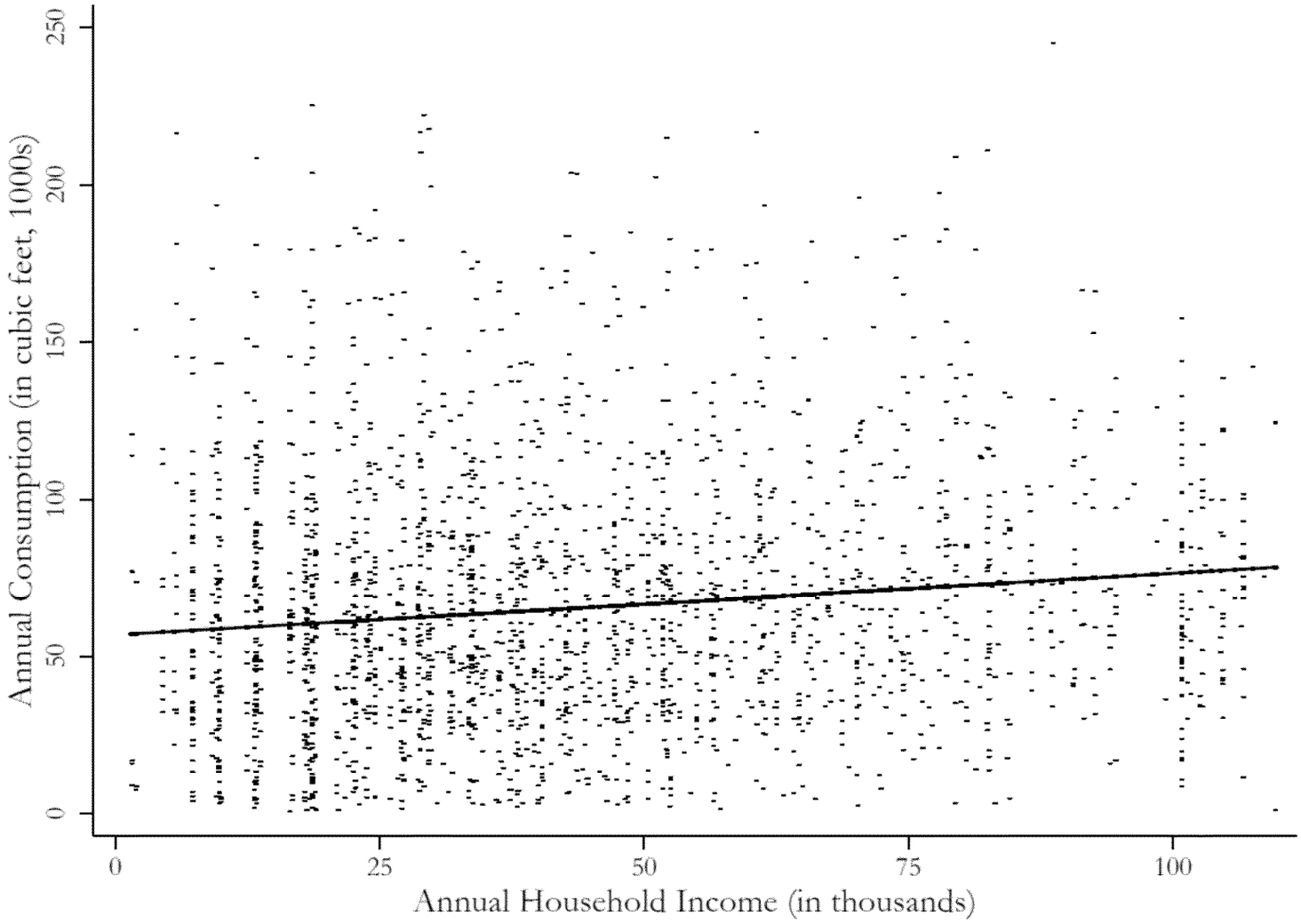

Figure 2: Natural Gas Consumption and Household Income, Controlling for Census Division

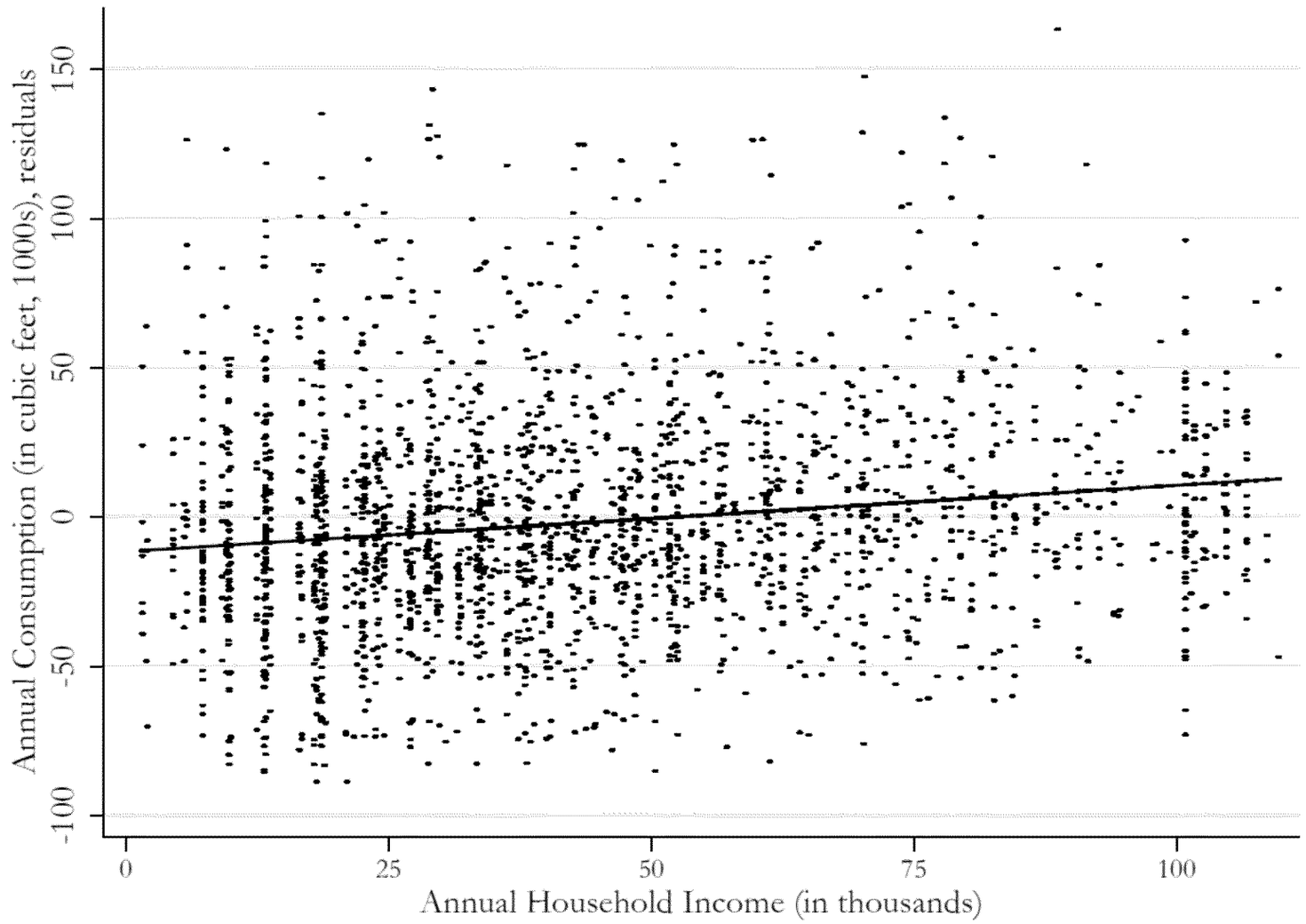

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Table 1: Descriptive Statistics by Needs-Adjusted Household Income Quintiles

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
			C. Energy Efficiency		
Main Heating System is Less than 10 Years Old	0.34	0.38	0.41	0.48	0.50
	(0.47)	(0.49)	(0.49)	(0.50)	(0.50)
Home is Well Insulated	0.30	0.39	0.38	0.37	0.45
	(0.46)	(0.49)	(0.49)	(0.48)	(0.50)
Double-Pane Windows	0.38	0.51	0.62	0.60	0.70
	(0.49)	(0.50)	(0.49)	(0.49)	(0.46)

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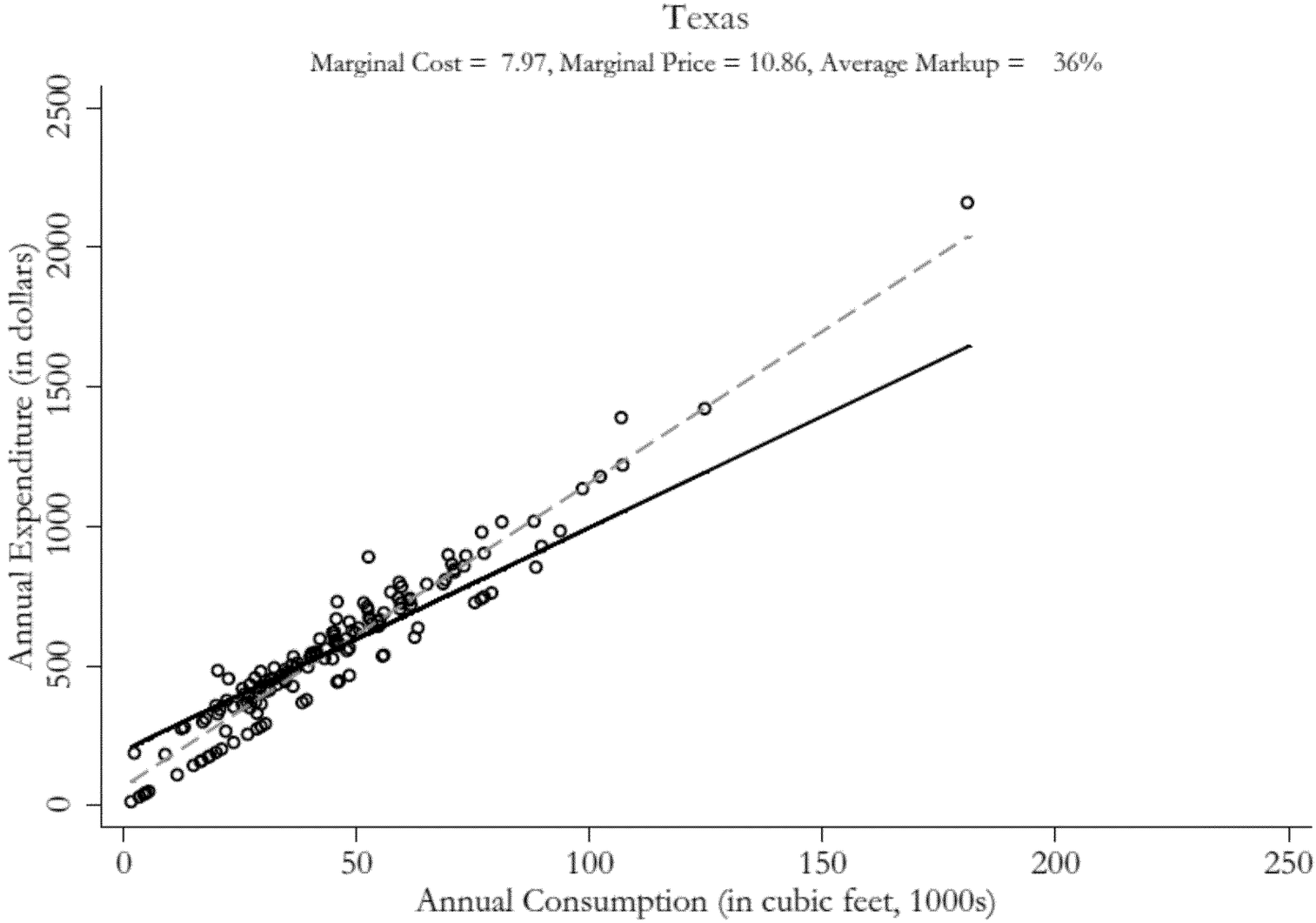

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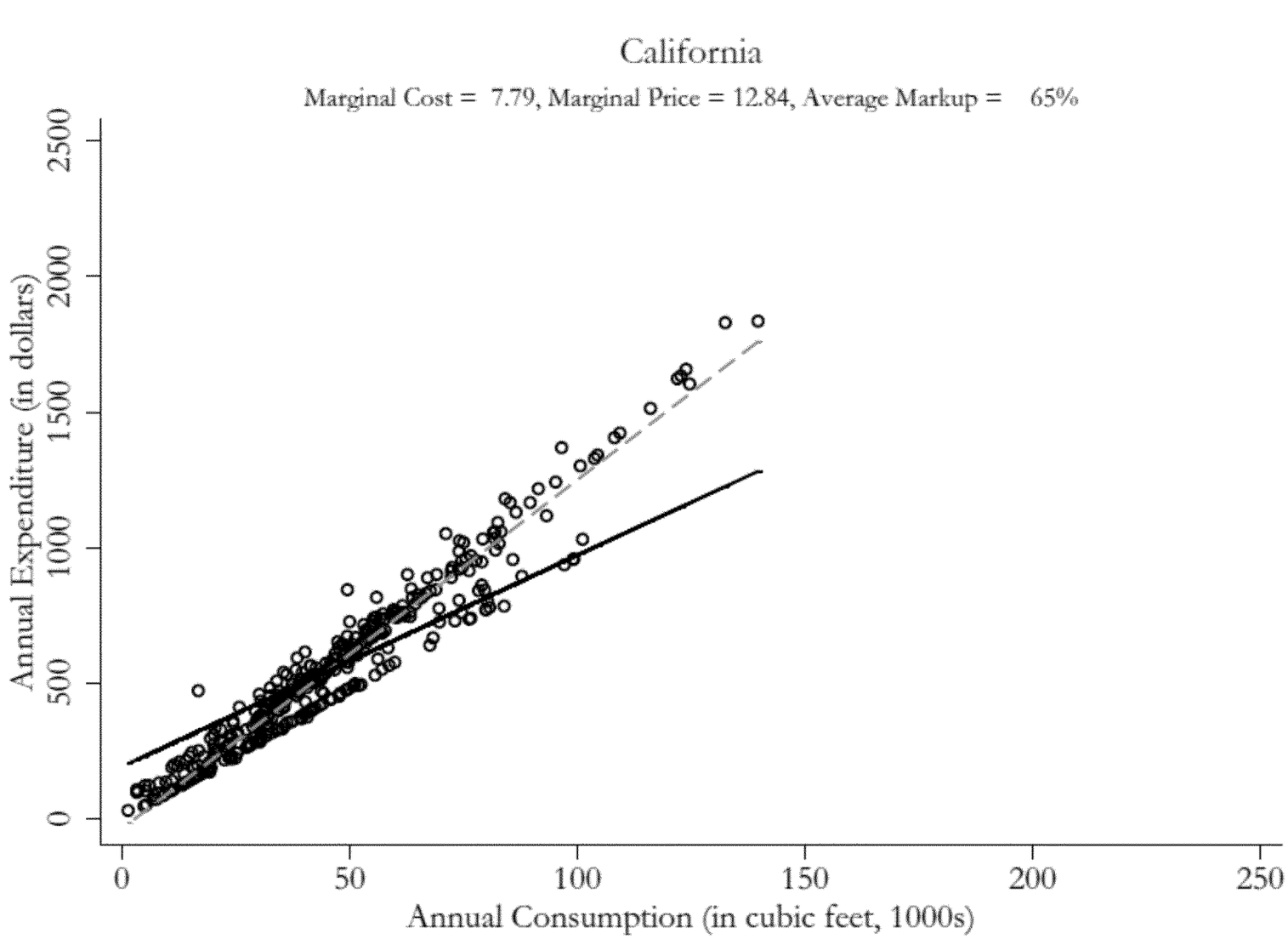

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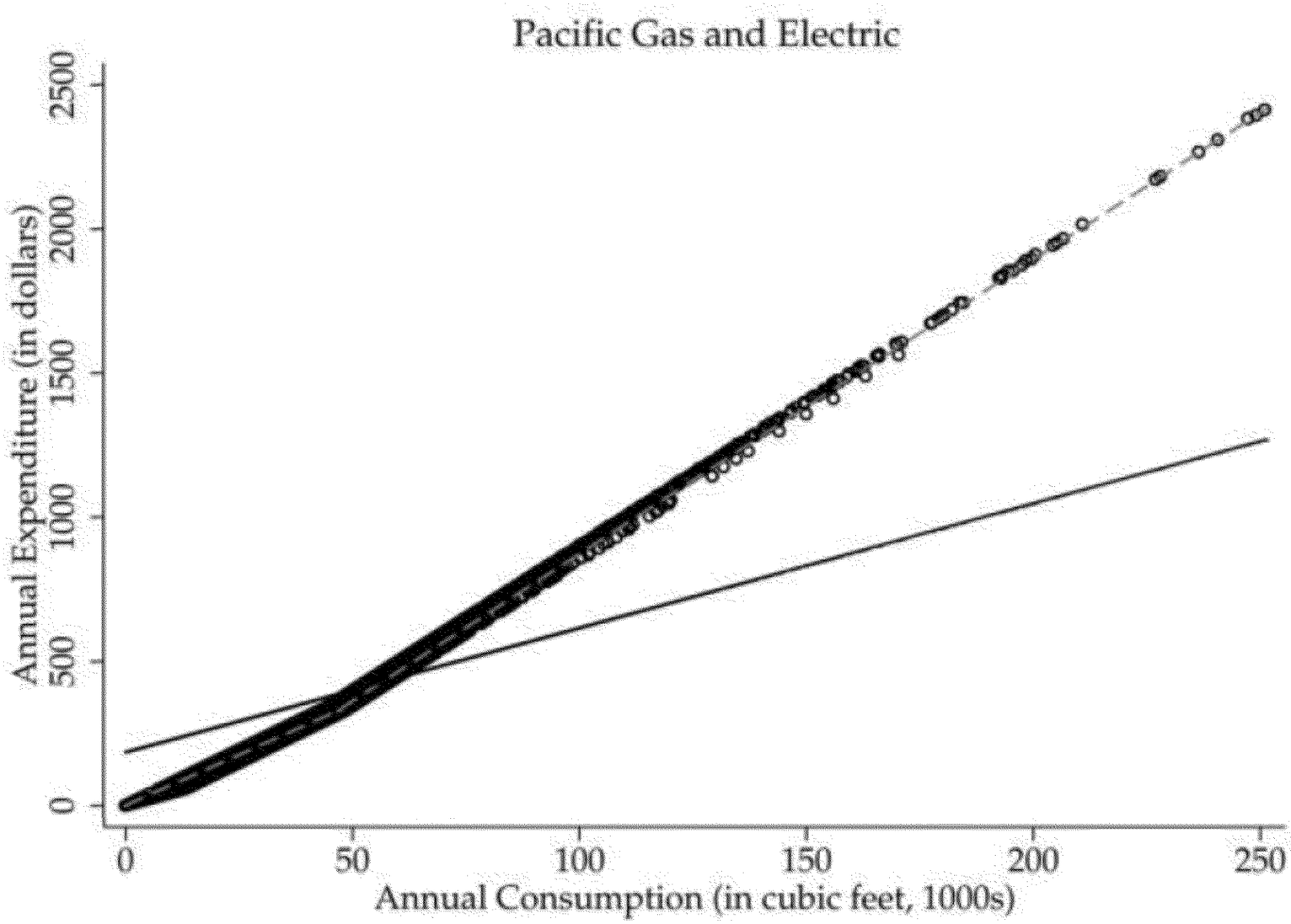

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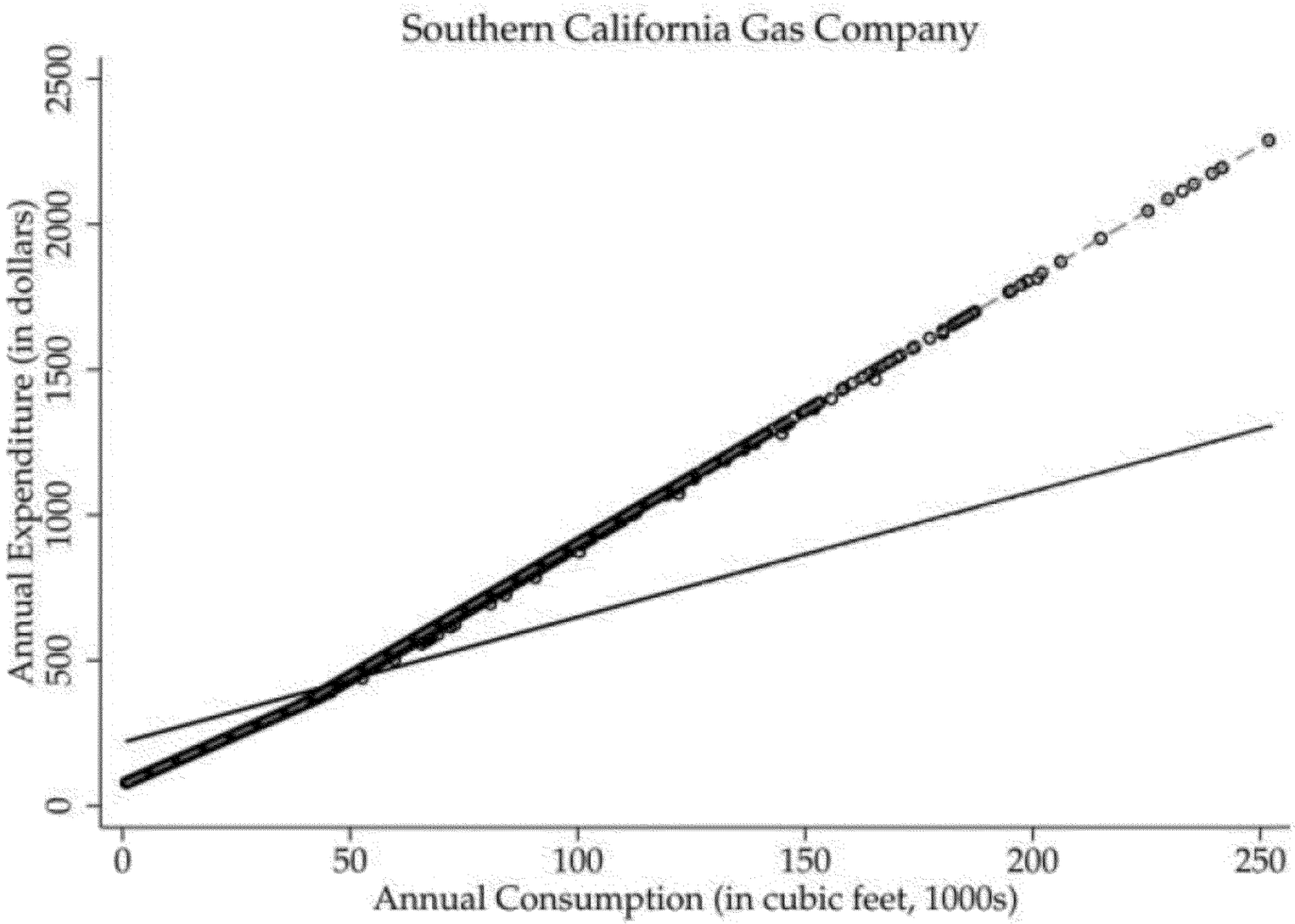

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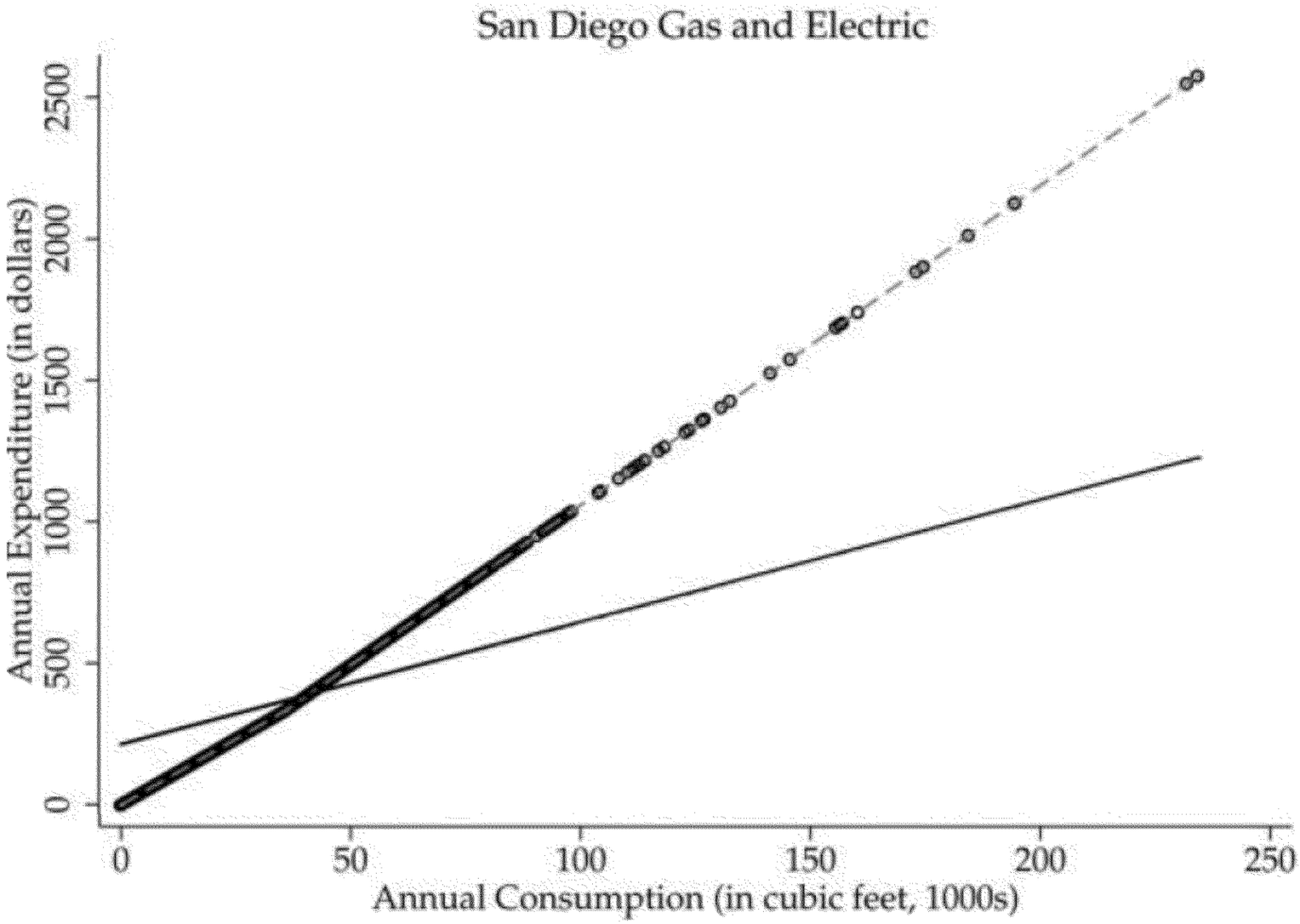

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Table 2: Natural Gas Rate Schedules By Region

	Current Rate Schedule		Rate Schedule After Rebalancing	
	Volumetric Charge	Fixed Monthly Fee	Volumetric Charge (Marginal Cost)	Fixed Monthly Fee
	(1)	(2)	(3)	(4)
Northeast	\$12.60	\$5.82	\$10.04	\$24.20
	(0.38)	(2.10)		(1.37)
Midwest	\$9.90	\$10.90	\$8.57	\$20.03
	(0.44)	(2.75)		(0.68)
South	\$11.97	\$4.22	\$8.58	\$19.67
	(0.46)	(1.90)		(0.93)
West	\$11.47	\$2.69	\$7.61	\$17.92
	(0.26)	(0.96)		(0.58)
Average	\$11.34	\$6.20	\$8.63	\$20.24
	(0.20)	(1.05)		(0.44)

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What We Do Next

Simulate the effect of tariff rebalancing

- Lower volumetric charge to marginal cost
- And raise monthly fixed fee to maintain total revenue.

Examine distributional impact

- Simulate average bill impacts
- Using household income and other measures of need
- And then including energy assistance programs

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Table 3: The Distributional Impact of a Change to Marginal Cost Pricing

	Mean Annual Change in Dollars		Percent Experiencing Bill Increase		Mean Bill Change in Percent	
A. By Household Income Quintile						
1st Quintile	$44.39	(9.79)	66.7%	(2.3)	6.1%	(1.5)
2nd Quintile	$23.26	(9.69)	60.2%	(2.5)	2.9%	(1.3)
3rd Quintile	$8.20	(10.19)	53.7%	(2.4)	1.0%	(1.3)
4th Quintile	-$19.04	(11.37)	49.2%	(2.6)	-2.1%	(1.2)
5th Quintile	-$58.45	(10.93)	39.0%	(2.4)	-5.9%	(1.0)
B. By Needs-Adjusted Household Income Quintile						
1st Quintile	$29.70	(10.05)	64.7%	(2.3)	4.0%	(1.4)
2nd Quintile	$28.16	(9.73)	59.9%	(2.4)	3.5%	(1.3)
3rd Quintile	$12.44	(9.70)	54.8%	(2.5)	1.5%	(1.2)
4th Quintile	-$16.47	(11.07)	50.4%	(2.6)	-1.9%	(1.3)
5th Quintile	-$54.97	(10.52)	39.2%	(2.4)	-5.6%	(1.0)

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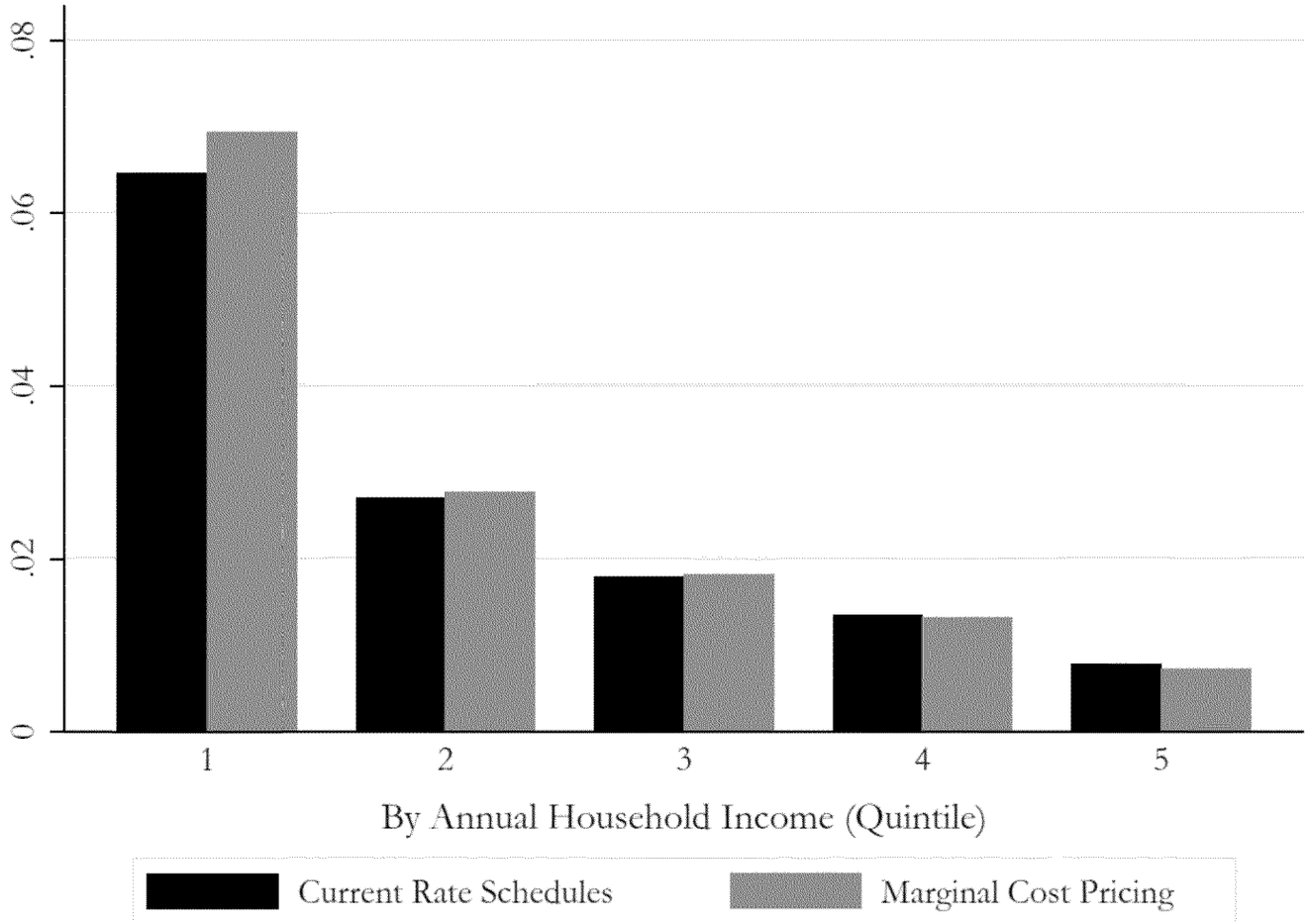
Table 3: The Distributional Impact of a Change to Marginal Cost Pricing

	Mean Annual Change in Dollars		Percent Experiencing Bill Increase		Mean Bill Change in Percent	
C. Households with Children						
All Households with Children	-$21.19	(6.20)	52.1%	(1.5)	-2.3%	(0.7)
Households with One Child	-$1.34	(10.94)	53.9%	(2.7)	-0.2%	(1.3)
Households with Two Children	-$33.63	(12.17)	53.5%	(2.6)	-3.6%	(1.2)
Households with Three or More Children	-$33.72	(16.37)	46.4%	(3.6)	-3.5%	(1.6)
D. Low-Income Households with Children						
Households with Children	$2.80	(18.47)	65.5%	(3.4)	0.3%	(2.2)
Households with One Child	$65.68	(21.68)	73.7%	(6.0)	10.1%	(3.8)
Households with Two Children	-$24.96	(36.58)	64.3%	(5.9)	-2.7%	(3.8)
Households with Three or More Children	-$29.94	(32.31)	58.2%	(6.4)	-3.2%	(3.3)

Natural Gas Expenditure as a Share of Income



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Natural Gas Expenditure as a Share of Income

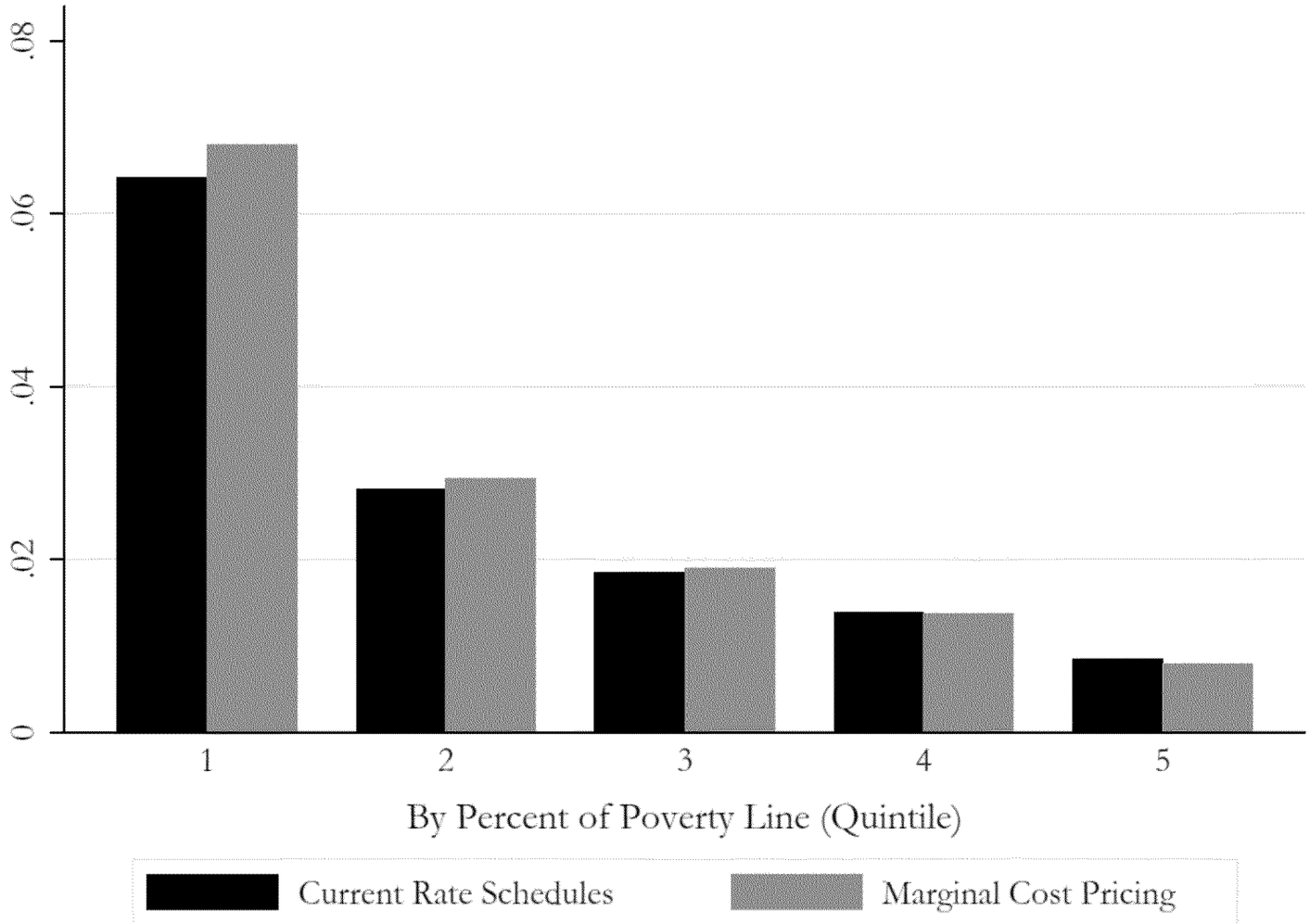

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Table 5: The Impact on Households Below 150% of Poverty Line

		Mean Annual Change (in Dollars)	Mean Change (in Percent)	Share Who Receive Benefits	Annual Cost Per Non-Recipient
(1)	No Energy Assistance Program	$29.70	4.0%	0.0%	$0.0
		(10.05)	(1.4)	(0.0)	(0.0)
(2)	Zero Fixed Monthly Fee for Households Below 150% Poverty Line (100% takeup)	-$210.14	-28.0%	20.0%	$60.07
		(11.41)	(1.0)	(0.1)	(1.52)
(3)	$10 Monthly Lump Sum Payment for Households Below 150% Poverty Line (100% takeup)	-$90.30	-12.0%	20.0%	$30.06
		(10.05)	(1.1)	(0.1)	(0.23)
(4)	$10 Monthly Lump Sum Payment for Households Below 150% Poverty Line (50% takeup)	-$30.30	-4.0%	10.0%	$13.36
		(10.05)	(1.2)	(0.1)	(0.09)
(5)	$10 Monthly Lump Sum Payment for Households Below 150% Poverty Line (20% takeup)	$5.70	0.8%	4.0%	$5.01
		(10.05)	(1.4)	(0.0)	(0.03)
(6)	$10 Monthly Lump Sum Payment for Households in Multi-Unit Buildings	-$24.25	-3.2%	27.6%	$45.65
		(10.19)	(1.3)	(1.0)	(2.34)

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Table 6: Consumer Surplus Impact of a Change to Marginal Cost Pricing

	Mean Annual Change in Consumer Surplus			
	ϵ=0	ϵ=-0.2	ϵ=-0.4	ϵ=-0.6
By Needs-Adjusted Household Income Quintile:				
1st Quintile	-$29.70	-$25.54	-$21.17	-$16.60
	(10.05)	(10.10)	(10.32)	(10.11)
2nd Quintile	-$28.16	-$23.66	-$18.94	-$14.01
	(9.73)	(9.97)	(10.16)	(9.89)
3rd Quintile	-$12.44	-$7.88	-$3.10	$1.91
	(9.70)	(9.81)	(9.92)	(9.71)
4th Quintile	$16.47	$21.46	$26.68	$32.15
	(11.07)	(11.12)	(11.20)	(11.61)
5th Quintile	$54.97	$61.72	$68.82	$76.28
	(10.52)	(11.24)	(11.75)	(11.90)
Average Across Quintiles	$0.00	$4.99	$10.21	$15.69
	(0.00)	(0.59)	(1.21)	(1.87)

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Conclusion

- What matters for distributional consequences is the correlation between income and energy consumption
- We show this relationship is weak, so that current price schedules are a crude tool for redistribution
- Our analysis highlights energy efficiency and household composition as important confounding factors
- Even a modest energy assistance program would more than offset the distributional impact of tariff rebalancing for most low-income households.
- Overall, redistribution through natural gas tariffs probably less effective than redistribution through, e.g., income tax

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