Efficiency and Equity Impacts of Energy Subsidies

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Policy motivation

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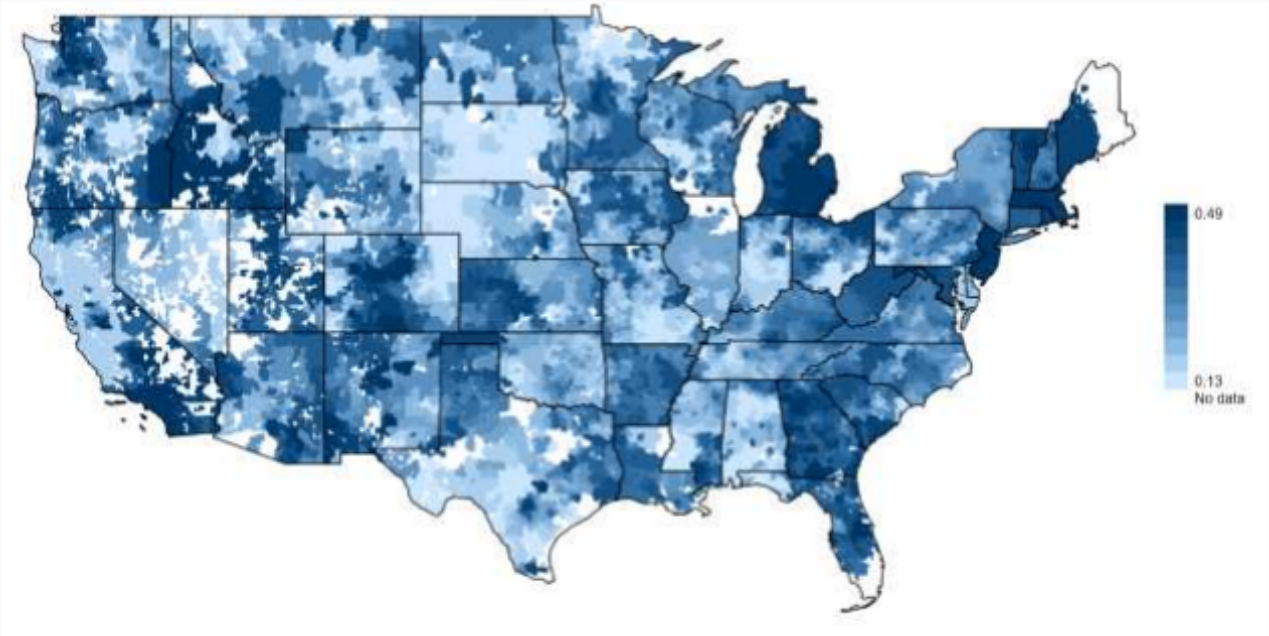

Source: Levinson & Silva (2019)

Theory

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Environmental costs of energy subsidies could be significant

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What is the correct counterfactual for a price subsidy?

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Aside: We do not have good causal estimates of energy elasticities from field experiments, and these may be crucial for understanding the impact of various policy interventions.

2. Estimate welfare change and policymakers' trade-off between equity and efficiency

Our price subsidy

The **California Alternate Rates for Energy (CARE)** program:

20% reduction in the marginal price of natural gas

30-35% reduction in the marginal price of electricity

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5.4 million eligible low-income HHs in CA (largest subsidy program in the U.S.)

Table 2: Eligibility and Expenditures for the 2015 CARE Program

	Eligible Households (million)	Actual Households (million)	Expected Cost (million)	Actual Cost (million)
SoCalGas	1.9	1.557	$147	$109
SCE	1.499	1.282	$424	$377
PG&E	1.636	1.424	$622	$573
SDG&E	0.37	0.271	$89	$82
Total	5.405	4.534	$1,282	$1,141

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3. We develop a two-sector model that includes the interaction between environment and regulation.

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3. The implicit efficiency-equity trade-off is about twice as high when greenhouse gas costs are included.

4. Removing the subsidy is much more cost-effective than some energy efficiency investments.

The CARE subsidy and sample

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Eligibility:

- At or below 2x the poverty line ($31,860 in 2015 CA)
- OR on any federal low-income programs

The SoCalGas experiment

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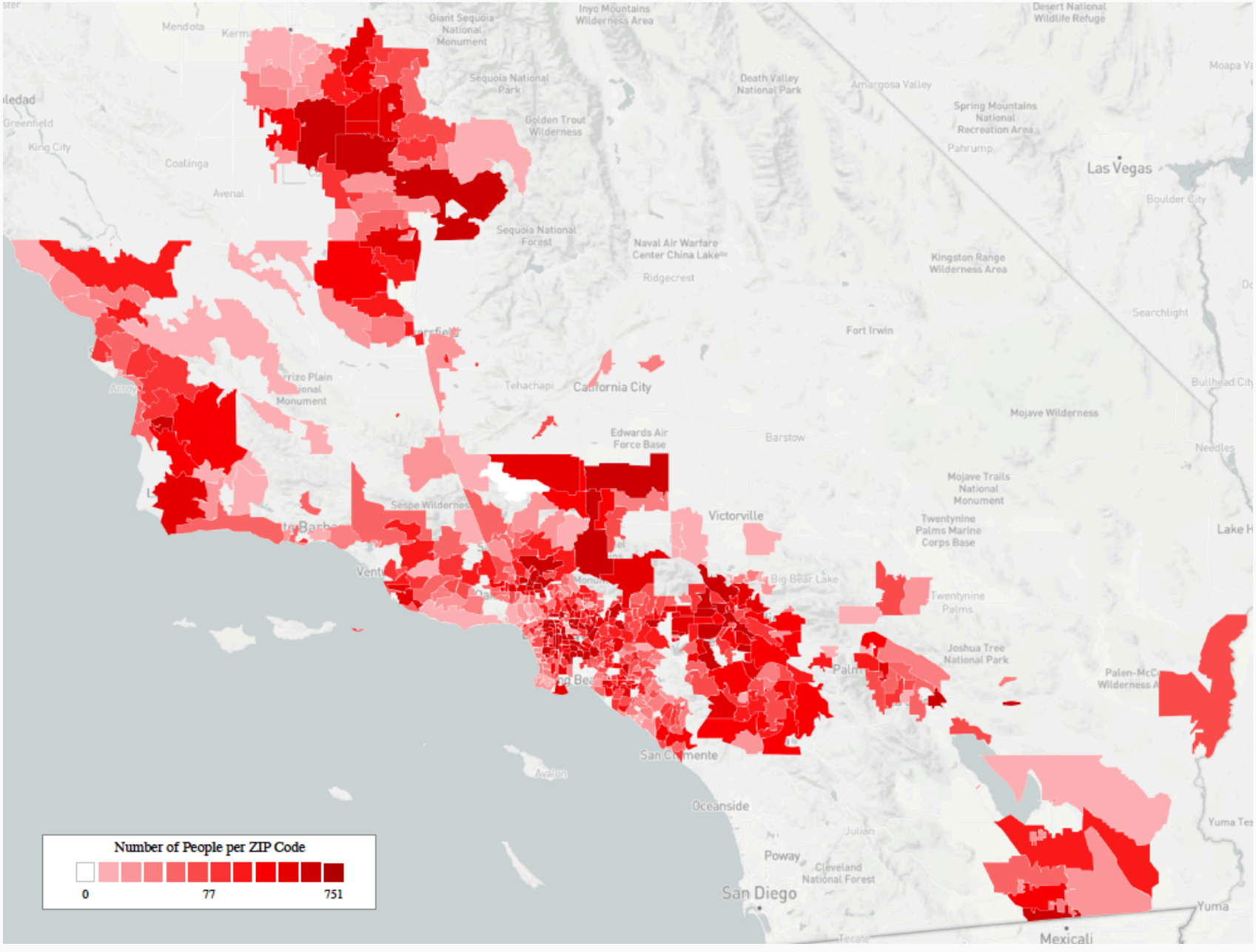
Our sample:

- 70,000 customers in 2014 and 2015 who fell off CARE and didn't come back on
- We do not know that they are definitely eligible.

The SoCalGas experiment



EXPERIMENTAL DESIGN

Identification 1

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Is this encouragement and sample representative?

- Monotonic treatment assumption (“no defiers”; instrument affects the treatment decision in the same direction for every individual).

Identification 2

We use a different approach than the existing literature:

GAS:

* Cross-sectional or panel data (Borenstein et al., 2012; Davis & Muehlegger, 2010; Davis, 2014; Hausman & Kellogg, 2015)
* Panel data with IV (Auffhammer & Rubin; 2018)

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ELECTRICITY:

* Discrete choice models (Reiss & White, 2005)
* Framed field experiments in peak time pricing (Jessoe & Rapson, 2014)

Both elasticities are important to estimate optimal first-best carbon pricing

Experimental setting

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Exp 1 (2014)	
T0 (Control)	No letter
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Exp 2 (2015)	
T0 (Control)	No letter
T1	Rebranded letter (T2 from wave 1)
T2	T1 + Thank you for being a customer
T3	T1 + More information on gas efficiency

Balance tables

An example - front

YOU CAN AVOID LOSING MONEY BY REAPPLYING FOR CARE TODAY

Dear [name],

We are writing because you participated in the California Alternate Rates for Energy (CARE) 20 percent discount program last year and **you saved $XXX.XX. Unfortunately, you no longer receive this special discount** because your application is out of date.

The good news is that you can still re-apply. If you or another member of your household is on a public assistance program listed in the enclosed application or meet the income guidelines listed below, you may still be eligible for the program. Once you are re-certified, assuming you still meet the requirements, **you will immediately receive the 20 percent discount.**

MAXIMUM HOUSEHOLD INCOME TO BE ELIGIBLE (effective June 1, 2015 to May 31, 2016)

Number of Persons in Household:	1-2	3	4	5	6	7	8
Total Annual Income[1]	$31,860	$40,180	$48,500	$56,820	$65,140	$73,460	$81,780

For each additional household member, add $8,320

1. Includes current household income from all sources before deductions.

What you NEED to do:

- Complete the attached application form
- Mail the completed form in the postage-paid envelope
- The CARE application can also be completed online at **socalgas.com** (search *"CARE"*).

Did you know? Each year more than 200,000 customers like you re-certify to save money.

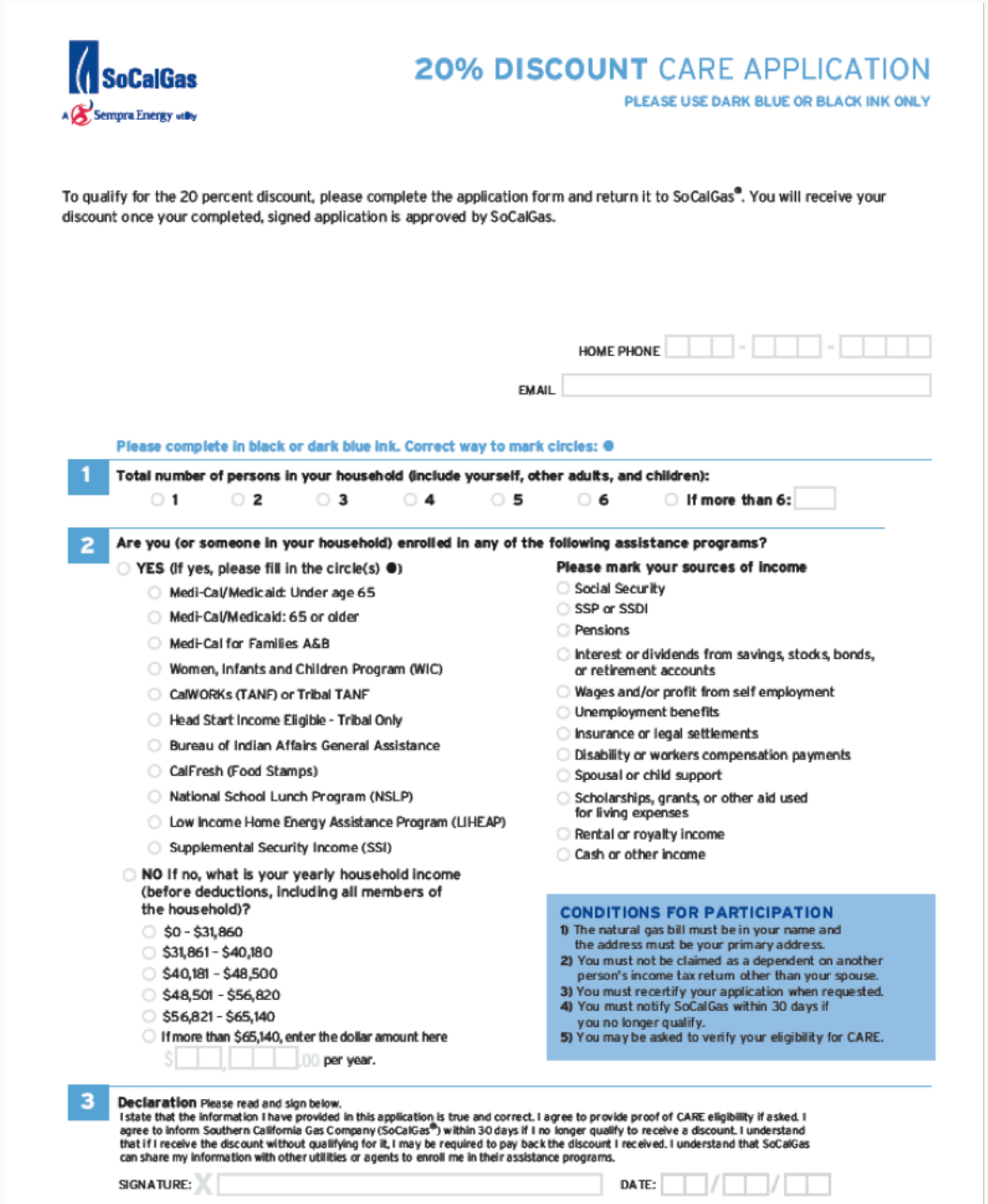
If you need more information about this discount, please visit **socalgas.com** (search *"CARE"*) or call us free at 1-800-427-2200.

Sincerely,

Ted Humphrey
CARE Program Senior Market Advisor

SoCalGas

An example - back



SoCalGas
A Sempra Energy utility

20% DISCOUNT CARE APPLICATION

PLEASE USE DARK BLUE OR BLACK INK ONLY

To qualify for the 20 percent discount, please complete the application form and return it to SoCalGas®. You will receive your discount once your completed, signed application is approved by SoCalGas.

HOME PHONE ☐☐☐ - ☐☐☐ - ☐☐☐☐

EMAIL

Please complete in black or dark blue ink. Correct way to mark circles: ●

1 Total number of persons in your household (include yourself, other adults, and children):

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ If more than 6: ☐

2 Are you (or someone in your household) enrolled in any of the following assistance programs?

○ **YES** (If yes, please fill in the circle(s) ●)

- ○ Medi-Cal/Medicaid: Under age 65
- ○ Medi-Cal/Medicaid: 65 or older
- ○ Medi-Cal for Families A&B
- ○ Women, Infants and Children Program (WIC)
- ○ CalWORKs (TANF) or Tribal TANF
- ○ Head Start Income Eligible - Tribal Only
- ○ Bureau of Indian Affairs General Assistance
- ○ CalFresh (Food Stamps)
- ○ National School Lunch Program (NSLP)
- ○ Low Income Home Energy Assistance Program (LIHEAP)
- ○ Supplemental Security Income (SSI)

○ **NO** If no, what is your yearly household income (before deductions, including all members of the household)?

- ○ $0 - $31,860
- ○ $31,861 - $40,180
- ○ $40,181 - $48,500
- ○ $48,501 - $56,820
- ○ $56,821 - $65,140
- ○ If more than $65,140, enter the dollar amount here $☐,☐☐☐.00 per year.

Please mark your sources of income

- ○ Social Security
- ○ SSP or SSDI
- ○ Pensions
- ○ Interest or dividends from savings, stocks, bonds, or retirement accounts
- ○ Wages and/or profit from self employment
- ○ Unemployment benefits
- ○ Insurance or legal settlements
- ○ Disability or workers compensation payments
- ○ Spousal or child support
- ○ Scholarships, grants, or other aid used for living expenses
- ○ Rental or royalty income
- ○ Cash or other income

CONDITIONS FOR PARTICIPATION

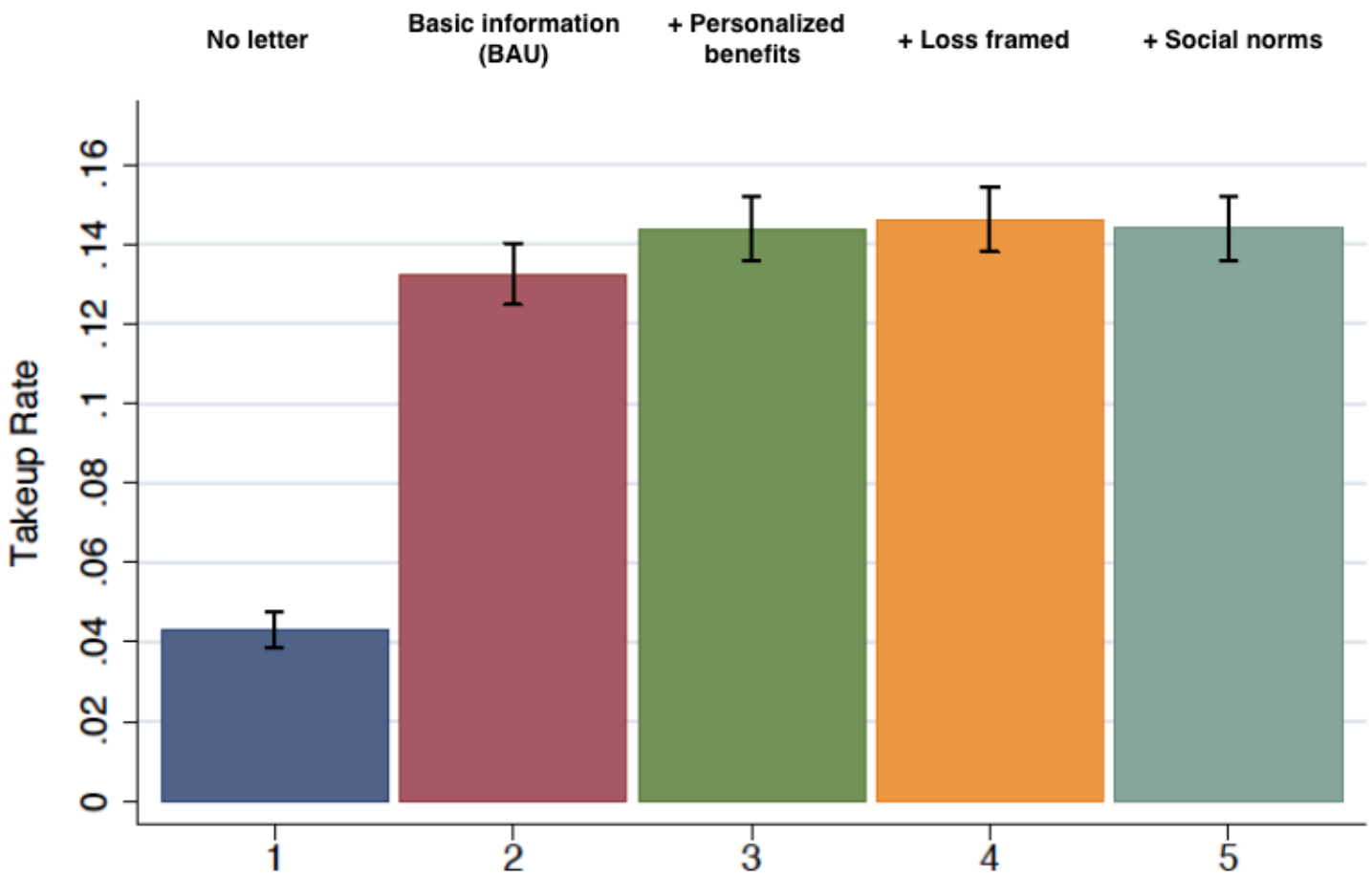
1) The natural gas bill must be in your name and the address must be your primary address.
2) You must not be claimed as a dependent on another person's income tax return other than your spouse.
3) You must recertify your application when requested.
4) You must notify SoCalGas within 30 days if you no longer qualify.
5) You may be asked to verify your eligibility for CARE.

3 **Declaration** Please read and sign below.
I state that the information I have provided in this application is true and correct. I agree to provide proof of CARE eligibility if asked. I agree to inform Southern California Gas Company (SoCalGas®) within 30 days if I no longer qualify to receive a discount. I understand that if I receive the discount without qualifying for it, I may be required to pay back the discount I received. I understand that SoCalGas can share my information with other utilities or agents to enroll me in their assistance programs.

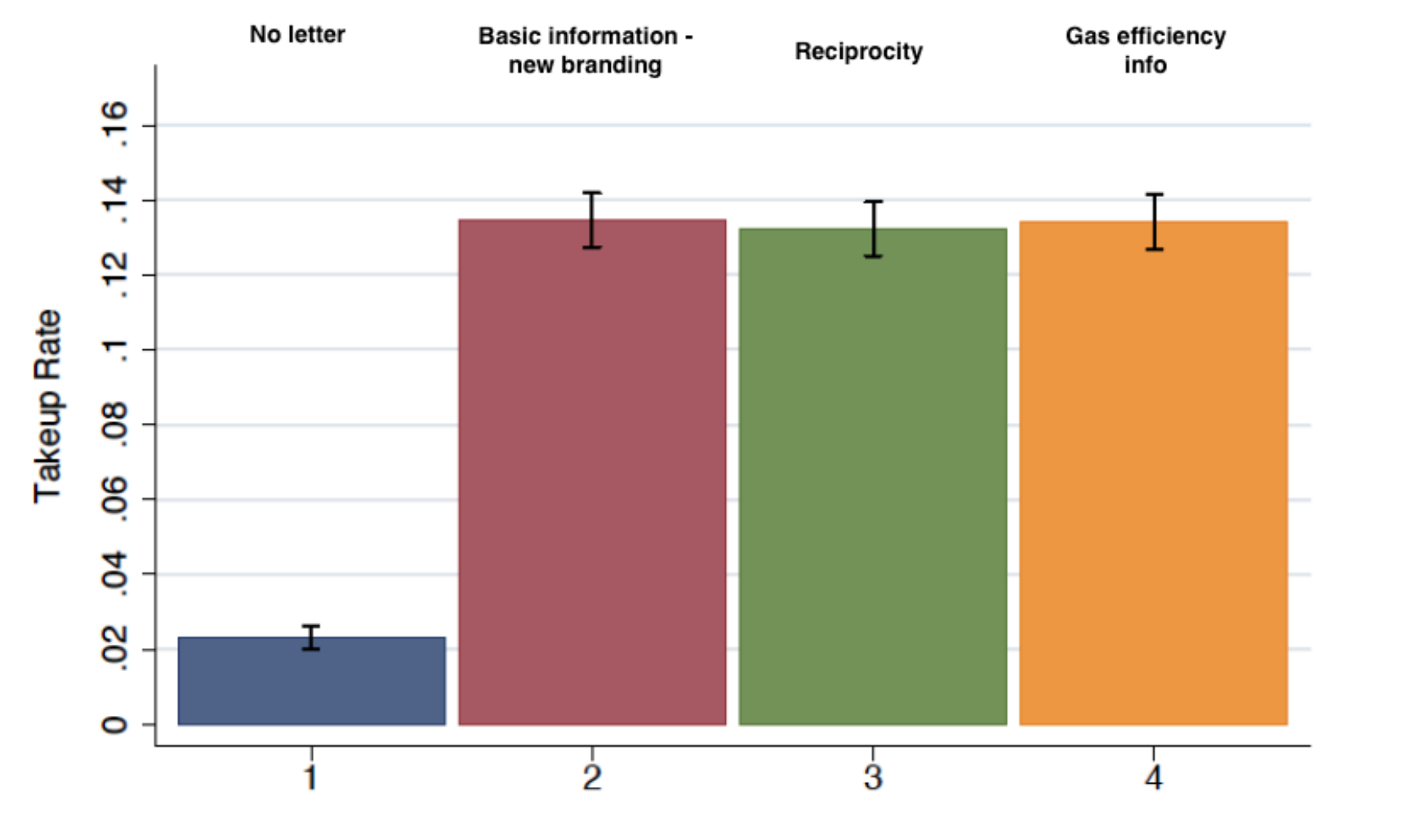
SIGNATURE: X ☐ DATE: ☐☐/☐☐/☐☐

RESULTS

Take up of CARE - Exp 1



Take up of CARE - Exp 2



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	(1) (First-stage)	(2) (ITT)	(3) (LATE)
	Take-up CARE	Gas consumption	Gas consumption
Receive encouragement	0.0772*** (0.0014)	0.1513** (0.0729)	
CARE			1.9090** (0.9198)
Control usage (Therms)	21	21	21
F-stat in first-stage	2018		
2015 data for wave 1			
R2	0.063	0.53	0.529
N	499,274	499,274	499,274

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% effects are slightly larger in summer than winter

ITT and LATE - up to 18 months

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Receive encouragement	0.0924*** (0.0020)	0.1615** (0.0711)	
CARE			1.6624** (0.7322)
Control usage (Therms)	23	23	23
F-stat in first-stage	2040		
2015 data for wave 1	x	x	x
R2	0.046	0.591	0.591
N	860,644	860,644	860,644

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Across all of our specifications, the elasticities range between -0.29 and -0.35.

Heterogeniety

	Elasticities	
	Yes	No
(1) Very low-income household 34%	-0.52	-0.24
(2) High gas user 50%	-0.41	-0.13
(3) Opower treatment group 12%	-0.35	-0.34
(4) Paperless billing 38%	-0.25	-0.31

External Validity

Two approaches:

(1) Selection into who enrolls onto CARE?

(2) Selection into the experiment?

1. External Validity

Untreated outcome test (Einav et al., 2010; Brinch et al., 2012; Bertanha and Imbens, 2014; Kowlaski, 2016; Mogstad et al., 2017)

Difference in average untreated outcomes between compliers and never takers is equal to zero $\rightarrow$ homogenous selection

Subtleties in always takers, compliers, and never takers.

2. External Validity

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	Exp Sample	Rest of CARE	Non-CARE
Overall monthly gas use pre-exp	27.8	26.4	41
Summer months gas use pre-exp	19.2	18.2	25
Winter months gas use pre-exp	36.7	34.6	56
Very low income	0.25	0.49	0.10
Paperless	0.29	0.25	0.35
Opower	0.09	0.09	0.09
LA area	0.17	0.17	0.24
Total number of households	70,784	1,198,191*	3,843,707

Notes: The gas use variables (first three rows) are average therms per month. The very low income, paperless, Opower, and LA variables are in fractions. *The sample size is those who were on CARE for twelve months before the experiment started and so is lower than the 1.5 million customers who are on CARE on any given month.

Re-weighting the LATE

We use the following variables:
- above/below median gas use for 12 months prior to experiment
- very low income dummy
- paperless customer dummy
- Opower dummy
- LA region dummy

Elasticities increase to between -0.31 to -0.39

WELFARE

Welfare analysis for SoCalGas

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Back out P_0 and use estimated elasticities to get Q_{0n} and Q_{0c}
Then estimate:

1. welfare when CARE is introduced
2. welfare from introducing cap-and-trade, vouchers, or 1st best pricing
3. implicit welfare trade-off

Welfare analysis from introducting CARE subsidy

1. ϵ_c and ϵ_n are -0.35 and -0.175

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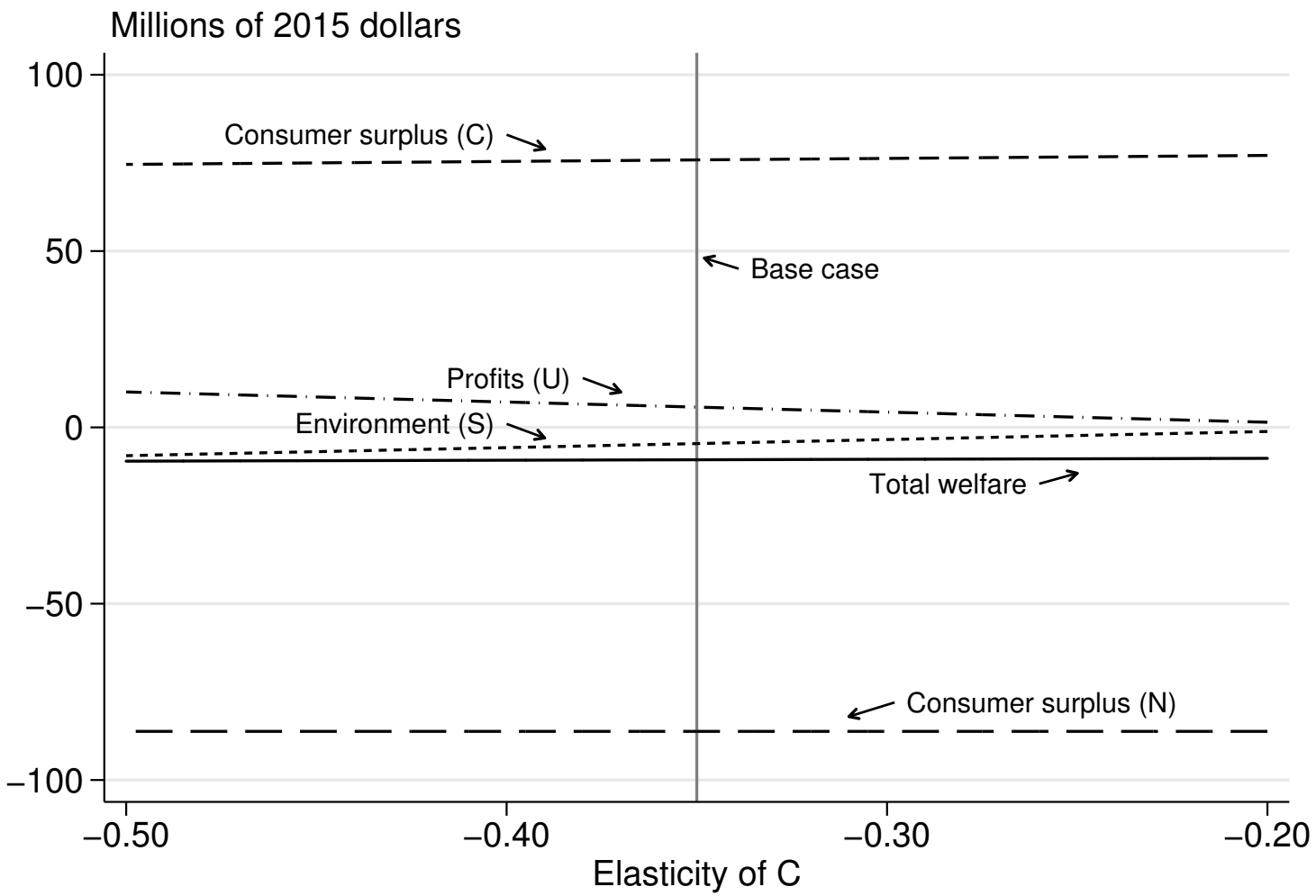
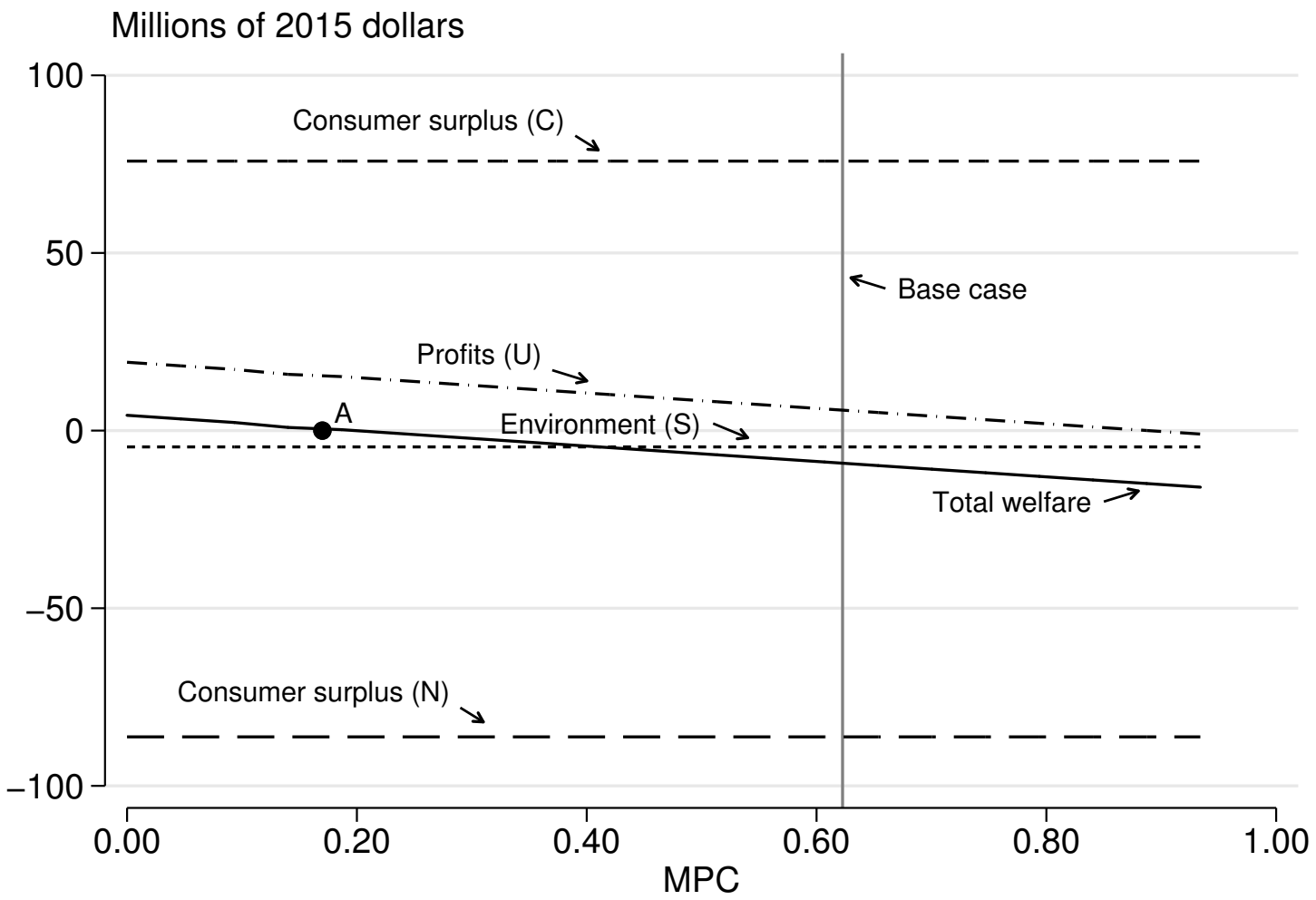
We vary all of these to understand their effects on welfare.

Varying ϵ_C



Varying MPC


Millions of 2015 dollars
100
50
0
−50
−100
Consumer surplus (C)
Base case
Profits (U)
A
Environment (S)
Total welfare
Consumer surplus (N)
0.00
0.20
0.40
0.60
0.80
1.00
MPC

Impact of introducing AB32 in CA

Current CARE and non-CARE prices already include SCC of about $19/$57, so raising these prices by including allowance price of @$13/ton doesn't necessarily improve welfare (depends on the SCC).

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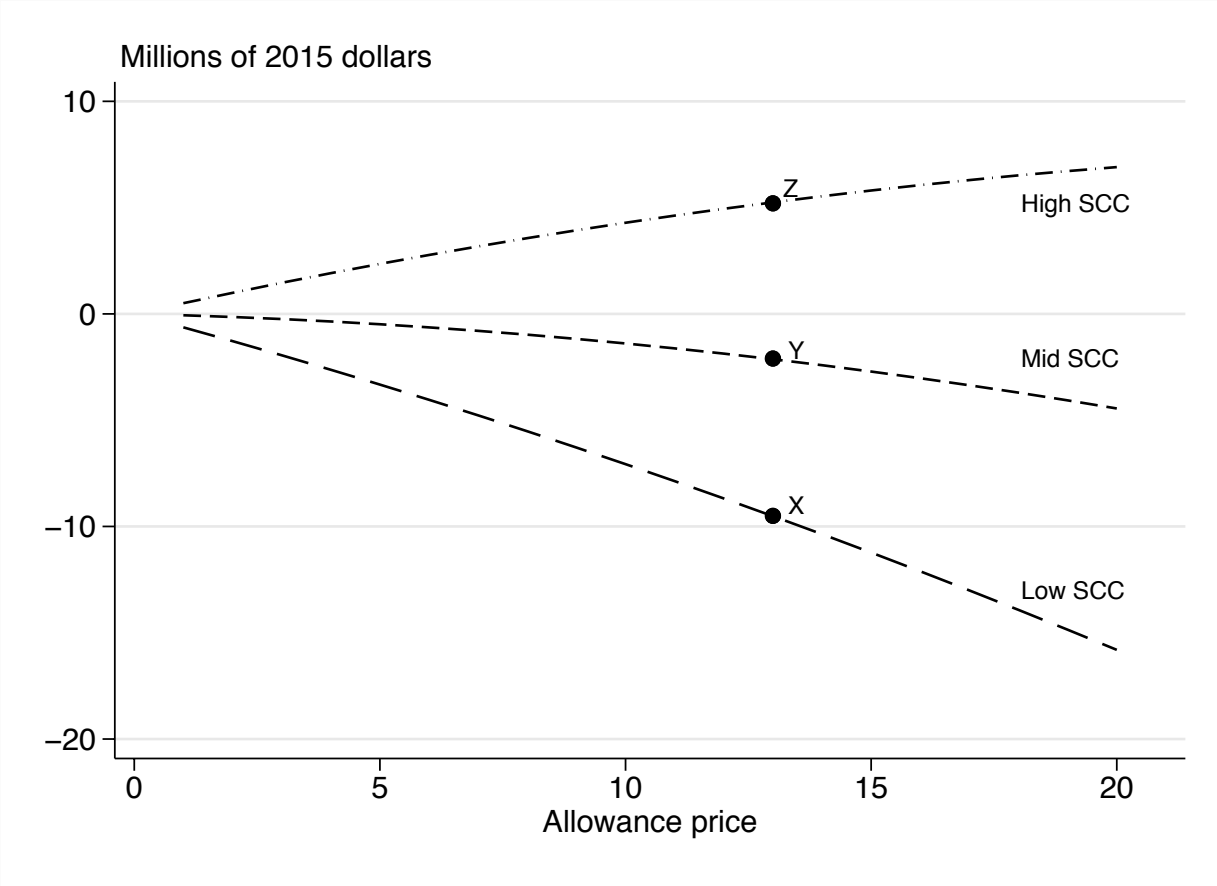

Vouchers

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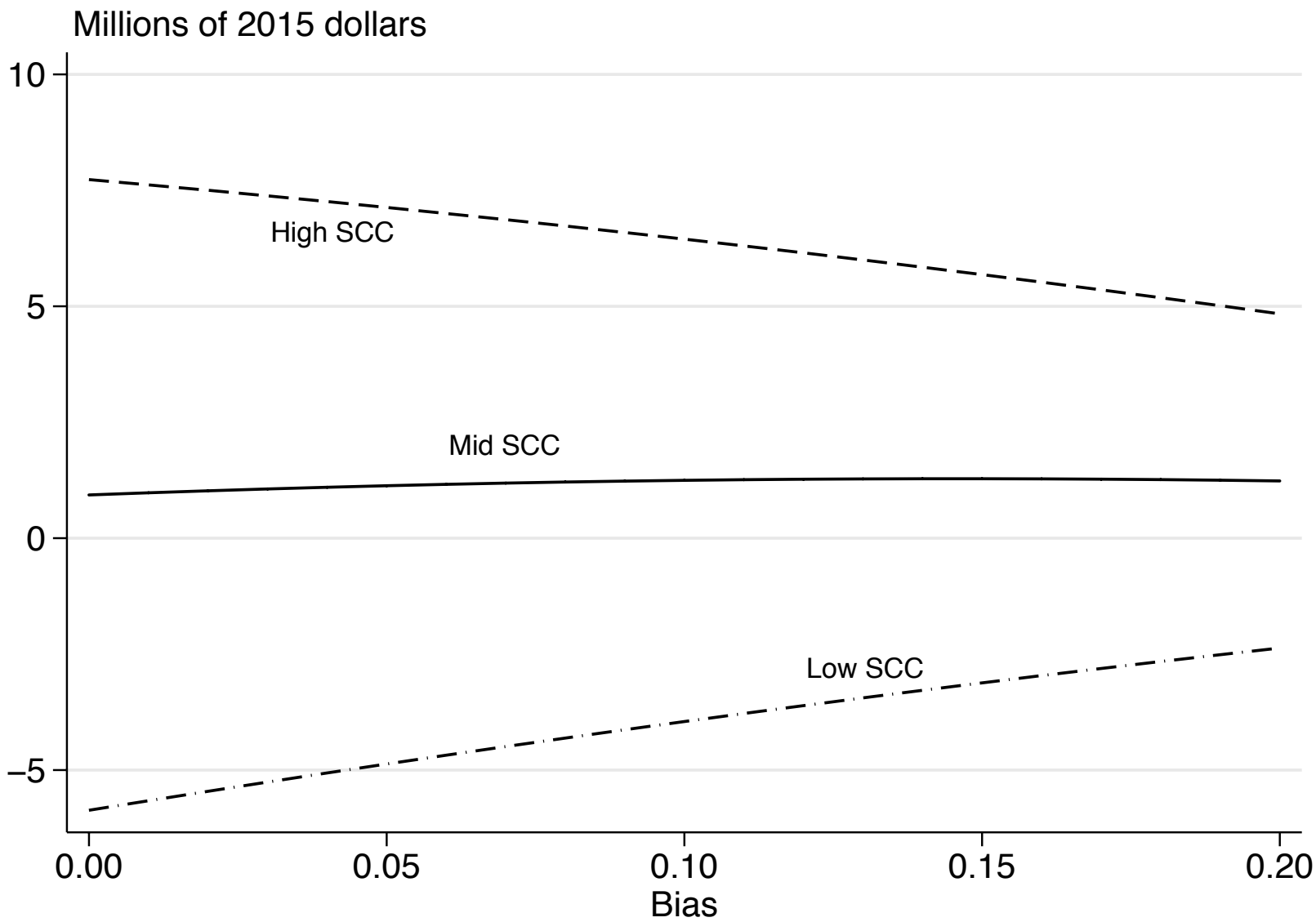
Millions of 2015 dollars
10
5
0
−5
High SCC
Mid SCC
Low SCC
0.00
0.05
0.10
0.15
0.20
Bias

Generalizing for CA

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- Private costs savings from reducing natural gas purchases (MPC) and the administrative costs of the CARE program = $37.8 million.

- Removing the subsidy would have an average abatement cost of -$190 per ton

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CARE would be worse for efficiency if it were a lump sum transfer from NC for the price subsidy.

CONCLUSION

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2. CA policymakers are placing an implicit 6-17% premium on CARE customers for net social benefits to be zero

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5. A lot depends on what you believe the SCC to be.

Thank you!

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Paperless - 0.6pp less likely (letters further decrease by 1.1pp)

Balance

Table 2: Balance for Pre-experimental Gas Use in Wave 1

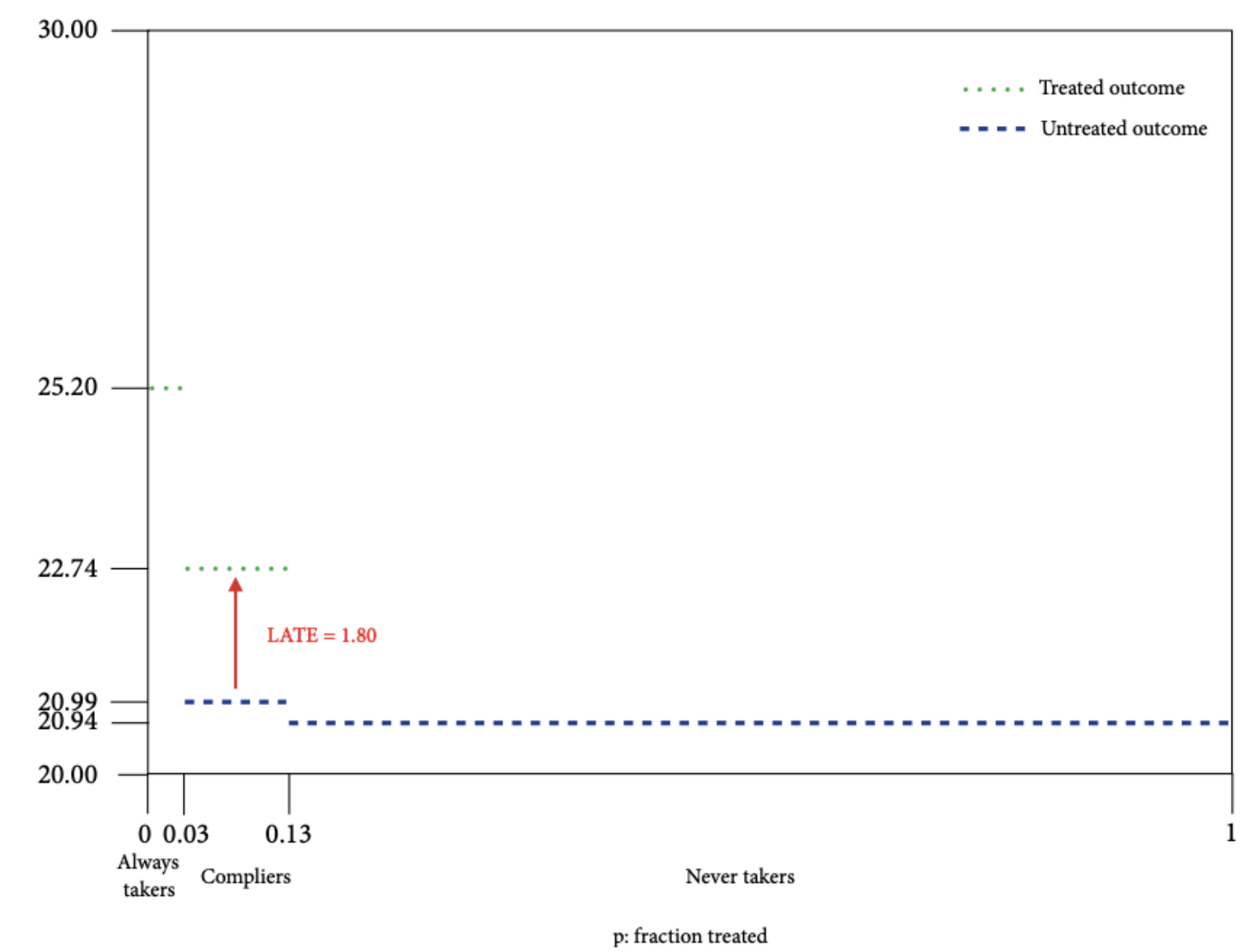
		t-tests [p-value]			
Treatment	Average Use	0	1	2	3
0	29.04	-			
1	29.03	0.97	-		
2	28.95	0.75	0.79	-	
3	28.92	0.67	0.71	0.92	-
4	29.14	0.72	0.70	0.52	0.44

Table 3: Balance for Pre-experimental Gas Use in Wave 2

		t-tests [p-value]		
Treatment	Average Use	0	1	2
0	26.30	-		
1	26.44	0.59	-	
2	26.31	0.97	0.61	-
3	26.20	0.67	0.34	0.65

Back

1. External Validity - gas use of always takers, compliers, and never takers



1. External Validity - Untreated outcome test does not reject selection homogeneity