Estimating Equilibrium in Health Insurance Exchanges

Price Competition and Subsidy Design under the ACA

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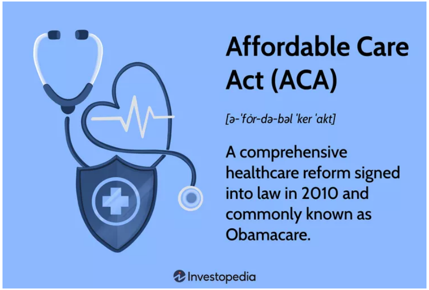
Contents

Government's Role in Private Health Insurance

- Adverse selection, consumption externalities, and affordability concerns justify government intervention.
  - Adverse selection occurs when individuals with higher health risks are more likely to purchase insurance, leading to higher costs for insurers.
  - Consumption externalities arise when the health outcomes of individuals impact others, justifying subsidies to increase coverage.
  - Affordability concerns are addressed by government interventions to ensure that lower-income individuals have access to health insurance.
- Examples include premium subsidies, regulations on minimum coverage standards, and financial assistance programs.

Affordable Care Act (ACA) Subsidies

- The ACA aims to make health insurance affordable for low- and middle-income individuals by providing income-based subsidies.
- Subsidies are designed to cap the maximum percentage of income that eligible individuals and families have to pay for health insurance.
- This design ensures that older individuals, who generally face higher premiums, receive sufficient subsidies to make coverage affordable.
- The goal is to balance affordability, equity, and market efficiency.
- ACA subsidies vary with income but not with age.



Research Objectives

- Analyze the interaction between insurers' competition and the design of premium subsidies in determining equilibrium outcomes
  - **Market Enrolment**: How many people enroll in the insurance plans. Different subsidy designs, such as the ACA subsidies or fixed vouchers, impact enrolment rates in small and large regions.
  - **Plan Premiums**: The equilibrium premium levels set by insurers. For example, under ACA price-linked subsidies, premiums may rise, while fixed vouchers tend to reduce premiums
  - **Consumer Surplus**: The net benefit consumers derive from purchasing insurance. In equilibrium, consumer surplus can increase if subsidies encourage broader enrolment and lower premiums.
  - **Subsidy Levels**: The financial support provided to consumers by the government. On the gov's side, the overall cost to the government.
  - **Insurer Profits and Medical-Loss Ratio**: Equilibrium impacts on insurer profitability and how much of premiums are spent on healthcare (medical-loss ratio).

Findings and Marginal Contributions

- Demand and cost Estimation
  - Demand estimation: Younger individuals are less willing to pay for insurance and more responsive to price changes, indicating higher price elasticity.
  - Cost estimation: Indicate adverse selection in the market, where individuals with higher expected medical costs are more likely to enroll.
- Counterfactual analysis
  - Analysis of alternative subsidy designs, including age-adjusted and income-based subsidy structures
  - Counterfactual scenarios show that shifting subsidy generosity towards younger individuals could lower premiums and increase overall enrolment
- Marginal contributions
  - Allowing premiums to re-equilibrate, and lead to different policy conclusions
  - Quantify the effects of different subsidy designs on premiums/enrolment/insurer behavior.
  - Assess how alternative subsidy structures could improve market outcomes(lower premiums and higher enrolment)

Institutional Background and Regulations

- Established in 2014 to address the uninsured population in the U.S. (17% under 65 without coverage)
- Created state-based health insurance marketplaces
- Key objectives: Expand health coverage, reduce healthcare costs, and regulate insurance
- Modified by the Tax Cuts and Jobs Act (2017), American Rescue Plan Act (2021), and Inflation Reduction Act (2022)

Key ACA Regulations

- **Rating Regions:** Geographic areas determining insurance offerings and premiums
- **Metal Tiers:**
  - Bronze (60% coverage), Silver (70%), Gold (80%), Platinum (90%)
- **Adjusted Community Rating:** Premiums vary by age, restricted adjustments based on tobacco use
- **Premium Subsidies:** Based on income, subsidies reduce the cost of the second-lowest Silver plan
- **Cost-Sharing Reductions:** For low-income individuals, increases actuarial value of Silver plans
- **Risk Adjustment:** Budget-neutral transfer system to balance insurer risk

Insurance Plan Characteristics

Standardized plan characteristics in 2015 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	80%
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: Section 6,460 of title 10 of the California Code of Regulations; 21 May 2014.

- Standardized plan characteristics in 2015 covered California

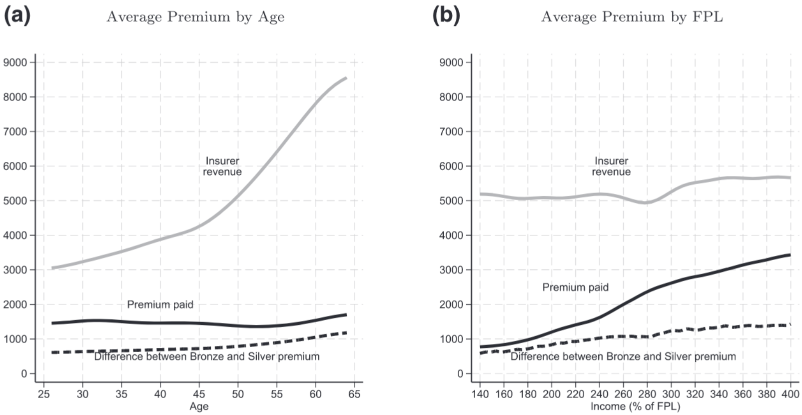
Data Sources

- **Enrolment Files**
  - 3.38 million individual plan choices (2014-2017) from Covered California.
  - Includes age, region, income, and selected plan details.
  - Focus on adults aged 26-64, representing 78% of total plan selections.
- **Rate Review Filings**
  - Data from the Center for Medicare & Medicaid Services (CMS) on average claims per plan.
  - Covers 1,099 unique insurer-region combinations.
  - Example of claims data:
    - Bronze: $2,199 per year.
    - Silver: $3,908 per year.
    - Gold: $4,834 per year.
- **Survey Data**
  - **ACS:** Data on potential buyers' age, income, and location.
  - **MEPS:** Medical spending data, with an average annual spending of $4,111.

Summary Statistics

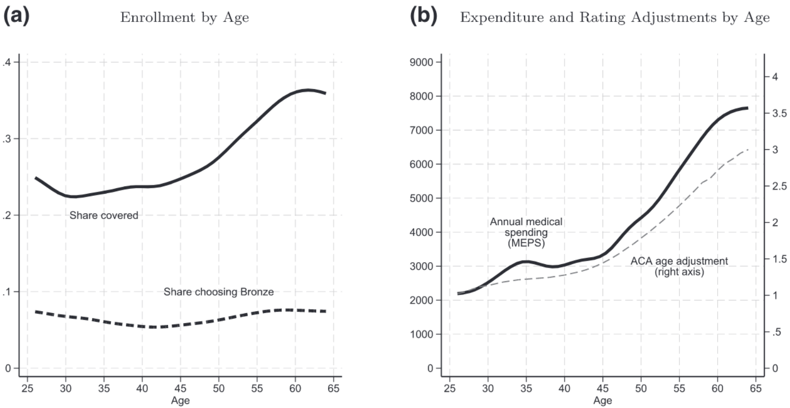
- **Average age:** 45.8 years
- **Income:** 214.2% of the Federal Poverty Level (FPL) on average
- **Enrolment by Metal Tier**
  - Bronze: 24%
  - Silver: 68%
  - Gold: 4%
  - Platinum: 4%
- **Premiums**
  - Average premium paid: $1,477 annually
  - Average subsidy: $3,928 annually
- **Medical Spending**
  - Average medical spending: $4,111 per year

Premiums by age and income



- average revenue collected by the insurer (gray line)/ average subsidized premium paid by the individual (black line)/ average difference between Bronze and Silver premiums for the individual (dashed line)

Enrolment, medical spending, and rating adjustments by age



- The left panel: the probability of choosing a marketplace (Bronze) plan Back
- The right panel: Annual medical expenditure/ the corresponding ACA age rating adjustment

Demand Model Overview

- The demand model estimates individual insurance choices based on:
  - Observable characteristics: age, income, region.
  - Unobservable characteristics: individual preferences and expected costs.
- Individuals choose from various insurance plans based on the utility derived from plan features:
  - Premium paid (adjusted for subsidies).
  - Actuarial value (coverage generosity).
  - Provider networks and insurer brand.
- The demand is modeled as a mixed-logit discrete choice model using enrolment data from Covered California.

Demand Model Equations

- The probability of individual i purchasing plan j in region m at time t is given by:

$$q_{jmt}(z,\theta) = \frac{e^{-\alpha_t(z_i)P_j(b_{mt},z_i)+\delta_{jmt}(z,\theta)}}{1+\sum_{k=1}^{J} e^{-\alpha_t(z_i)P_k(b_{mt},z_i)+\delta_{kmt}(z,\theta)}}$$

- Total enrolment in plan j is then:

$$Q_{jmt} = \int q_{jmt}(z,\theta)dG_{mt}(z,\theta)$$

- Change in enrolment with respect to plan k's premium is given by:

$$\frac{\partial Q_{jmt}}{\partial b_{kmt}} = \sum_{=1}^{J} \int \frac{\partial P(b_{mt},z)}{\partial b_{kmt}} \left(\alpha_t(z)q_{jmt}(z,\theta)q_{mt}(z,\theta)\right) dG_{mt}(z,\theta)$$

Cost Model Overview

- The cost model estimates expected medical spending for individuals based on:
  - Age, insurance preferences, and health status.
- Medical costs are calculated using plan-level average claims data.
- The model incorporates adverse selection, where individuals with higher willingness-to-pay for generous coverage also tend to incur higher medical costs.

Cost Model Equations

- Insurer expected claims from covering individual i under plan j, region m, and year t are modeled as:

$$\kappa_{jmt}(z_i, \theta_i) = AV_j^S L_{jmt}(z_i, \theta_i)$$

- Where medical spending $L_{jmt}(z_i, \theta_i)$ is modeled as:

$$L_{jmt}(z_i, \theta_i) = e^{\phi_{jmt} + \eta(z_i, \theta_i)}$$

- Plan-level expected average cost is then:

$$AC_{jmt} = \frac{1}{Q_{jmt}} \int \kappa_{jmt}(z, \theta) q_{jmt}(z, \theta) dG_{mt}(z, \theta)$$

Back

Cost and Demand Interaction

- Adverse selection is key in linking the demand for insurance with the cost to insurers.
- Higher willingness-to-pay for coverage correlates with higher expected medical costs.
- The model's findings illustrate that the joint distribution of preferences and costs plays a significant role in determining equilibrium outcomes in health insurance markets.

Identification: Setup

Parametric Assumptions (Demand Model) Details

- Age bins: $A^1 = \{26, ..., 31\}, A^2 = \{32, ..., 37\}, ..., A^7 = \{62, 63, 64\}$
- **Log-normally Distribution**: implied by the definition of $\beta_t(\mathbf{z}, \theta)$ and $G(\theta|\mathbf{z})$
- **Independence**: $G_{mt}(\mathbf{z}, \theta) = G_{mt}(\mathbf{z})G(\theta)$, where $G_{mt}(\mathbf{z})$ is observed
- **644** parameters $=$ 7 bins $\times$ 4 years $\times$ (13 insurer indicators $+$ 10 paramters)

Functional Form

$$\eta(\mathbf{z}, \theta) = \eta^{\text{Age}} z^{\text{Age}} + \eta^{\text{WTP}} \frac{\beta_t(\mathbf{z}, \theta)}{\alpha_t(\mathbf{z})}, \quad \text{and} \quad \phi_{jmt} = \phi_t^1 + \phi_m^2 + \boldsymbol{\phi}^3 \, \text{Insurer}_{jmt}$$

- individual medical spending vary with age and WTP for generosity of coverage
- cost parameters: combination of a constant, year, region and insurer indicators

Identification: Demand

Variations

- regional variation in premiums (conditional on age-bin and year)
- variation in the set of insurers and plans across markets
- discontinuous variation in acturial value (AV) of Silver plans

Control Function

- Waldfogel IV (Berry and Waldfogel, 1999) (Waldfogel, 2003)

$$\mathbb{E}\left[\xi_{jmt} \mid G_{mt}, \mathbf{z}, \mathbf{x}\right] = 0, \text{ while } \mathbb{E}\left[b_{jmt} G_{mt} \mid \mathbf{z}, \mathbf{x}\right] \neq 0 \Rightarrow \mathbb{E}[P_j(\mathbf{b}_{mt}, \mathbf{z}) G_{mt} | \mathbf{z}, \mathbf{x}] \neq 0$$

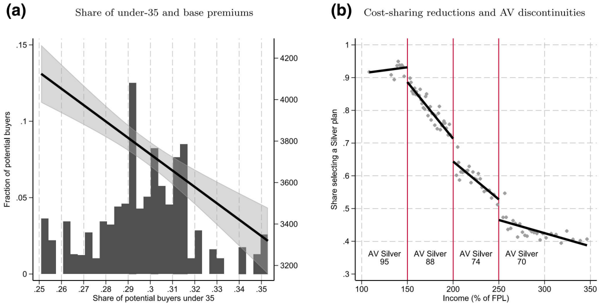
- use the residual $\hat{\xi}_{jmt}$ to obtain control function

$$b_{jmt} = \lambda^{35} \int \mathbf{1}\left[z^{\text{Age}} \leq 35\right] dG_{mt}(\mathbf{z}) + \lambda^{\text{Tier}} + \lambda^{\text{Year}} + \lambda^{\text{Insurer}} + \xi_{jmt}$$

the effect of AV on indirect utility: $\beta_t(\mathbf{z}, \theta)$ (Lavetti et al., 2023)

- three discontinuities: $z_i^{Inc} = 150, 200, 250, \; AV\_Silver = 95, 88, 74, 70$

Identification: Demand



(a) First stage OLS estimate: $\hat{\lambda}^{35} = -5,208$

- 0.1 increase in the share of potential buyers aged under-35 $\Rightarrow$ \$521 reduction of b

(b) Strongest Effect: $z_i^{Inc} = 200$

- 16% drop in AV $\Rightarrow$ 9.8% reduction in the probability of choosing a Silver plan

Identification: Cost

Intuition: "residual average cost" (similar to Bundorf et al. (2012))

$$C_j = \int c\left(u_i\right) dF\left(u_i \mid i \text{ chooses } j\right)$$

- **Demand**: individual level, **Cost**: plan level
- $\mathbf{F}\left(\mathbf{u_i} \mid \mathbf{i} \text{ chooses } \mathbf{j}\right)$: composition of buyers of j in terms of preferences for insurance
- **Key requirement of identification**: shifters of buyers' composition excluded from cost functions

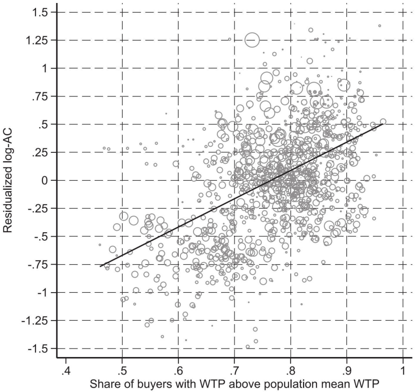
Calibration Illustration

- $\eta^{\mathbf{Age}}$: MEPS, age evolution of average annual medical spending when insured
- $\eta^{\mathbf{WTP}}$: empirical relationships between average claims and composition of enrolment in terms of $\frac{\beta_t(\mathbf{z},\theta)}{\alpha_t(\mathbf{z})}$

Identification: Cost

If residualized claims are higher for plans covering a larger share of individuals with high $\frac{\beta_t(\mathbf{z},\theta)}{\alpha_t(\mathbf{z})}$ Back

- $\eta^{\mathbf{WTP}} > \mathbf{0}$, and vice versa (*Adverse Selection*)



Estimation: Demand

	Age 26–31	Age 32–37	Age 38–43	Age 44–49	Age 50–55	Age 56–61	Age 62–64
Mean WTP	249.6	293.8	333.5	395.8	507.5	684.8	853.5
for 10% AV increase	(9.3)	(10.2)	(12.7)	(10.9)	(14.4)	(16.4)	(20.7)
St. Dev. of WTP	202.6	231.3	250.1	304.4	373.3	495.5	609.3
for 10% AV increase	(5.7)	(6)	(6.7)	(6.1)	(7.2)	(9.2)	(11.4)
% Change in enrolment if	−7.434	−6.822	−6.552	−5.69	−4.86	−3.832	−3.137
+$120/year in all Premium	(0.203)	(0.224)	(0.215)	(0.136)	(0.108)	(0.097)	(0.078)
% Change in Silver Enrolment	−2.356	−2.478	−2.113	−2.272	−1.887	−1.732	−1.492
if +1% in all Silver Premiums	(0.074)	(0.081)	(0.059)	(0.06)	(0.047)	(0.033)	(0.026)
Control Function	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Specific Parameters	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer-Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. Individuals	2, 335, 251	2, 050, 631	1, 814, 069	1, 764, 925	1, 822, 717	1, 841, 849	803, 613

- **Distribution of WTP for AV**: mean WTP increase steadily with age
- **Extensive margin semi-elasticity of demand**: much smaller for older buyers
- **Average own-price elasticity of demand for Silver**: smaller for older buyers
- **Interpretation**: highlight the model of plan choice is **static** Limitation

Estimation: Cost

$\eta^{\text{Age}} = \mathbf{0.038}$: 1 year of age $\Rightarrow \approx 3.8\%$ higher expected medical spending
$\eta^{\text{WTP}} = \mathbf{0.08}$: \$100 increase in $\frac{\beta_t(\mathbf{z},\theta)}{\alpha_t(\mathbf{z})} \Rightarrow \approx 8\%$ higher expected medical spending

Parameters of $\eta(\mathbf{z},\theta) = \eta^{\text{Age}} z^{\text{Age}} + \eta^{\text{WTP}} \frac{\beta_t(\mathbf{z},\theta)}{\alpha_t(\mathbf{z})}$			Estimator, N. Obs.	Data Source	Region FE	Year FE	Insurer FE
Age	η^{Age}	0.0379 (0.0021)	NLLSQ, N = 20,171	2014-17 MEPS	Y	Y	N
WTP for 10% AV increase (\$100/year)	η^{WTP}	0.0803 (0.0104)	NLLSQ, N = 1,026	2016-19 RRF	Y	Y	Y
Insurer Expected Average Cost at Observed Premiums							
	Age 26–31	Age 32–37	Age 38–43	Age 44–49	Age 50–55	Age 56–61	Age 62–64
Bronze Enrolees	1,030 (136)	1,421 (169)	1,861 (203)	2,581 (247)	3,647 (272)	5,334 (263)	7,503 (240)
Silver Enrolees	1,311 (137)	1,821 (164)	2,361 (205)	3,336 (220)	4,742 (229)	7,571 (201)	11,208 (364)

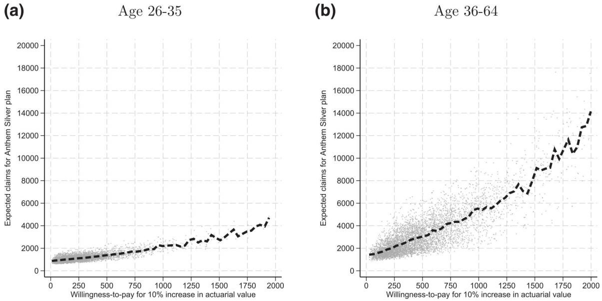
Compare Silver and Bronze

- enrolees of Silver plans have higher $\frac{\beta_t(\mathbf{z},\theta)}{\alpha_t(\mathbf{z})} \Rightarrow$ higher expected average claims
- relative difference increases with age $\Rightarrow$ larger premium differences
  - following ACA rating regulations

Estimation: Cost

Relevance of heterogeneity and adverse selection

- Higher WTP ⇒ Higher expected cost
- Steeper for **older** individuals, significant heterogeneity in preferences
- Joint distribution is important for market design in a health insurance marketplace



Expected Profit

Recall

- Each insurer f offers the plans in the set $\mathcal{J}(f)$ in region m, year t
- Base premiums $\mathbf{b}_{fmt} = \{b_{jmt}\}_{j\in\mathcal{J}(f)}$

Expected Total Revenues for each product $j \in \mathcal{J}(f)$

$$R_{jmt}\left(\mathbf{b}_{fmt}, \mathbf{b}_{-fmt}\right) = \int \text{Adjustment}\left(z^{\text{Age}}\right) b_{jmt} q_{jmt}(\mathbf{z}, \theta) dG_{mt}(\mathbf{z}, \theta)$$

Expected Total Costs

$$TC_{jmt}\left(\mathbf{b}_{fmt}, \mathbf{b}_{-fmt}\right) = \int \kappa_{jmt}(\mathbf{z}, \theta) q_{jmt}(\mathbf{z}, \theta) dG_{mt}(\mathbf{z}, \theta)$$

Expected Profit

Risk Adjustment (Saltzman, 2021) (Pope et al., 2014) Details

$$RA_{jmt}\left(\mathbf{b}_{fmt},\mathbf{b}_{-fmt}\right) = Q_{jmt} \underbrace{\frac{\sum_k R_{kmt}}{\sum_k Q_{kmt}}}_{\substack{\text{average premium} \\ \text{in region-year}}} \left(\text{Relative Risk}_{jmt} - \text{Relative Adjustment}_{jmt}\right)$$

- Risk adjustment transfer follows the ACA formula (ensure transfers sum to zero)
- **Costlier-than-average** individuals $\Rightarrow$ Positive transfers

Expected Profits for insurer f in region-year mt

$$\Pi_{fmt} = \sum_{j \in \mathcal{J}(f)} \left[R_{jmt} - TC_{jmt} + RA_{jmt}\right]$$

- Different subsidy design $\Rightarrow$ different R, TC and RA functions

Insurers' Conduct

Two Alternative Models

- **Static Multi-product Nash Pricing** (Bertrand) (Bundorf et al., 2012) (Starc, 2014) (Decarolis et al., 2020) (Saltzman, 2021) (Curto et al., 2021)

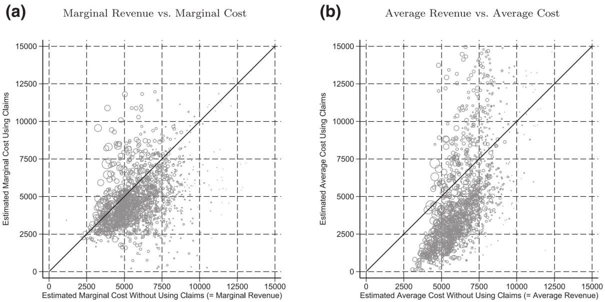
$$\frac{\partial \Pi_f}{\partial b_{jmt}} = \sum_{k \in \mathcal{J}(f)} \frac{\partial R_{kmt}}{\partial b_{jmt}} - \frac{\partial TC_{kmt}}{\partial b_{jmt}} + \frac{\partial RA_{kmt}}{\partial b_{jmt}} = 0$$

- **Perfect Competition** (every plan breaks even in expectation) (Azevedo and Gottlieb, 2017)

$$\Pi^{AG}_{jmt} = R^{AG}_{jmt} - TC^{AG}_{jmt} + RA^{AG}_{jmt} = 0$$

Insurers' Conduct

An Informal Test



- **(a)** per-enrolee MR for every *jmt* combination nearly **equals** to risk-adjusted MC
- **(b)** Large number of *jmt* estimated risk-adjusted AC significantly **lower** than AR
- Evidence **against** perfect competition
- A **static oligopoly model** seems to perform well

Counterfactual 1: Vouchers

Two Subsidy Designs

- **ACA Subsidies**: Price-linked (Jaffe and Shepard, 2020)
- **"equivalent" Fixed Vouchers**: subsidies that do not adjust endogenously with base premiums

Intuition

- Voucher increase the **own-premium semi-elasticity** for the Silver plan in the region-year (under Nash Pricing)
- **ACA**: increase base premium ⇒ only lower other plans' premiums
- **Voucher**: Silver plan has incentives to charge lower premiums
  - Larger effects in less-competitive markets

Jaffe and Shepard (2020) discuss this for single-plan insurers

- pre-ACA Massachusetts marketplace

Counterfactual 1: Vouchers

	Multi-Product Nash pricing				Perfect Competition			
	2–3 insurers 27 region-years		4–7 insurers 49 region-years		2–3 insurers 27 region-years		4–7 insurers 49 region-years	
	ACA subsidy	Equivalent voucher	ACA subsidy	Equivalent voucher	ACA subsidy	Equivalent voucher	ACA subsidy	Equivalent voucher
Share enroled	0.32	0.36	0.28	0.29	0.27	0.27	0.28	0.28
2nd cheapest Silver b_j	4, 127	2, 998	2, 709	2, 559	2, 387	2, 387	2, 116	2, 115
Share in Bronze plans	0.15	0.14	0.13	0.13	0.16	0.16	0.14	0.14
Medical-loss ratio	0.82	0.8	0.89	0.84	1	1	1	1
ΔCS_i relative to ACA	–	90	–	30	–	0	–	1
Average subsidy	5, 705	4, 187	3, 249	3, 258	2, 713	2, 709	2, 223	2, 211

- **Right (perfect competition)**: ACA is non-distortionary
  - equilibrium premiums depend only on enrolees expected costs
- **Left**: Vouchers ⇒ Slightly higher marketplace enrolment
  - Consumer Surplus ↗, insurer profitability ↗
  - Share of bronze plan ↘, medical-loss ratio ↘
- Distortion **larger in small regions** (2-3 insurers, more concentrated)
- Similar to the results in Jaffe and Shepard (2020)

Counterfactual 2: Subsidies to the Young Invincibles

Details

- individuals aged between 26 and 35
- cheaper to cover, **price sensitive**
- lower premiums $\Rightarrow$ higher enrolment and higher CS
- rating regulations: more gains

Two Alternative Ways of Measurement

- maintain **price-linked** design, lower the max affordable amount for young
- increase **vouchers** for the "young", lower vounchers for the "old"

Two Effects

- **First Order**: "off-equilibrium" effect (holding base premiums fixed)
- **Second Order**: "equilibrium" effect (endogenous pricing behaviour)

Counterfactual 2: Subsidies to the Young Invincibles

Measurement 1

- Change the ACA price-linked design
- Lower the **Max Affordable Amount (MAA)** for young invincibles by **30%**

Panel (a): Lowering MAA for under-35 by 30%

	Multi-product Nash			Perfect Competition		
	ACA MAA	Counterfactual MAA		ACA MAA	Counterfactual MAA	
	Equilibrium	Off-equilibrium	Equilibrium	Equilibrium	Off-equilibrium	Equilibrium
Share enroled:						
26–35	0.26	0.33	0.33	0.26	0.32	0.32
36–64	0.3	0.3	0.3	0.29	0.29	0.29
Premium paid:						
26–35	1, 571	1, 265	1, 311	1, 756	1, 438	1, 440
36–64	1, 693	1, 693	1, 764	2, 009	2, 009	2, 014
Average cost ($/year)	4, 357	4, 112	4, 136	4, 192	3, 984	3, 987
Average revenue ($/year)	4, 946	4, 824	4, 842	4, 202	4, 106	3, 995
Medical-loss ratio	0.9	0.87	0.87	1	0.97	1
Per-person CS ($/year)	771	815	799	733	771	774
Average subsidy ($/year)	3, 632	3, 614	3, 542	2, 288	2, 324	2, 208
Total profits ($ million)	2, 117	2, 781	2, 694	35	454	28

(continued)

Effects

- **increase enrolment** in all demographic groups, annual per-person CS
- average cost and average subsidies are lower

Counterfactual 2: Subsidies to the Young Invincibles

Measurement 2

- Modify ACA-euivalent vouchers
- raise annual under-35 vouchers by **$600**, lower over-35 vouchers by **$100**

Panel (b): Increasing under-35 voucher by $600/year while lowering over-35 voucher by $100/year

	Multi-product Nash			Perfect Competition		
	ACA-voucher	Counterfactual voucher		ACA-voucher	Counterfactual voucher	
	Equilibrium	Off-equilibrium	Equilibrium	Equilibrium	Off-equilibrium	Equilibrium
Share enroled:						
26–35	0.28	0.37	0.39	0.26	0.36	0.39
36–64	0.32	0.31	0.33	0.29	0.28	0.31
Premium paid:						
26–35	1, 565	1, 097	1, 012	1, 754	1, 202	1, 066
36–64	1, 660	1, 737	1, 584	2, 005	2, 100	1, 830
Average cost ($/year)	4, 207	3, 929	3, 889	4, 191	3, 873	3, 815
Average revenue ($/year)	5, 041	4, 860	4, 704	4, 200	4, 027	3, 818
Medical-loss ratio	0.84	0.81	0.83	1	0.96	1
Per-person CS ($/year)	810	851	914	734	778	864
Average subsidy ($/year)	3, 412	3, 375	3, 344	2, 278	2, 297	2, 300
Total profits ($ million)	3, 145	3, 812	3, 580	31	590	12

Effects

- **"Off-equilibrium"**: young invincibles better off, older buyers worse off
- **"Equilibrium"**: larger enrolment share of under-35 individuals ⇒ reduction in base premiums ⇒ all buyers better off

Counterfactual 2: Subsidies to the Young Invincibles

Measurement 2: Modified ACA-equivalent vouchers

Panel (b): Increasing under-35 voucher by $600/year while lowering over-35 voucher by $100/year

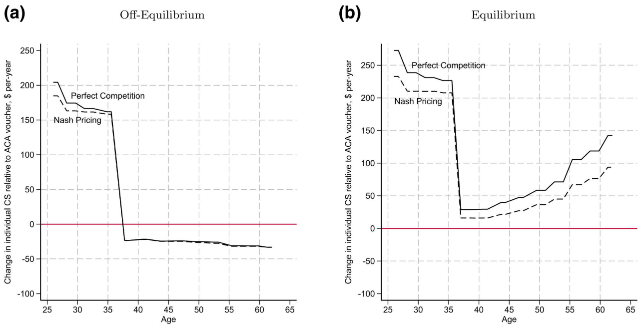
	Multi-product Nash			Perfect Competition		
	ACA-voucher	Counterfactual voucher		ACA-voucher	Counterfactual voucher	
	Equilibrium	Off-equilibrium	Equilibrium	Equilibrium	Off-equilibrium	Equilibrium
Share enroled:						
26–35	0.28	0.37	0.39	0.26	0.36	0.39
36–64	0.32	0.31	0.33	0.29	0.28	0.31
Premium paid:						
26–35	1, 565	1, 097	1, 012	1, 754	1, 202	1, 066
36–64	1, 660	1, 737	1, 584	2, 005	2, 100	1, 830
Average cost ($/year)	4, 207	3, 929	3, 889	4, 191	3, 873	3, 815
Average revenue ($/year)	5, 041	4, 860	4, 704	4, 200	4, 027	3, 818
Medical-loss ratio	0.84	0.81	0.83	1	0.96	1
Per-person CS ($/year)	810	851	914	734	778	864
Average subsidy ($/year)	3, 412	3, 375	3, 344	2, 278	2, 297	2, 300
Total profits ($ million)	3, 145	3, 812	3, 580	31	590	12

Consider Nash pricing (Results are robust to assuming perfect competition)

- **Younger Composition**: under-35 enrolment (0.28 ↗ 0.39); over-35 (0.32 ↗ 0.33)
- **Subsidized premiums** of over-35 buyers: $76 lower; average costs: 7.6% lower
- **per-person CS** increase by $104 per-year, average per-enrolee subsidies $68 lower

Counterfactual 2: Subsidies to the Young Invincibles

Measurement 2: Modified ACA-equivalent vouchers



Improvement for all buyers (while not increase average subsidies)

- **(a)** under-35 experience a **net gain**, over-35 are **worse off**
- **(b)** over-35 are better relative to the ACA-voucher equilibrium
  - annual amount between $10 and $100

Takeaways

Health insurance market

- **Government-sponsored**: Expanding coverage while limiting public costs
- **Adjustment**: Possible under heterogeneity in preferences

Main Conclusions

- **Price Competition**: support oligoboly pricing over imperfect competition
- **Subsidy Design**: shift subsidy generosity toward young uninsured

Limitation: w/o Dynamic and Behavioural aspects

- **Model**: plan switching, consumers' inertia, state dependence back
  - Drake et al. (2022), Saltzman (2021)
- **Identification**: richer data + measures of health risk and healthcare utilization at individual level

Extension: alternative subsidy schemes & other market design

- role of a public option, different risk adjustment models, quality regulations...

Let's think...

- Why is the cost function set as exponential form? Details
- How should we understand the term $\frac{\beta}{\alpha}$? Details
- (open-ended) What are the policy implications for China's medicare design?
- (open-ended) What is the policy implications of this paper considering the urban-rural dual structure of China?

Thank You!

Appendix A: Parametric Assumptions in Demand Model

Letting $A^1 = \{26, ..., 31\}, A^2 = \{32, ..., 37\}, ...A^6 = \{56, ..., 61\}, A^7 = \{62, 63, 64\}$

$$\alpha_t(\mathbf{z}) = \begin{cases} \alpha_t^{0,1} + \alpha_t^{1,1} z^{\text{Inc}} & \text{if } z^{\text{Age}} \in A^1 \\ \alpha_t^{0,2} + \alpha_t^{1,2} z^{\text{Inc}} & \text{if } z^{\text{Age}} \in A^2 \\ \dots & \\ \alpha_t^{0,7} + \alpha_t^{1,7} z^{\text{Inc}} & \text{if } z^{\text{Age}} \in A^7 \end{cases}$$

Coefficient on actuarial value is log-normally distributed

$$\beta_t(\mathbf{z}, \theta) = \begin{cases} e^{\beta_t^1 + \sigma_t^1 \theta}, & \text{if } z^{\text{Age}} \in A^1 \\ \dots & \\ e^{\beta_t^7 + \sigma_t^7 \theta}, & \text{if } z^{\text{Age}} \in A^7 \end{cases}, \quad \text{where} \quad \theta \sim G(\theta) = \mathcal{N}(0, 1)$$

where $\mathcal{N}$ indicates the standard normal distribution, θ and $\mathbf{z}$ are independent:

$$G_{mt}(\mathbf{z}, \theta) = G_{mt}(\mathbf{z}) G(\theta)$$

Appendix A: Parametric Assumptions in Demand Model

$\boldsymbol{\mu}_t(\mathbf{z})\mathbf{x}_{jmt}$ allows the value of marketplace coverage to vary piecewise linearly

$$\boldsymbol{\mu}_t(\mathbf{z})\mathbf{x}_{jmt} = \begin{cases} \mu_t^{0,1} + \mu_t^{1,1} z^{\text{Inc}} + \mu_t^{2,1} z^{\text{Age}} + \mu_t^{3,1}\text{HMO}_{jmt} + \boldsymbol{\mu}_t^{4,1} \text{ Insurer }_{jmt} & \text{if } z^{\text{Age}} \in A^1 \\ \dots \\ \mu_t^{0,7} + \mu_t^{1,7} z^{\text{Inc}} + \mu_t^{2,7} z^{\text{Age}} + \mu_t^{3,7}\text{HMO}_{jmt} + \boldsymbol{\mu}_t^{4,7} \text{ Insurer }_{jmt} & \text{if } z^{\text{Age}} \in A^7 \end{cases}$$

Let γ_t to be a cubic function of ξ_{jmt}, specific to every year and every age bin:

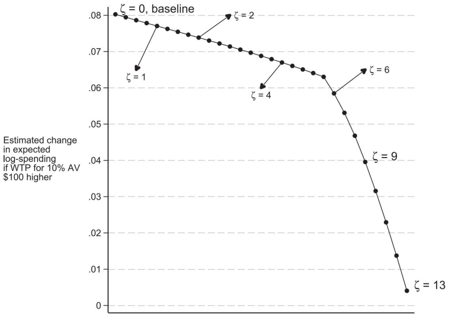
$$\gamma_t\left(\xi_{jmt}; \mathbf{z}\right) = \begin{cases} \gamma_t^{1,1}\xi_{jmt} + \gamma_t^{2,1}\xi_{jmt}^2 + \gamma_t^{3,1}\xi_{jmt}^3 & \text{if } z^{\text{Age}} \in A^1 \\ \dots \\ \gamma_t^{1,7}\xi_{jmt} + \gamma_t^{2,7}\xi_{jmt}^2 + \gamma_t^{3,7}\xi_{jmt}^3 & \text{if } z^{\text{Age}} \in A^7 \end{cases}$$

Back

Appendix B: Robustness to Moral Hazard

- lack of data $\Rightarrow$ assume no moral hazard
- Re-estimate cost parameters and simulate policy counterfactuals under varying degrees of moral hazard (Pope et al., 2014) (Lavetti et al., 2023)
- Medical spending augmented for moral hazard ($\zeta = 0 \Rightarrow$ no moral hazard)

$$L_{jmt}^{\mathrm{MH}}\left(\mathbf{z}_i, \theta_i\right) = \left(1 + \zeta \times \chi_{ij}\right) L_{jmt}\left(\mathbf{z}_i, \theta_i\right)$$



Appendix C: Relative Risk & Adjustment

Relative Risk

Back

$$\text{Relative Risk}_{jmt} \equiv \frac{IDF_j AV_j^S Q_{jmt}^{-1} \int L_{mt}(\mathbf{z},\theta) q_{jmt}(\mathbf{z},\theta) dG_{mt}(\mathbf{z},\theta)}{\left(\sum_\ell Q_{\ell mt}\right)^{-1} \sum_k IDF_k AV_k^S \int L_{mt}(\mathbf{z},\theta) q_{kmt}(\mathbf{z},\theta) dG_{mt}(\mathbf{z},\theta)}$$

Relative Adjustment

$$\text{Relative Risk}_{jmt} \equiv \frac{IDF_j AV_j^S Q_{jmt}^{-1} \int \text{Adj}_{mt}(z^{\text{Age}}) q_{jmt}(\mathbf{z},\theta) dG_{mt}(\mathbf{z},\theta)}{\left(\sum_\ell Q_{\ell mt}\right)^{-1} \sum_k IDF_k AV_k^S \int \text{Adj}_{mt}(z^{\text{Age}}) q_{kmt}(\mathbf{z},\theta) dG_{mt}(\mathbf{z},\theta)}$$

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