Models of insurance demand

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1. Starc (2014)
   - Medigap
   - Model
   - Results
2. Saltzman (2019)
3. Tebaldi, Torgovitsky, and Yang (2019)
   - Setting
   - Model
   - Application
4. Einav et al. (2013)

References

- Reviews: Einav, Finkelstein, and Levin (2010), Einav and Finkelstein (2011), Gaynor, Ho, and Town (2015) sections 6 & 7
- BLP models of insurance demand: Bundorf, Levin, and Mahoney (2012), Starc (2014)
- Expected utility models of insurance demand: Cardon and Hendel (2001), Einav et al. (2013)
- Behavioral: Handel (2013), Barseghyan et al. (2013), Handel and Kolstad (2015)

Section 1

Starc (2014)

Starc (2014) 1

- Health insurance industry concentrated
- Mergers often blocked by antitrust
  - Aetna & Humana
  - Anthem & Cigna
- What are the sources and consequences of insurer market power?
- Medigap insurance
- Estimate model of demand and firm pricing
- Results
  - Low demand elasticity, strong brand preferences
  - Average cost pricing would decrease premiums by 17%

Medigap 1

- Medicare has high deductibles & copays
  - Part A (hospitalizatoin) deductible ≈$1000
  - Part B (outpatient) copays 20%, no maximum
- Medigap provides extra coverage
- Set of plans regulated (price [and branding] is only characteristic chosen by firms)
- Open-enrollment period (within 6 months of enrolling in Medicare) price only based on age, gender, state, & smoking
- Minimum Loss Ratio: at least 65% of premiums must be used to cover claims
- Taxes vary within consumer state based on insurer state
- Data:
  - NAIC: insurer premiums, quantities, claims
  - MCBS: individual demographics, whether have any Medigap (but not which insurer & plan), claims

TABLE 1 Medicare Supplement Plans

	A	B	C	D	E	F	G	H	I	J	K	L
Part A coinsurance	X	X	X	X	X	X	X	X	X	X	X	X
Part B coinsurance	X	X	X	X	X	X	X	X	X	X	0.5	0.75
Blood	X	X	X	X	X	X	X	X	X	X	0.5	0.75
Hospice											0.5	0.75
Skilled nursing			X	X	X	X	X	X	X	X	0.5	0.75
Part A deductible		X	X	X	X	X	X	X	X	X	0.5	0.75
Part B deductible			X			X				X		
Part B excess charges						X	0.8		X	X		
Foreign travel emergency			X	X	X	X	X	X	X	X		
At-home recovery							X		X	X		
Preventative care coinsurance	X	X	X	X								
Preventative care						X				X		
Market share	4%	3%	12%	4%	2%	49%	8%	1%	1%	15%	1%	1%

Source: NAIC data. Percentages do not add to one because of rounding. The "X" denotes plan coverage. The numbers in the final two columns represent the fraction of cost covered.

TABLE 2 Subsample Demographics

	Subsample
Income	$36,803.60
	($57,278.53)
Self-reported health	2.59
	(1.11)
% Medigap	23.62%
	(42.48%)
Private insurance premium paid given purchase	$1,702.13
	($1,440.84)

Source: MCBS individual-level data. Standard deviations in parentheses. Self-reported health is ranked on a 1–5 scale where 1 is excellent and 5 is poor. Sample is restricted to consumers under 72 years of age. Medigap coverage is defined as having self-purchased private insurance. Consumers who are eligible for VA benefits (TRICARE) or Medicaid are not included in the subsample.

TABLE 3 Firms and Market Structure

	National Market Share	Share of Active Markets	Average Premium
UnitedHealth	0.46	0.98	1534.82
Mutual of Omaha	0.24	0.95	1398.38
Conseco	0.09	0.90	1615.26
American Financial	0.04	0.78	1630.09
HCHSC	0.03	0.05	1815.55
Genworth Financial	0.02	0.88	1517.81
State Farm	0.02	0.59	2159.99
American Republic Mutual	0.02	0.53	1323.05
Universal American Financial	0.01	0.79	1771.63
Guarantee Trust	0.01	0.50	1756.02
Physicians Mutual	0.01	0.68	1596.92
USAA	0.01	0.90	1677.31
American National Financial	0.01	0.67	1247.75
Atlantic American	0.01	0.63	1531.27
Thrivent Financial for Lutherans	0.01	0.38	1629.46
State Mutual Company	0.01	0.16	703.04
Humana	0.01	0.67	1247.23
Liberty National	0.01	0.88	1736.36

Source: NAIC plan-level data. The first column is the percentage of all Medigap plans sold by the firm. The second column gives the percentage of markets in which the firm offers any policy, and the third column is the average list premium.

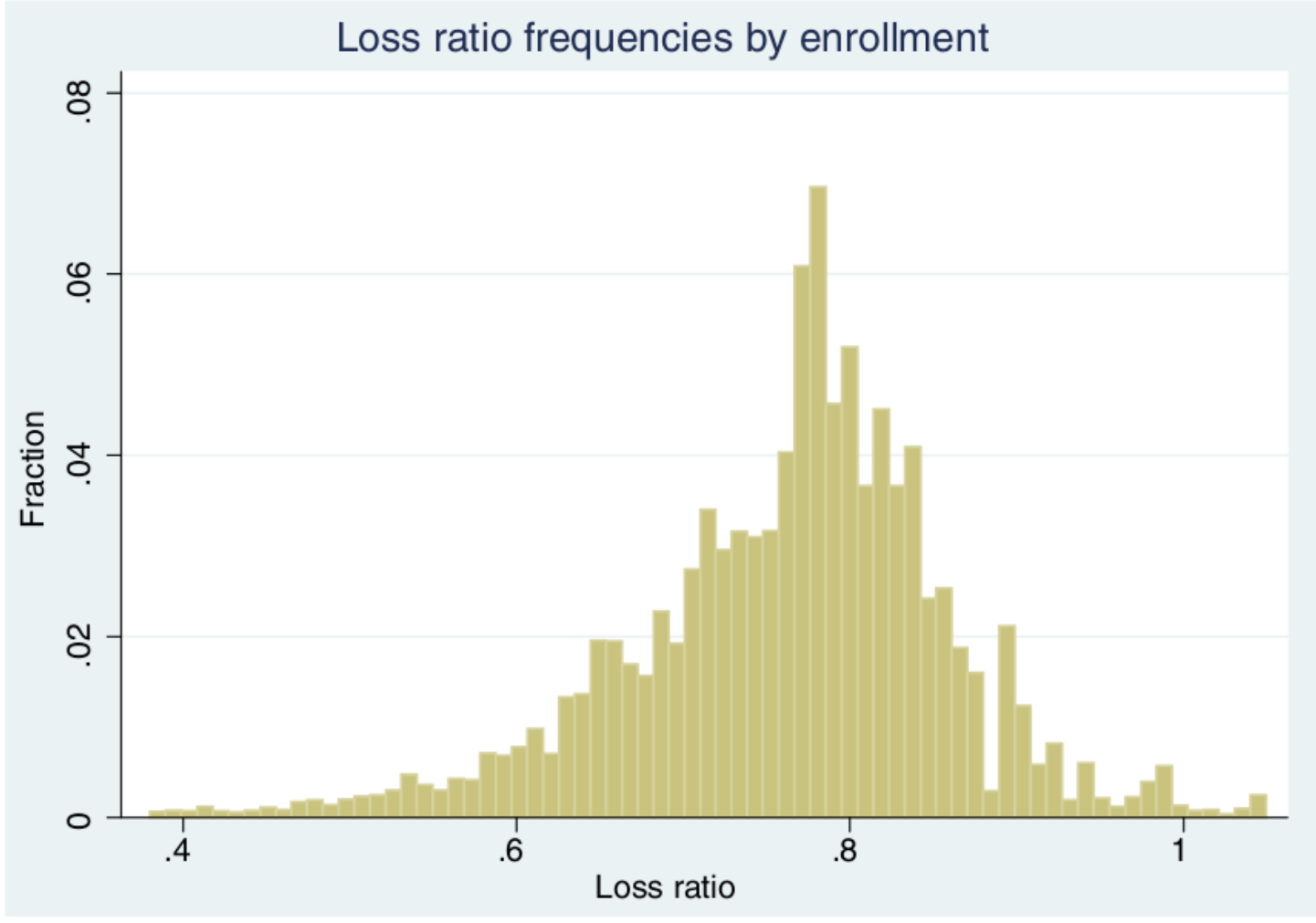
TABLE 4 Premiums and Claims by Plan

Plan	% Load	Number of Policies	Weighted Premium ($)	Weighted Claim ($)	Enrollment
A	0.2006	1403	1457.25	1223.8	356.33
	(0.8152)		(743.26)	(1161.64)	(1789.9)
B	0.2192	1079	1562.31	1218.03	350.83
	(0.9803)		(493.55)	(554.31)	1159.28
C	0.2387	1764	1729.26	1398.4	908.62
	(0.5814)		(389.37)	(460.22)	(4973.19)
D	0.3182	1822	1546.58	1150.81	325.11
	(0.5145)		(459.44)	(451.93)	(1057.07)
E	0.3055	668	1691.22	1235.19	424.98
	(0.3863)		(511.84)	(459.03)	(1343.59)
F	0.3213	3518	1518.81	1170.77	1908.30
	(0.4834)		(663.37)	(524.24)	(7807.93)
G	0.3228	1936	1500.26	1094.19	591.17
	(0.4301)		(446.44)	(380.99)	(2034.61)
H	0.2414	266	1379.37	1033.05	394.96
	(0.4582)		(1379.37)	(493.11)	(1326.39)
I	0.3778	327	1675.13	1252.45	573.50
	(0.3777)		(352.85)	(310.48)	(1363.90)
J	0.3539	716	1503.1	1130.17	2977.45
	(0.4335)		(380.23)	(341)	(9524.50)
K	0.4543	308	712.59	477.71	176.87
	(0.4739)		(196.4)	(183.35)	(429.76)
L	0.36	339	1183.35	784.1	251.01
	(0.5218)		(263.68)	(784.3)	(1502.79)

Source: NAIC market-level data. Standard deviations in parentheses. Self-reported health is ranked on a 1–5 scale where 1 is excellent and 5 is poor. Column 2 describes the unweighted average load, and column 3 describes the number of policies. Columns 4 and 5 represent total enrollment-weighted averages of premiums and claims, respectively, with the weights reported in the final column.

FIGURE 1

LOSS RATIOS



Model 1

- Firm pricing:

$$\max_{p_{jfm}} \sum_j \left[\left(p_{jfm} - \underbrace{\gamma_{jfm}(\mathbf{p}_m)}_{\text{claims}} - \underbrace{a_{jfm}(\mathbf{p_m})}_{\text{commissions}} \right) s_{jfm}(\mathbf{p}_m) M_m \right]$$

$$s.t. \gamma_{jgm}(\mathbf{p}_m) \geq 0.65 p_{jfm}$$

- Demand
  - Consumer valuations:

$$v_{ijm} = x_j \beta_1 + b_f \beta_2 + x_m \beta_3 + \xi_{jfm} + \alpha p_{jfm} + \mu_{ijfm} + \epsilon_{ijfm}$$

  - μ_{ijfm} = interactions between x_j and (z_i, ω_i)
  - Claims:

$$\gamma_{ijfm} = \theta_0 + x_j \theta_1 + \underbrace{\omega_i \theta_2}_{\text{income}} + \underbrace{z_i \theta_3}_{\text{SRH}} + \varepsilon_{jm} + \eta_i$$

Estimation 1

- Demand estimation moments:
  - BLP market level data: $E[\xi_{jfm}|\text{instruments}] = 0$
    - Retaliatory taxes
    - Average $p_{jf(-m)t}$
  - Expected claims given plan:

$$E[\gamma_{ifm}|J = j] = \theta_0 + x_j\theta_1 + E[\omega_i|J = j]\theta_2 E[z_i|J = j]\theta_3 + \varepsilon_{jm}$$

  - Individual P(any Medigap), premium
- Pricing FOC used to estimate marginal costs (commissions)
  - Equality if MLR slack, inequality if binding or violated

TABLE 5 Demand Parameters

	(1)	(2)	(3)	(4)
Premium (in hundreds of $)	−0.0767	−0.1053	−0.1049	−0.0771
	(0.0070)	(0.0070)	(0.0070)	(0.0076)
B	0.1007	0.1046	0.1043	0.0995
	(0.0819)	(0.0818)	(0.0818)	(0.0848)
C	0.5484	0.5521	0.5520	0.5434
	(0.0864)	(0.0860)	(0.086)	(0.0900)
D	0.5235	0.5350	0.5347	0.5247
	(0.0826)	(0.0826)	(0.0827)	(0.0845)
E	0.4254	0.4395	0.4390	0.4315
	(0.1105)	(0.1107)	(0.1108)	(0.1129)
F	1.5931	1.6028	1.6024	1.5987
	(0.0765)	(0.0764)	(0.0764)	(0.0782)
G	0.8371	0.8478	0.8474	0.8471
	(0.0856)	(0.0856)	(0.0856)	(0.0873)
H	−0.4497	−0.4403	−0.4406	−0.4455
	(0.1229)	(0.1232)	(0.1232)	(0.1309)
I	0.1165	0.1236	0.1233	0.1219
	(0.1071)	(0.1072)	(0.1072)	(0.1119)
J	1.8904	1.8999	1.8996	1.9010
	(0.0960)	(0.0961)	(0.0961)	(0.0985)
K	−1.4513	−1.4460	−1.4463	−1.4439
	(0.1094)	(0.1096)	(0.1096)	(0.1161)
L	−1.0290	−1.0224	−1.0228	−1.0206
	(0.1054)	(0.1057)	(0.1057)	(0.1114)

Notes and Sources: MCBS data, NAIC data, and author calculations described in the text in detail. Brand dummies are included in the demand moments. Standard errors, adjusted for simulation error, are in parentheses.

TABLE 6 Additional Demand and Claim Parameters

	(1)	(2)	(3)	(4)
Panel A. Parameters of claim equation				
income	0.0075	0.0012	0.0013	0.0082
	(0.0005)	(0.0008)	(0.0284)	(0.0011)
SRH	−0.0795	0.6696	0.6581	0.1643
	(0.0338)	(0.0324)	(1.2776)	(0.0122)
B	0.3728	0.3234	0.3249	0.3170
	(0.0410)	(0.0410)	(0.0410)	(0.0480)
C	0.5091	0.4750	0.4765	0.4857
	(0.0365)	(0.0354)	(0.0365)	(0.0357)
D	0.2708	0.2426	0.2436	0.2793
	(0.0366)	(0.0357)	(0.0366)	(0.0361)
E	0.2667	0.2574	0.2581	0.2670
	(0.0464)	(0.0457)	(0.0464)	(0.0451)
F	0.2031	0.1980	0.1985	0.2367
	(0.0348)	(0.0338)	(0.0348)	(0.0340)
G	0.2372	0.2226	0.2233	0.2422
	(0.036)	(0.0351)	(0.036)	(0.0353)
H	0.2486	0.2559	0.2561	0.2045
	(0.064)	(0.0632)	(0.064)	(0.0612)
I	0.1512	0.1550	0.1554	0.0955
	(0.0646)	(0.0640)	(0.0646)	(0.0637)
J	−0.0760	−0.0443	−0.0446	−0.0521
	(0.0548)	(0.0535)	(0.0548)	(0.0523)
K	−0.9429	−0.8876	−0.8891	−0.9487
	(0.0723)	(0.0715)	(0.0723)	(0.0673)
L	−0.3868	−0.35419	−0.35493	−0.39877
	(0.0695)	(0.0638)	(0.0603)	(0.0625)
Panel B. Consumer demand heterogeneity				
income*premium	0.0002	0.0002	0.0002	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.1669)
Self-reported health*premium		0.0106	0.0104	
		(0.0004)	(0.0055)	
Self-reported health*1(Medigap)			0.0023	
			(0.1398)	
Self-reported health*1(United or Mutual of Omaha)				2.2397
				(0.1669)
Panel C. Impact of estimates				
mean elasticity	−1.1301	−1.1227	−1.1230	−1.1338
Mean derivative of claims w/r/t price	0.0091	0.0716	0.0697	0.0940
Value of AARP brand effect (in hundreds of $)	1.1863	1.1122	1.1131	2.0279

Source: NAIC market-level data, MCBS individual-level data, and author calculations described in the text in detail. Brand dummies are included in the demand side moments. Standard errors in parentheses. Self-reported health is ranked on a 1–5 scale where 1 is excellent and 5 is poor.

TABLE 7 Marginal Costs

	Estimate	S.E.
Market Average, Unconstrained Model	0.1942	0.0049
Market Average	0.1587	0.0011
UnitedHealth	0.0747	0.0000
Mutual of Omaha	0.1809	0.0252
Conseco	0.0814	0.0029
American Financial	0.1061	0.0010
HCHSC	0.0700	0.0002
Genworth Financial	0.1495	0.0003
State Farm	0.1630	0.0019
American Republic Mutual	0.1486	0.0001
Universal American Financial	0.1437	0.0004
Guarantee Trust	0.1506	0.0002
Physicians Mutual	0.1558	0.0002
USAA	0.1643	0.0002
American National Financial	0.1602	0.0001
Atlantic American	0.1624	0.0001
Thrivent Financial for Lutherans	0.1511	0.0002
State Mutual Company	0.2405	0.0000
Humana	0.1653	0.0001
Liberty National	0.1533	0.0006

Source: NAIC market-level data, MCBS individual-level data, and author calculations described in the text in detail. Standard errors are obtained using a bootstrap procedure that accounts for error in the demand estimates.

Consequences of market power

TABLE 8 Average Cost and Claim Pricing

	Average Claim	Average Cost
Median premium (in hundreds of $)	8.8604	10.355
Median % change in premium	−0.24241	−0.17447
Median % change in enrollment	0.31231	0.21809
Median compensating variation	4.7237	3.5532
Median CV net of profit loss	2.0227	1.8458

Notes: The median premium paid is calculated as the median average premium paid across all state-year markets. The median percentage change in premium paid is calculated similarly. When noted, the change in total surplus includes both compensating variation and insurer profits. Compensating variation is calculated as the average across consumers within a market using the standard log-sum formula; the number reported is the median acrossmarkets.

Consequences of market power

TABLE 9 Policy Counterfactuals

	65% MLR	80% MLR	Mutual of Omaha Branding	United Branding
Median premium (in hundreds of $)	12.1970	11.4540	10.3520	10.2600
Median % change in premium	−0.0573	−0.1148	−0.1999	−0.2070
Median % change in consumer surplus	0.0320	0.0668	−0.1823	0.0884

Notes: The median premium paid is calculated as the median average premium paid across all state-year markets. The median percentage change in premium paid is calculated similarly.

Source of market power

TABLE A7 Fixed and Sunk Cost Estimates

	Lower Bound	Upper Bound
Sunk cost,	\$99, 261, 645.01	\$487, 935, 210.41
UnitedHealth	(\$1, 530, 902, 861, 706.31)	(\$23, 031, 614, 127.02)
Fixed cost,	\$445, 010.32	\$796, 342.56
Mutual of Omaha	(\$225, 593.04)	(\$3, 578, 033.82)

TABLE A8 Marketing Expenditure and Advertising Value

	United Health	Mutual of Omaha
L.B. of sunk (fixed) cost/consumer	\$23.65	\$8.37
U.B. of sunk (fixed) cost/consumer	\$73.09	\$14.81
Average marginal cost/consumer	\$98.27	\$238.67
L.B. of total marketing cost/consumer	\$121.92	\$247.05
U.B. of total marketing cost/consumer	\$171.36	\$253.48

Notes: Compensating variation is calculated as the average across consumers within a market using the standard log-sum formula; the number reported is the median across markets.

Section 2

Saltzman (2019)

Saltzman (2019) "Demand for health insurance: Evidence from the California and Washington ACA exchanges"

- Estimate insurance demand
- Simulate impact of subsidies, mandate penalty, and mandate existence

ACA Exchanges

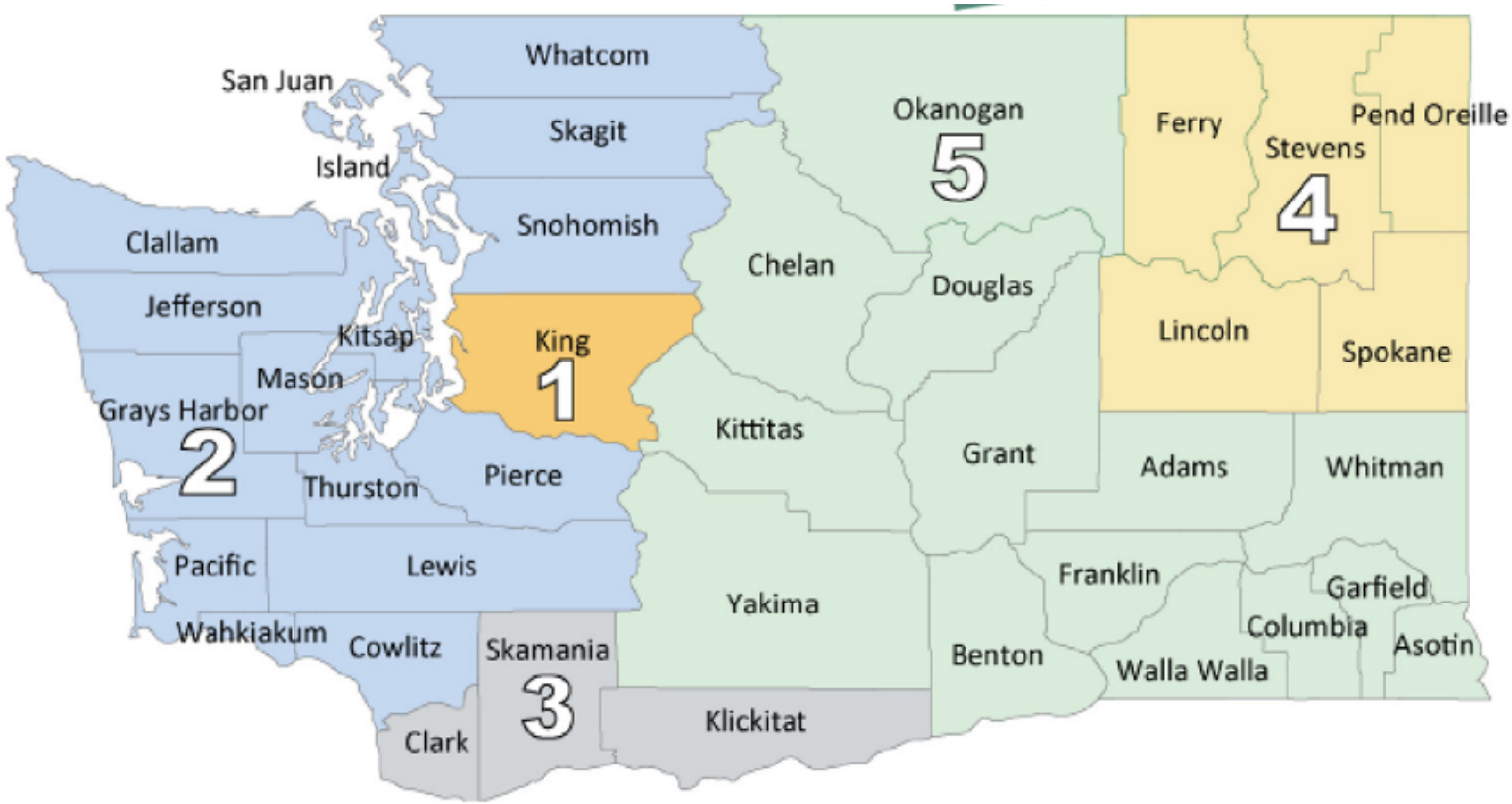
- Regulated state insurance exchanges
- Plan tiers based on expected percentage of health care costs covered
  - Bronze 60%, Silver 70%, Gold 80%, Platinum 90%
  - In California, plans standardized, elsewhere insurers can choose deductible, copay, etc
- Restrictions on price discrimination
  - Age: 64 year-old at most $3\times$ 21 year old
  - Smoking: 50% more than non (prohibited in California)
  - Same price within geographic areas defined by states
- Mandatory to have some health insurance
  - Penalty: increased from $\max\{\$95, 1\%\text{income}\}$ to $\max\{\$625, 2.5\%\text{income}\}$ from 2014-2018, then \$0 after
  - Some exemptions
- Premium subsidies if income less than 400% of federal poverty level (price after subsidy is a max percentage of income ranging from 2%-9.5%)

Table 11
California exchange standard plan benefit designs (2014).

	Bronze	Silver	Gold	Platinum	Silver 73	Silver 87	Silver 94
Actuarial value	60%	70%	80%	90%	73%	87%	94%
Deductible	$5,000	$2,000	$0	$0	$1,500	$500	$0
Coinsurance	30%	20%	20%	10%	20%	15%	10%
PCP copay	$60	$45	$30	$20	$40	$15	$3
Specialist copay	$70	$65	$50	$40	$50	$20	$5
Out-of-pocket limit	$6,350	$6,350	$6,350	$4,000	$5,200	$2,250	$2,250

Notes: Table summarizes the standard plan benefit designs in the California exchange for the 2014 plan year. The silver 73, silver 87, and silver 94 plans are the enhanced versions of the basic silver plan and reduce cost sharing for consumers who qualify for cost sharing subsidies.


Del Norte
Siskiyou
Modoc
Humboldt
Trinity
Shasta
Lassen
Tehama
Plumas
Mendocino
Glenn
Butte
Sierra
Nevada
Lake
Colusa
Yuba
Sutter
Placer
Yolo
El Dorado
Sonoma
Napa
Sacramento
Alpine
Amador
Solano
Calaveras
Tuolumne
Mono
Marin
Contra Costa
San Joaquin
San Francisco
Alameda
Stanislaus
Mariposa
San Mateo
Santa Clara
Merced
Madera
Inyo
Santa Cruz
San Benito
Fresno
Monterey
Kings
Tulare
San Luis Obispo
Kern
San Bernardino
Santa Barbara
Ventura
Los Angeles
Riverside
Orange
San Diego
Imperial


Whatcom
San Juan
Skagit
Island
Snohomish
Clallam
Jefferson
Kitsap
King
1
Mason
Grays Harbor
2
Thurston
Pierce
Pacific
Lewis
Wahkiakum
Cowlitz
Skamania
3
Clark
Okanogan
5
Chelan
Douglas
Kittitas
Grant
Yakima
Klickitat
Ferry
Stevens
Pend Oreille
4
Lincoln
Spokane
Adams
Whitman
Franklin
Garfield
Columbia
Asotin
Benton
Walla Walla

Model

$$U_{ij} = \overbrace{\alpha_i \underbrace{p_{ij}}_{\text{premium}} + \underbrace{x_j}_{\text{plan characteristics}} \beta + \underbrace{d_i}_{\text{household characteristics}} \varphi + \xi_j}^{v_{ij}} + \epsilon_{ij}$$

$$\underbrace{U_{i0}}_{\text{uninsured}} = \alpha_i' \underbrace{\rho_i}_{\text{penalty}} + \epsilon_{i0}$$

- d_i includes d_{mi} = whether i subject to mandate, with coefficient φ_m
- Nested logit for ϵ_i with all plans in one nest, and uninsured in other (ϵ_{ij} are correlated with one another for $j \geq 1$ with correlation $\sqrt{1-\lambda}$)

$$\mathbb{P}(i \text{ chooses } j) = \frac{e^{v_{ij}/\lambda}\left(\sum_j e^{v_{ij}/\lambda}\right)^{\lambda-1}}{1 + \left(\sum_j e^{v_{ij}/\lambda}\right)^{\lambda-1}}$$

[1] This is the equation in the paper, but I think it's incorrect. It would

Data

Table 2
Choice and demographic distribution by state.

	California		Washington	
	Exchange	Uninsured	Exchange	Uninsured
Metals				
Catastrophic	0.7%		0.4%	
Bronze	24.0%		36.6%	
Silver	64.9%		55.1%	
Gold	5.5%		7.7%	
Platinum	4.8%		0.2%	
Network type				
HMO	45.7%		38.5%	
PPO	45.1%		61.4%	
EPO	9.2%		0.0%	
Access to free plan	45.4%	19.3%	33.0%	13.6%
Income				
0% to 138% of FPL	2.9%	2.8%	5.0%	4.3%
138% to 150% of FPL	15.0%	5.4%	8.5%	4.6%
150% to 200% of FPL	33.8%	20.5%	30.3%	18.0%
200% to 250% of FPL	17.4%	16.2%	18.7%	17.3%
250% to 400% of FPL	22.7%	29.6%	25.0%	30.9%
400%+ of FPL	8.2%	25.4%	12.5%	25.0%
Subsidy eligibility				
Premium tax credits	90.7%	74.6%	85.5%	75.0%
Cost sharing reduction subsidies	68.5%	44.9%	61.4%	44.2%
Penalty status				
Exempt	3.8%	6.3%	5.3%	9.5%
Subject	96.2%	93.7%	94.7%	90.5%
Age				
0–17	4.8%	3.2%	0.3%	2.9%
18–25	10.4%	20.9%	8.5%	19.1%
26–34	15.7%	25.5%	17.5%	25.2%
35–44	15.6%	17.0%	17.4%	19.9%
45–54	24.4%	17.8%	22.6%	16.6%
55–64	29.0%	15.4%	33.8%	16.3%
Gender				
Female	52.3%	43.1%	54.1%	40.8%
Male	47.7%	56.9%	45.9%	59.2%
Race				
Asian			14.9%	8.8%
Black/African American			2.9%	3.6%
Other Race			5.4%	12.1%
White			76.8%	75.5%
Smoking status				
Non-smoker			91.1%	70.2%
Smoker			8.9%	29.8%
Year				
2014	48.9%	58.9%	48.0%	56.5%
2015	51.1%	41.1%	52.0%	43.5%

Data

Table 3
Insurers, plans, and premiums by state and year.

	California		Washington	
	2014	2015	2014	2015
Insurers available				
Minimum	1.0	2.0	2.0	3.0
Median	5.0	5.0	6.0	7.0
Average	4.8	4.7	5.5	6.8
Maximum	6.0	6.0	7.0	8.0
Plans available				
Minimum	5.0	10.0	16.0	21.0
Median	25.0	25.0	28.0	47.0
Average	24.6	24.5	26.2	45.8
Maximum	35.0	35.0	31.0	61.0
Silver plan premiums				
County average	$309.70	$320.25	$306.00	$303.46
Minimum	$221.56	$230.31	$234.72	$218.55
Maximum	$480.59	$554.26	$369.11	$363.24
Minimum second-lowest	$253.27	$257.19	$260.01	$252.67
Maximum second-lowest	$422.58	$423.67	$312.61	$297.00

Notes: The first two panels provide summary statistics on the number of insurers and plans available to consumers. The third panel shows variation in silver plan premiums for a 40-year old nonsmoker.

Results

Table 4
Estimated mean own-premium elasticities and semi-elasticities.

	California		Washington	
	Elasticity	Semi-elasticity	Elasticity	Semi-elasticity
Overall	−9.1	−21.8	−7.2	−19.9
Income (% of FPL)				
0–138	−8.8	−21.3	−10.7	−28.6
138–250	−9.7	−23.1	−7.3	−20.3
250–400	−8.2	−20.0	−6.6	−18.5
400+	−7.8	−19.1	−5.3	−15.3
Gender				
Female	−8.8	−21.0	−6.8	−18.9
Male	−9.5	−22.6	−7.6	−20.9
Age				
18–34	−13.1	−27.9	−10.0	−24.9
35–54	−9.3	−19.9	−7.5	−18.7
55+	−5.6	−12.0	−4.9	−12.4
Smoking status				
Smoker			−10.3	−27.6
Non-smoker			−6.6	−18.3
Race				
Asian			−8.2	−22.1
Black			−11.5	−30.3
White			−6.8	−18.7

Notes: Table shows mean own-premium elasticities and semi-elasticities by demographic group. A plan's own-premium elasticity indicates the percentage change in enrollment for a 1% increase in its premium and is computed using Eq. (9). A plan's

Results

Table 5
Estimated mean elasticities and semi-elasticities for exchange coverage.

	California		Washington	
	Elasticity	Semi-elasticity	Elasticity	Semi-elasticity
Overall	−1.2	−3.3	−1.1	−3.7
Income (% of FPL)				
0–138	−1.2	−3.3	−1.6	−5.4
138–250	−1.3	−3.5	−1.2	−4.0
250–400	−1.1	−3.1	−1.1	−3.7
400+	−1.0	−2.9	−0.9	−3.1
Gender				
Female	−1.1	−3.2	−1.0	−3.5
Male	−1.2	−3.4	−1.1	−3.9
Age				
18–34	−1.6	−4.1	−1.4	−4.4
35–54	−1.1	−2.9	−1.0	−3.3
55+	−0.7	−1.7	−0.7	−2.2
Smoking status				
Smoker			−1.5	−4.6
Non-smoker			−1.0	−3.1
Race				
Asian			−1.2	−3.9
Black			−1.7	−5.2
White			−1.1	−3.3

Notes: Table shows mean elasticities and semi-elasticities for exchange coverage by demographic group. The mean elasticity for exchange coverage indicates the percentage change in exchange enrollment if all exchange premiums increase by 1% and is computed using Eq. (11). The mean semi-elasticity for exchange coverage

Results

Table 6
Estimated parameters of non-premium plan characteristics.

	California	Washington
Actuarial value (AV)	4.125***	3.591***
	(0.240)	(0.159)
HMO	−0.275***	1.009***
	(0.016)	(0.085)
Deductible ratio		−0.096***
		(0.008)
Max. OOP ratio		0.010
		(0.009)

Notes: ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level. Table shows parameter estimates for the non-premium plan characteristics, including the actuarial value, whether the plan is an HMO, the ratio of the plan's deductible to the maximum deductible in the plan's metal tier, and the ratio of the plan's out-of-pocket limit to the maximum out-of-pocket limit in the plan's metal tier. Parameters for the latter two variables cannot be estimated for California because of plan standardization. Robust standard errors that correct for potential misspecification are shown in parentheses (see p. 503 of Wooldridge (2010)).

Results

Table 10
Impact of repealing the individual mandate.

	Percent change in exchange enrollment		Percent change in consumer surplus	
	ACA subsidies	Vouchers	ACA subsidies	Vouchers
California				
5% premium increase	−18.6%	−20.5%	1.6%	−2.8%
10% premium increase	−18.9%	−22.8%	1.5%	−7.4%
25% premium increase	−19.7%	−29.3%	1.2%	−20.1%
Washington				
5% premium increase	−13.4%	−17.2%	6.8%	−3.5%
10% premium increase	−14.3%	−21.9%	6.0%	−14.0%
25% premium increase	−16.1%	−35.7%	5.0%	−40.3%

Notes: Table shows the impact on enrollment and average annual consumer surplus of repealing the individual mandate under a voucher subsidy and under ACA subsidies. Three alternative supply response scenarios are considered: a 5% premium increase, a 10% premium increase, and a 25% premium increase.

Section 3

Tebaldi, Torgovitsky, and Yang (2019)

Tebaldi, Torgovitsky, and Yang (2019) "Nonparametric estimates of demand in the California health insurance exchanges"

- How much do logit / mixed logit assumptions influence demand estimates?
- Setting: California ACA exchange
- Nonparametric partially identified demand estimates

Covered California

- 19 rating regions (premiums vary across regions and are constant within)
- 4 tiers of insurance coverage
- Region, tier, & age specific premium $=$ insurer chosen region, tier premium $\times$ federal age adjustment
- Premium subsidies and cost-sharing reductions for low income individuals
- Mandated participation with tax penalty (penalty repealed in 2017)

Covered California

Panel (a): Characteristics by metal tier before cost-sharing reductions

Tier	Annual deductible	Annual max out-of-pocket	Primary visit	E.R. visit	Specialist visit	Preferred drugs	Advertised AV$^{(*)}$
Bronze	\$5,000	\$6,250	\$60	\$300	\$70	\$50	60%
Silver	\$2,250	\$6,250	\$45	\$250	\$65	\$50	70%
Gold	\$0	\$6,250	\$30	\$250	\$50	\$50	79%
Platinum	\$0	\$4,000	\$20	\$150	\$40	\$15	90%

Panel (b): Silver plan characteristics after cost-sharing reductions

Income (%FPL)	Annual deductible	Annual max out-of-pocket	Primary visit	E.R. visit	Specialist visit	Preferred drugs	Advertised AV$^{(*)}$
200-250% FPL	\$1,850	\$5,200	\$40	\$250	\$50	\$35	74%
150-200% FPL	\$550	\$2,250	\$15	\$75	\$20	\$15	88%
100-150% FPL	\$0	\$2,250	\$3	\$25	\$5	\$5	95%

Source: http://www.coveredca.com/PDFs/2015-Health-Benefits-Table.pdf .
(*): Actuarial value (AV) is advertised to consumers as a percentage of medical expenses covered by the plan.

Model

- Individual i, plans $j \in \{0, 1, \ldots, J\}$
- Valuations V_{ij} with premiums P_{ij}, with utility additively separable in premium

$$\max_j V_{ij} - P_{ij}$$

Price Variation

- Premiums depend on market, M_i, and individual characteristics, X_i (age & income)

$$P_i = \pi(M_i, X_i)$$

- Price variation within market will be used in estimation
- Price variation within market not present in typical demand estimation
- Appendix discusses modifications to use when there is not within market price variation

Target Parameters

- Density of valuation given observables $f(v|m,x)$
- Functionals of this density, $\theta : \mathcal{F} \to \mathbb{R}^{d_\theta}$, e.g.
  - Fraction that choose plan j if premiums were p^*

$$P(j|p^*,m,x) = \int \mathbf{1}\{v_j - p_j^* \geq v_k - p_k^* \; \forall k\} f(v|m,x) dv$$

  - Change in consumer surplus from changing p to p^*

$$\Delta CS(p^*|m,x) = \int \max_j (v_j - p_j^*) f(v|m,x) dv - \int \max_j (v_j - p_j) f(v|m,x) dv$$

Assumptions

- W_i, Z_i subvectors of M_i, X_i
  - In application W_i is M_i and course age and income bins, Z_i is variation in age and income within bins
- Z_i is instrument
  - Exogenous:

$$f_{V|W,Z}(v|w,z) = f_{V|W,Z}(v|w,z') \tag{1}$$

  - No relevance or rank assumption required, but size of identified will depend on instrument variation and relevance
- Support restrictions

$$\int_{\mathcal{V}^\bullet(w)} f_{V|W,Z}(v|w,z)dz = 1 \tag{2}$$

e.g. at same prices, consumers prefer higher tier plan $\mathcal{V}^\bullet(w) = \{v : v_4 \geq v_1\}$

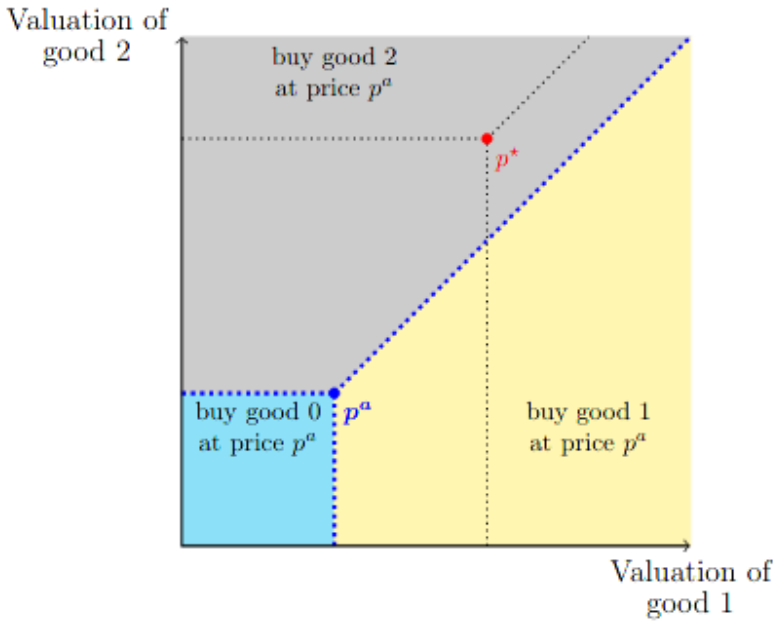
Identified Set

- Define $\mathcal{V}_j(p) = \{v : v_j - p_j \geq v_k - p_k \, \forall k\}$
- Observed shares = model shares:

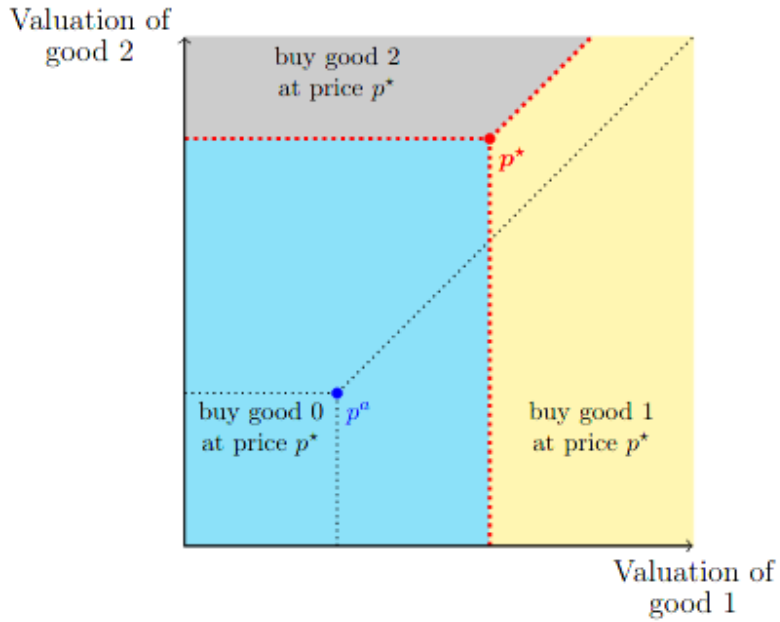
$$s_j(m,x) = \int_{\mathcal{V}_j(p)} f(v|m,x)dv \tag{3}$$

- Identified set $\mathcal{F}^* \equiv \{f \in \mathcal{F} : 1, 2, 3\}$
- Identified set for target parameter $\Theta^* \equiv \{\theta(f) : f \in \mathcal{F}^*\}$
- Goal : characterize and then estimate Θ^*

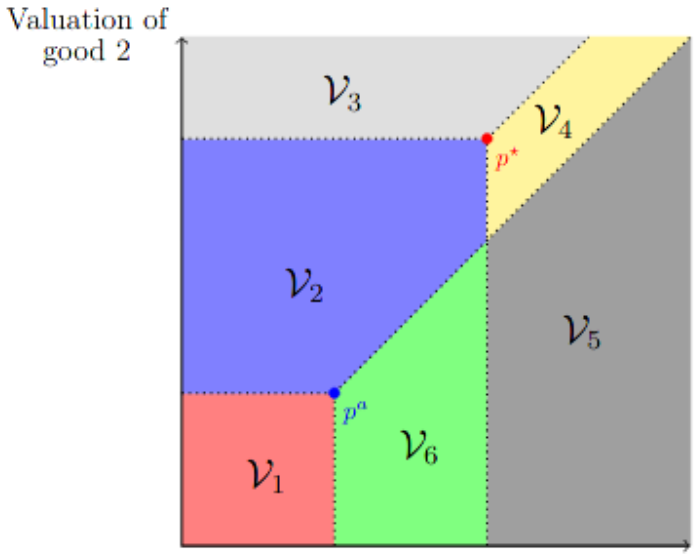
Figure 1: *Partitioning the Space of Valuations*

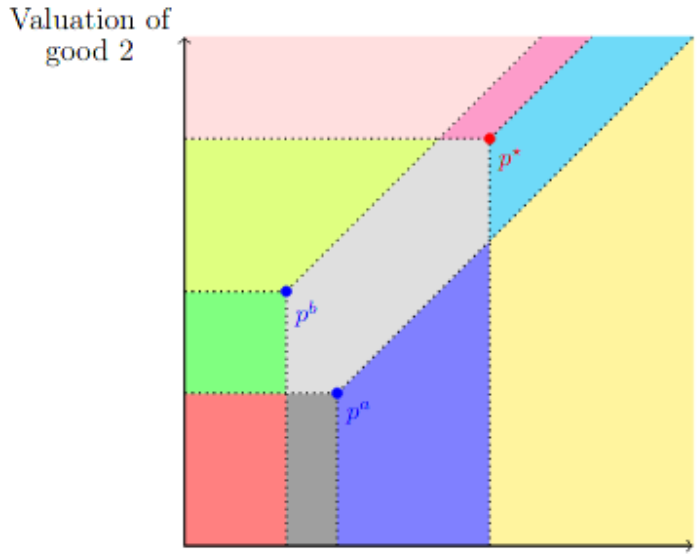


(a) *Choices if prices were p^a.*



(b) *Choices if prices were $p^\star$.*





Identified Set

- Observe p^a, counterfactual p^*, want $\theta(f)$ = share of good 2 at p^*
- Partition support of v into minimal relevant partition (c)
- We observe

$$s_0(m, p^a) = \int_{\mathcal{V}_1} f(v|m, p^a)dv$$
$$s_1(m, p^a) = \int_{\mathcal{V}_5 \cup \mathcal{V}_6} f(v|m, p^a)dv$$
$$s_2(m, p^a) = \int_{\mathcal{V}_2 \cup \mathcal{V}_3 \cup \mathcal{V}_4} f(v|m, p^a)dv$$

- Assume p exogenous, so $f(v|m, p^a) = f(v|m, p^*) = f(v|m)$ (i.e. $Z = p$)
- Let $\phi_\ell = \int_{\mathcal{V}_\ell} f(v|m)dv$, note that $s_2(m, p^*) = \phi_3$ is the parameter of interest
- Upper bound: $\max_\phi \phi_3$ s.t. observed shares

$$t^*_{ub} = \max_{\phi} \phi_3 \text{ s.t.} \qquad \begin{aligned} \phi_1 &= s_0(m, p^a) \\ \phi_2 + \phi_3 + \phi_4 &= s_2(m, p^a) \\ \phi_5 + \phi_6 &= s_1(m, p^a) \\ \phi_\ell &\geq \quad \forall \ell \end{aligned}$$

- $t^*_{lb} = \min \phi_3$ gives lower bound, paper shows $[t^*_{lb}, t^*_{ub}]$ is the identified set

Estimation 1

- Notation:
  - $\mathbb{V}$ is minimal relevant partition
  - $\mathbb{V}_j(p)$ is subset of $\mathbb{V}$ that rationalizes choice j given prices p
  - $\phi(\mathcal{V}|m,x) = \int_{\mathcal{V}} f(v|m,x)dv$
  - $\phi(\mathcal{V}|w,z) = \int_{\mathcal{V}} f(v|w,z)dv$

Estimation 1

- Just replace unknown population shares with observed market shares:

$$\min_{\phi \geq 0} \bar{\theta}(\phi) \text{s.t.} \qquad \hat{s}_j(m,x) = \sum_{\mathcal{V} \in \mathbb{V}_j(p(m,x))} \phi(\mathcal{V}|m,x) \; \forall j$$

$$\phi_{\mathbb{V}|wz}(\mathcal{V}|w,z) = \phi_{\mathbb{V}|wz}(\mathcal{V}|w,z') \; \forall z, z', w, \mathcal{V}$$

$$\sum_{\mathcal{V} \in \mathbb{V}^\bullet(w)} \phi_{\mathbb{V}|wz}(\mathcal{V}|w,z) = 1 \; \forall w, z$$

  but might have no solution[2]

- Define:

$$\hat{Q}(\phi) = \sum_{j,m,x} \hat{\mathbb{P}}(m,x) \left| \hat{s}_j(m,x) - \sum_{\mathcal{V} \in \mathbb{V}_j(p(m,x))} \phi(\mathcal{V}|m,x) \right|$$

  and $\hat{Q}^* = \min_\phi \hat{Q}(\phi)$

Estimation 2

- Relax problem to

$$\hat{t}^*_{lb} = \min_{\phi \geq 0} \bar{\theta}(\phi) \text{s.t.} \qquad \hat{Q}(\phi) \leq \hat{Q}^* + \eta$$

$$\phi_{\mathbb{V}|WZ}(\mathcal{V}|w,z) = \phi_{\mathbb{V}|WZ}(\mathcal{V}|w,z') \; \forall z, z', w, \mathcal{V}$$

$$\sum_{\mathcal{V} \in \mathbb{V}^\bullet(w)} \phi_{\mathbb{V}|WZ}(\mathcal{V}|w,z) = 1 \; \forall w, z$$

- How to do inference for this estimator is unknown (maybe Hsieh, Shi, & Shum (2020) would apply)

[2] I think this is the reason, but the paper says "The purpose of this tuning parameter is to smooth out potential discontinuities caused by set convergence."

Identifying Assumptions

- California ACA pricing
  - 19 rating regions (premiums vary across regions and are constant within)
  - 4 tiers of insurance coverage
  - Region, tier, & age specific premium $=$ insurer chosen region, tier premium $\times$ federal age adjustment
  - Premium subsidies and cost-sharing reductions for low income individuals
- So price variation within a region due to age and income should be exogenous to demand shocks
- Assume that preferences for insurance do not depend on age or income within "coarse bins" (defined by 5 years and 50 percentage points of FPL)
- Support restriction: at equal prices, consumers prefer plan with more coverage

Table 2: *Summary Statistics*

Panel (a): Data by region, age, income

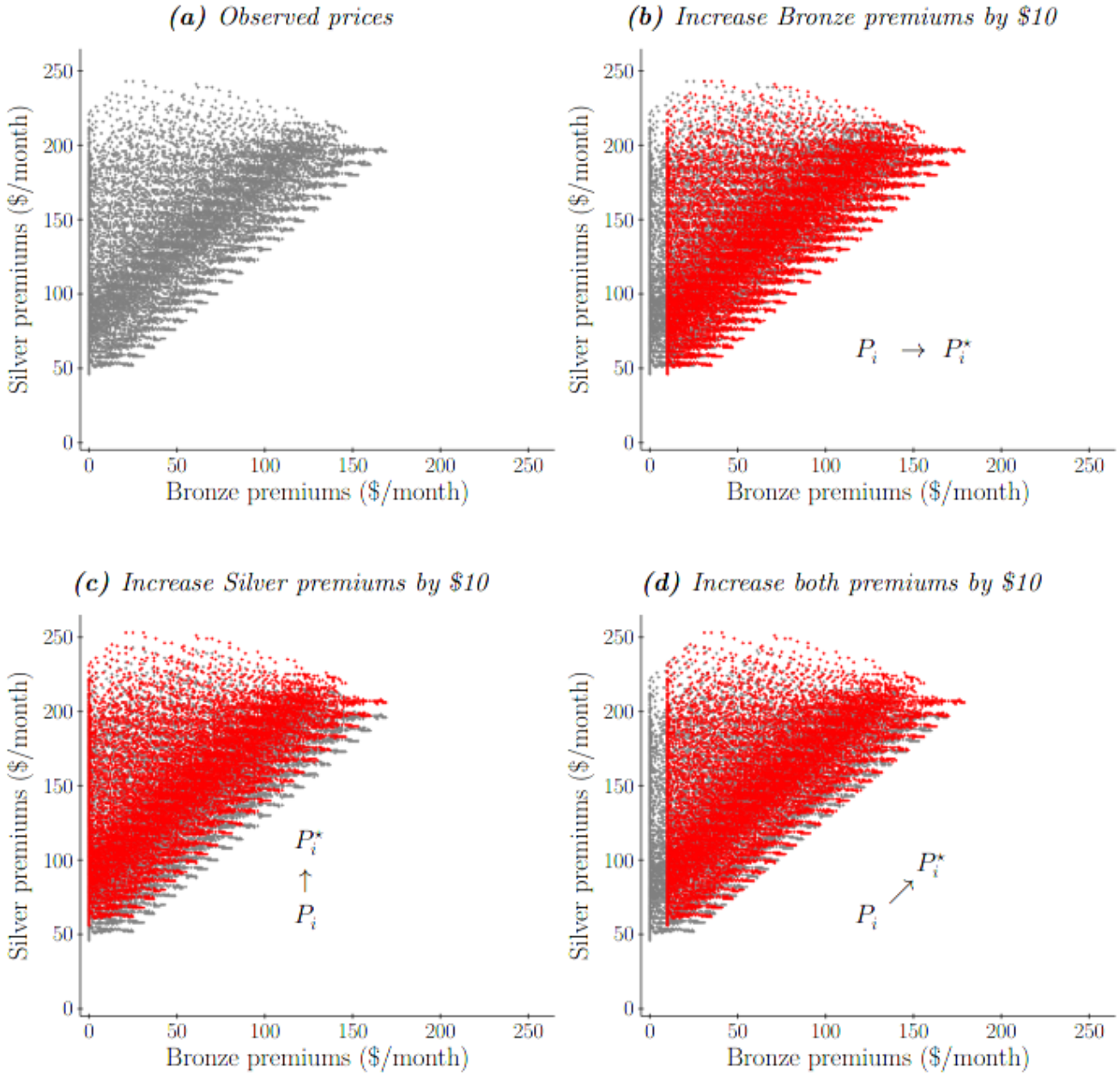
	Obs. (# of bins)	Mean	St. Dev.	P-10	Median	P-90
Number of buyers$^{(\star)}$	30,027	85.27	90.86	14	55	194
Age	30,027	43.41	10.70	29	43	59
Income (FPL%)	30,027	243.98	72.05	155	230	355
Takeup rate	30,027	0.280	0.208	0.053	0.235	0.576
Average premium paid	30,027	175.51	89.06	69	163	298
Share choosing Bronze	30,027	0.065	0.073	0	0.045	0.147
Share choosing Silver	30,027	0.188	0.173	0.018	0.139	0.424
Share choosing Gold	30,027	0.015	0.021	0	0.009	0.038
Share choosing Platinum	30,027	0.012	0.018	0	0.007	0.030

Panel (b): Heterogeneity by age and income

	Bronze		Silver		Gold		Platinum	
	Premium	Share	Premium	Share	Premium	Share	Premium	Share
By age:								
27-34	120	0.050	175	0.122	229	0.010	271	0.009
35-49	118	0.058	182	0.175	248	0.013	300	0.011
50-64	105	0.086	210	0.259	321	0.022	409	0.016
By income (FPL%):								
140-150	5	0.011	59	0.338	133	0.005	191	0.006
150-200	29	0.046	95	0.318	170	0.008	229	0.009
200-250	87	0.084	164	0.193	241	0.018	302	0.015
250-400	197	0.074	278	0.084	357	0.019	419	0.014

Note: Each observation in panel (a) is a unique combination of rating region × age × income bins of the observable characteristics, (M_i, X_i). All statistics except the number of buyers are calculated across bins, weighted by number of buyers in each bin. Standard deviation refers to the standard deviation across bins of the within-bin median of the corresponding variable. In panel (b), premium is

Figure 3: *Observed and Counterfactual Premiums*

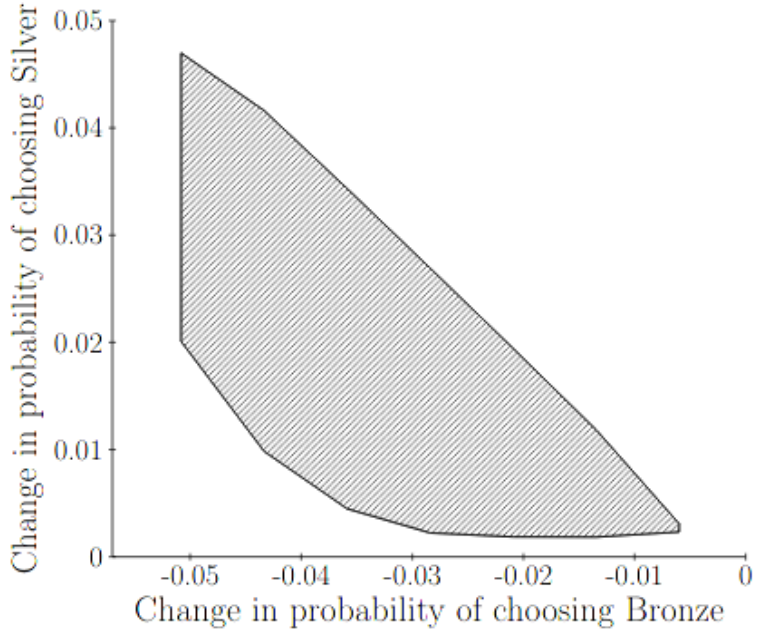


Note: *The figure shows observed and counterfactual premiums of Bronze and Silver plans. Panel (a) plots the prices observed in the data in grey, where each observation is a unique region-age-income combination (N=30,027). Panel (b) overlays in red the counterfactual prices representing an increase in $10 per person, per month for Bronze premiums. Panel (c) is like Panel (b), but*

Table 3: *Substitution Patterns, Upper and Lower Bounds*

	Change in probability of choosing									
$10/month premium	Bronze		Silver		Gold		Platinum		Any plan	
increase for	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
Panel (a): Full sample (140 - 400% FPL)										
Bronze	-0.051	-0.006	+0.002	+0.048	+0.000	+0.031	+0.000	+0.026	-0.013	-0.001
Silver	+0.000	+0.128	-0.170	-0.013	+0.000	+0.126	+0.000	+0.100	-0.052	-0.003
Gold	+0.000	+0.007	+0.000	+0.013	-0.016	-0.001	+0.000	+0.014	-0.004	-0.000
Platinum	+0.000	+0.005	+0.000	+0.008	+0.000	+0.012	-0.012	-0.001	-0.003	-0.000
All plans	-0.014	-0.003	-0.053	-0.010	-0.005	-0.001	-0.004	-0.000	-0.070	-0.016
Panel (b): Lower income (140 - 250% FPL)										
Bronze	-0.049	-0.006	+0.002	+0.047	+0.000	+0.030	+0.000	+0.025	-0.011	-0.001
Silver	+0.001	+0.184	-0.243	-0.017	+0.000	+0.178	+0.000	+0.144	-0.078	-0.004
Gold	+0.000	+0.006	+0.000	+0.011	-0.013	-0.001	+0.000	+0.012	-0.003	-0.000
Platinum	+0.000	+0.005	+0.000	+0.008	+0.000	+0.012	-0.012	-0.001	-0.003	-0.000
All plans	-0.012	-0.002	-0.080	-0.014	-0.004	-0.000	-0.004	-0.000	-0.093	-0.018
Panel (c): Higher income (250 - 400% FPL)										
Bronze	-0.053	-0.006	+0.001	+0.049	+0.000	+0.032	+0.000	+0.027	-0.015	-0.002
Silver	+0.000	+0.058	-0.077	-0.008	+0.000	+0.059	+0.000	+0.044	-0.019	-0.001
Gold	+0.000	+0.009	+0.000	+0.015	-0.019	-0.002	+0.000	+0.016	-0.005	-0.000
Platinum	+0.000	+0.005	+0.000	+0.008	+0.000	+0.012	-0.012	-0.001	-0.003	-0.000
All plans	-0.016	-0.004	-0.020	-0.005	-0.006	-0.001	-0.004	-0.000	-0.040	-0.014

Figure 4: *Effect of Increasing Bronze Premiums by $10 on Bronze and Silver Choice Shares*



Note: *The figure shows the joint identified set for the effect of a $10 increase in Bronze monthly premiums on the choice probabilities of Bronze and Silver plans. To construct the set, we take a grid of equidistant points between the estimated upper and lower bounds for the change in Bronze choice shares. At each point in the grid, we find bounds on the change in Silver, while fixing the change in Bronze to be the value at the grid point.*

Figure 5: *Extensive Margin Demand for Different Counterfactuals*

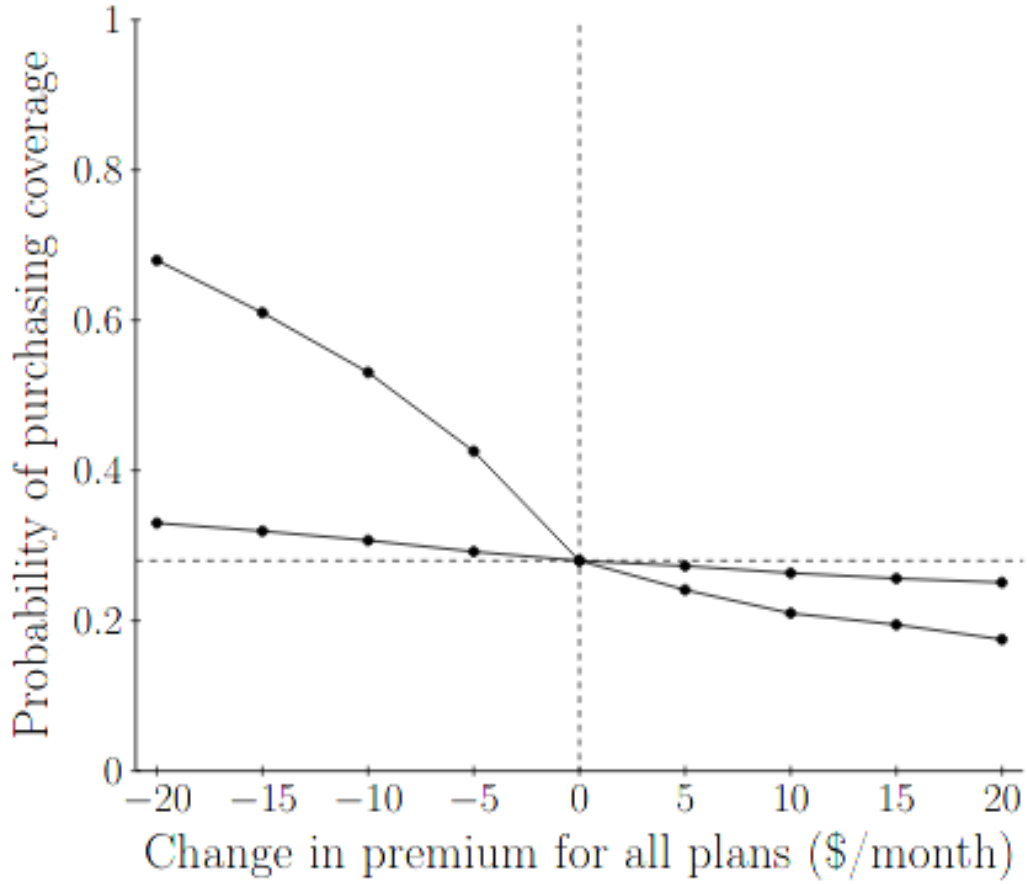
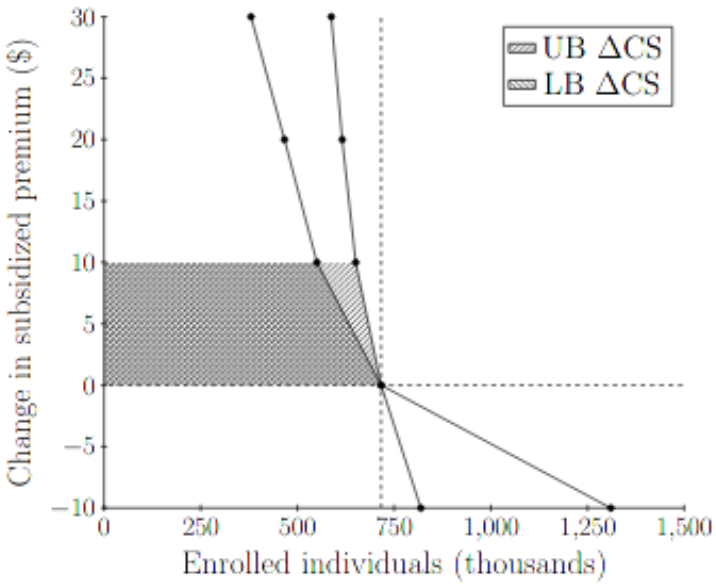
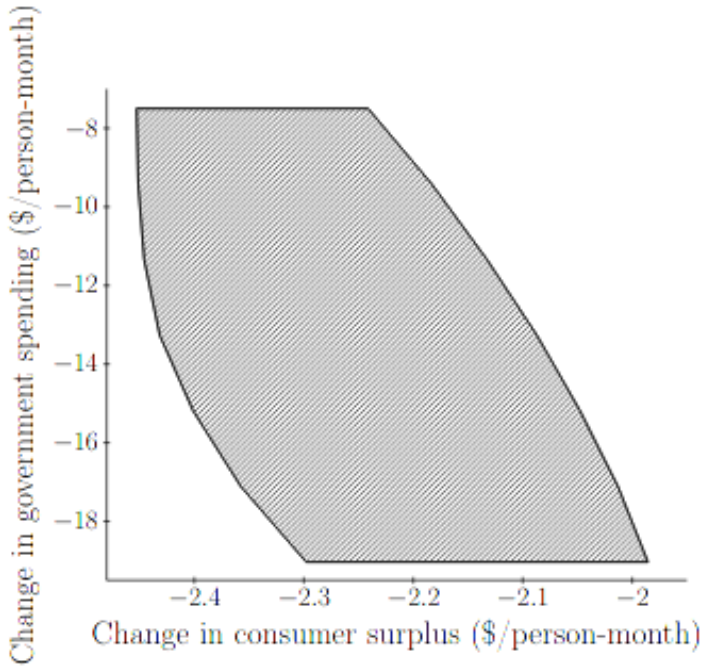


Figure 6: *Changes in Consumer Surplus and Government Spending*



(a) *Bounds on the change in consumer surplus.*



(b) *The joint identified set of consumer surplus and government spending.*

Table 4: *The Impacts of Reducing Premium Subsidies by $10 per Month*

	140 - 400% FPL Change in consumer surplus		140 - 250% FPL Change in consumer surplus		250 - 400% FPL Change in consumer surplus		140 - 400% FPL Associated change in subsidy outlays	
	LB	UB	LB	UB	LB	UB	LB	UB
Average ($/person-month)	-2.45	-1.99	-3.16	-2.55	-1.55	-1.27	-19.03	-7.50
Aggregate ($ million/year)	-77.82	-62.99	-57.59	-46.48	-22.48	-18.33	-603.89	-237.80

Table 5: *Allowing for Valuations to Vary Within Coarse Age and Income Bins*

Allowed variation in preference with age and income		Change in probability of purchasing coverage if all per-person premiums increase by $10/month		Change in consumer surplus ($/person-month) if per-person subsidies decrease by $10/month		Change in government spending ($/person-month) if per-person subsidies decrease by $10/month	
κ_{age}	κ_{inc}	LB	UB	LB	UB	LB	UB
0	0	-0.070	-0.016	-2.45	-1.99	-19.03	-7.50
0.2	0	-0.072	-0.017	-2.46	-1.98	-19.47	-7.48
0.6	0	-0.076	-0.019	-2.47	-1.96	-20.43	-7.70
$+\infty$	0	-0.089	-0.015	-2.51	-1.80	-23.92	-6.52
0	0.2	-0.075	-0.019	-2.47	-1.98	-20.22	-8.00
0	0.6	-0.089	-0.022	-2.48	-1.92	-23.36	-8.72
0	$+\infty$	-0.147	-0.021	-2.53	-1.44	-39.01	-8.26
0.2	0.2	-0.098	-0.023	-2.52	-1.92	-25.90	-9.35
0.6	0.6	-0.154	-0.015	-2.66	-1.65	-40.50	-7.71
$+\infty$	$+\infty$	-0.280	-0.000	-2.80	-0.00	-72.56	-2.70

Figure 7: *Extensive Margin Demand Relaxing Exclusion Restrictions*

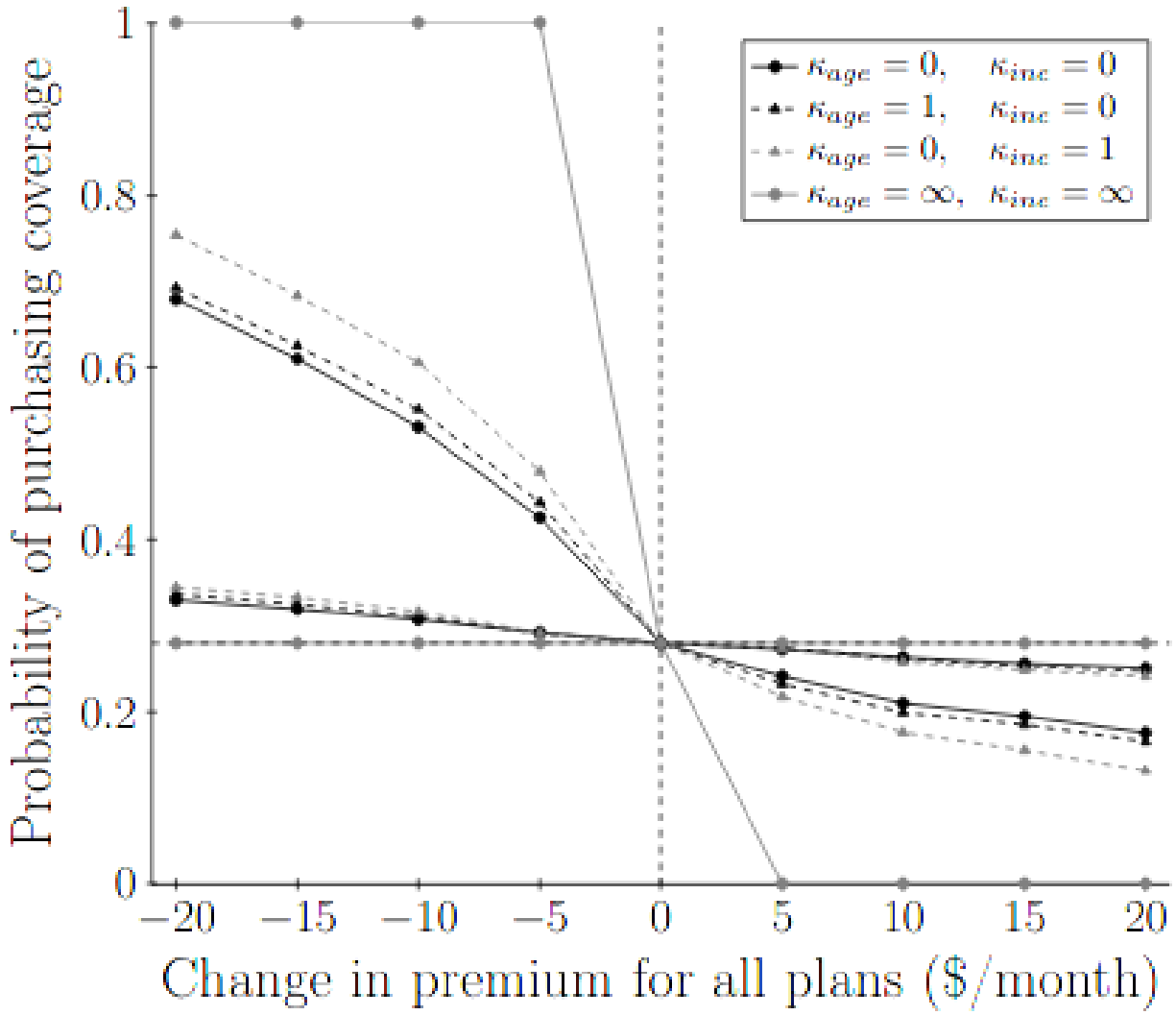


Figure 8: *Extensive Margin: Nonparametric Bounds vs. Parametric Point Estimates*

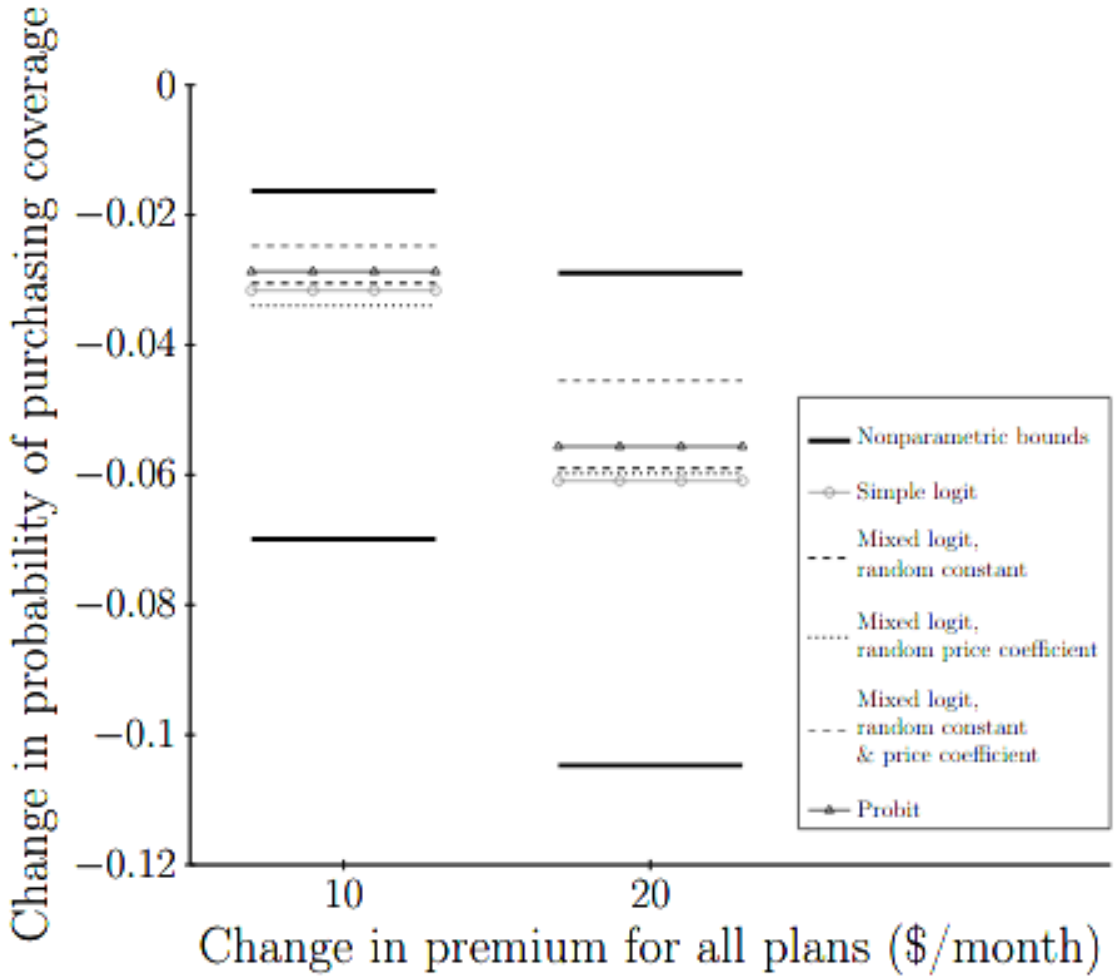
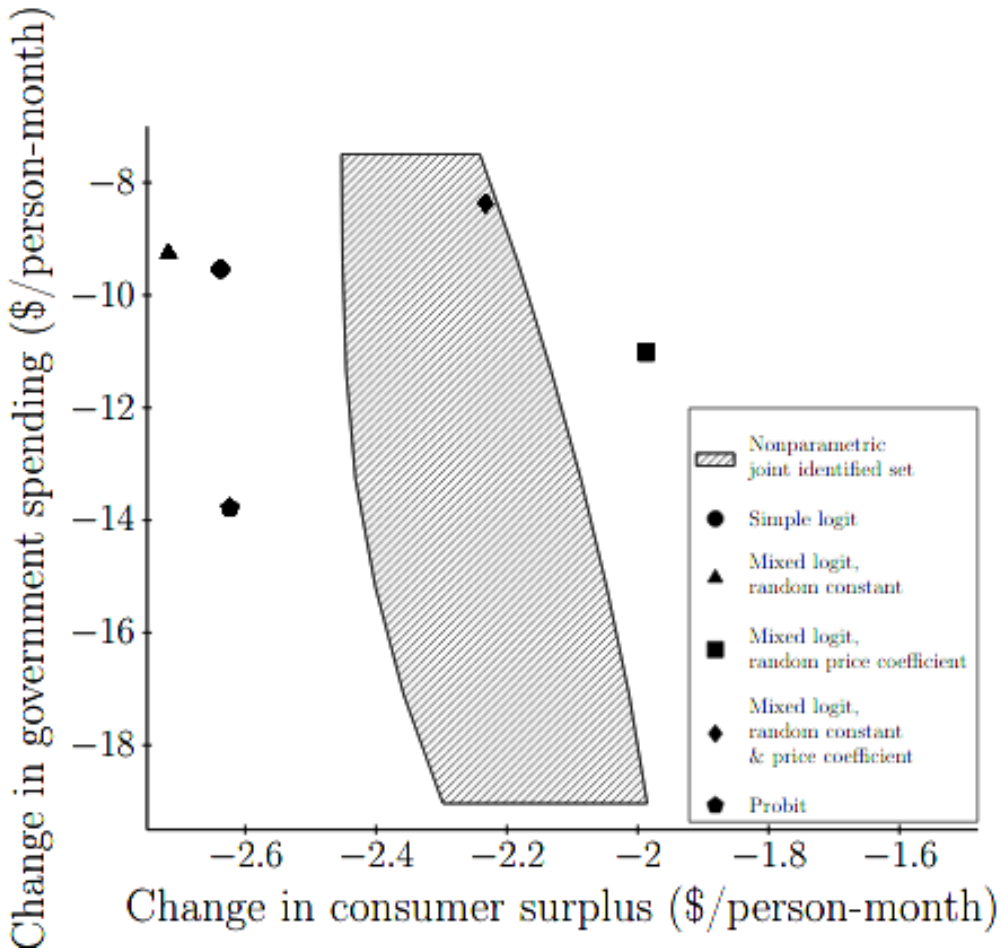


Figure 9: *Consumer Surplus and Government Expenditure Changes from a $10 Decrease in Premium Subsidies: Nonparametric Bounds vs. Parametric Point Estimates*



Section 4

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