Participation and Spending in the Medicare Shared Savings Program

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Motivating Facts

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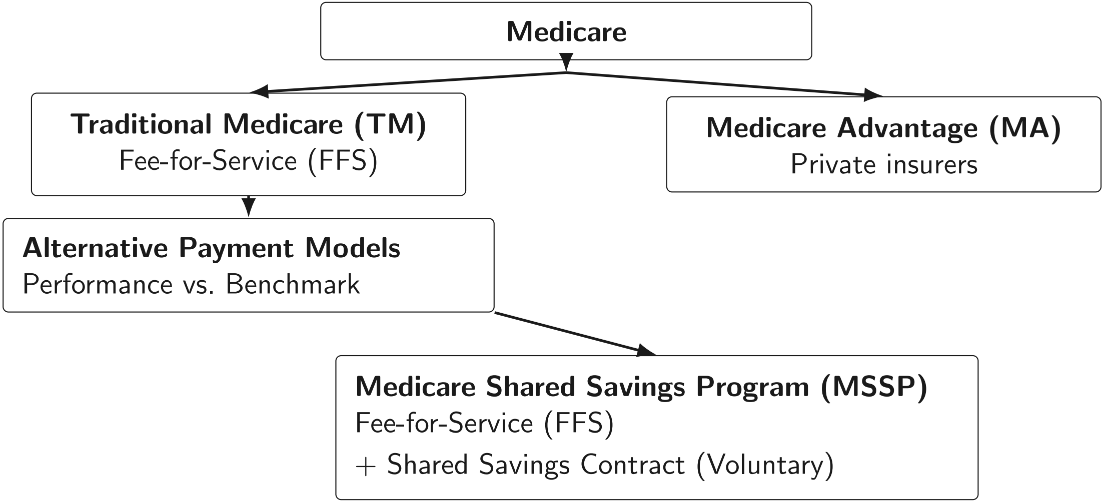
- **Alternative Payment Models:** government initiatives to reduce overspending under Medicare.
- **The Medicare Shared Savings Program (MSSP)**
  - Aims to reduce spending compared to Medicare's FFS expenditure.
  - Makes it profitable for providers to **reduce the volume of unnecessary care**.

Institutional Setting



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  - **Regional Adjustment ⇒ Adverse Selection (AS)** ⏩ details
    Ex-ante more efficient ACOs can earn SS rewards without changing spending.

Research Questions and Contributions

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  - How do RE and AS affect MSSP savings?
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- **Literature contributions**
  - Financial incentives for healthcare providers.

    Gaynor et al. (2004); Ho & Pakes (2014); Eliason et al. (2018); Einav et al. (2021)
  - Unnecessary spending in the U.S.

    Fisher et al. (2009); Skinner and Fisher (2010); Cutler (2010); Berwick and Hackbarth (2012); Shrank et al. (2019)
  - MSSP design and its limitations.

    McWilliams et al. (2020); Chernew et al. (2023); Aswani et al. (2019); Reddig (2020)

Data Sources

- **ACO Public Use Files (2013 - 2022):**
  - ACOs financial data: benchmark, spending prior to FFS, spending under MSSP, regional expenditure, beneficiaries demographics.
  - ACOs Participants list.
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- **“Potential ACOs”** = coalition of providers that resemble the actual ACOs, but do not participate in the MSSP:
  - AHRQ Compendium of U.S. Health Systems.
  - Hospital–provider affiliation data from the Physician Compare database.
  - Physician Shared Patients Patterns data.

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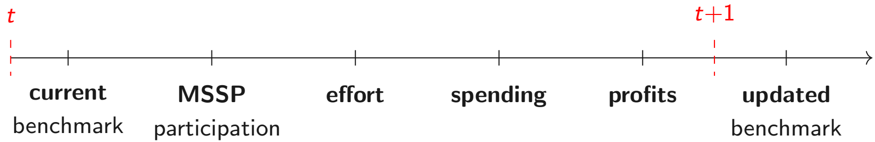
  ⏩ Logit model shows that ACOs with positive RA are $\approx$ 75% less likely to exit.

Structural Model



- **(1) Participation** details

$$d_{it} = 1 \iff V_{it}^{MSSP}(B_{it}) > V_{it}^{FFS}$$

- **(2) Dynamic effort choice** Euler eq.

$$e_{it}^{*} = \underset{e_{it}}{\text{argmax}} \left\{ \pi_{it}^{MSSP}(e_{it}) + \delta\, \mathbb{E}\left[V_{it+1}(B_{it+1}) \right] \right\}$$

- **(3) Spending** details

$$Y_{it}^{MSSP} = Y_{it}^{FFS} - e_{it}, \qquad e_{it} \geq 0$$

$$\ln Y_{it}^{FFS} = \ln Y_{it-1}^{FFS} + \ln \mathrm{tf}_{it} + \ln \mathrm{rr}_{it} + u_{it}$$

- **(4) Per-period MSSP profits** details

$$\pi_{it}^{MSSP}(e_{it}) = SS(Y_{it}^{MSSP}, B_{it}) - C(e_{it}) - F_i$$

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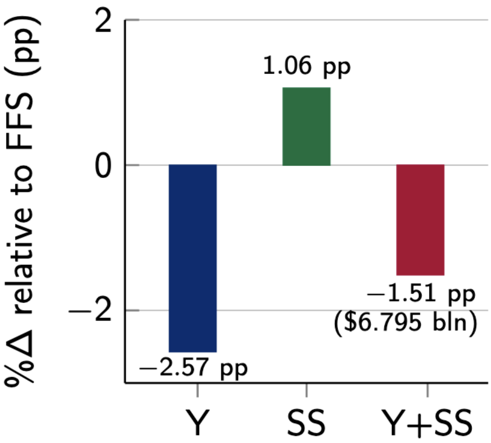
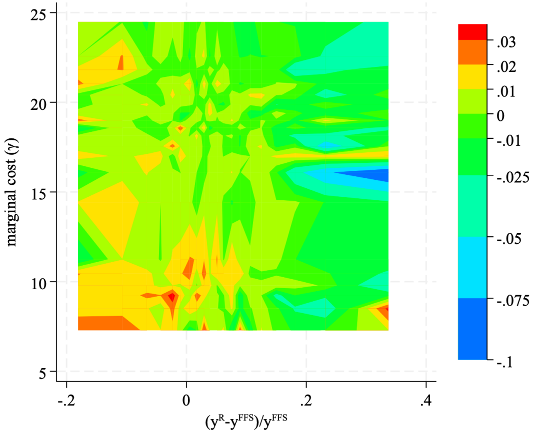
- Estimated Primitives: effort cost and fixed costs

Does MSSP generate savings relative to FFS?



Net Spending (Y), Shared Savings (SS),

Total Spending (Y + SS)



x-axis = adverse selection incentive

y-axis = marginal cost of effort

z-axis = $(Y - y^{FFS})/y^{FFS}$

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  - **Alternative design: Conditional Regionalization** Results
    - apply regionalization only when it rewards *real* savings,
    - do not regionalize when rewards come purely from being ex-ante efficient. details

Key Takeaways

- MSSP can be a **win-win** for both healthcare providers (higher profits) and Medicare (lower wasteful spending).
- Issues with current MSSP benchmarking design:
  - **Ratchet Effect**
  - **Adverse Selection**

  and both have a negative impact on MSSP savings.
- There is a **tradeoff** between them RE and AS.
- **Policy Recommendation**: to mitigate the RE while preventing AS, Medicare should apply the regional adjustment to the ACOs the reduce their spending relative to their historical level.

Thank You!

email your comments at cappelae@bc.edu

Part I

Appendix

Part content

Estimates of national health spending by type of waste

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Type of waste	Berwick & Hackbarth (2011) Billions (2011)	Berwick & Hackbarth (2011) % total (2011)	Shrank et al. (2019) Billions (2019)	Shrank et al. (2019) % total (2019)[b]
Care delivery[a]	102–154	3.8–5.7	102–166	2.7–4.4
Care coordination[a]	25–45	0.9–1.7	27–78	0.7–2.1
Overtreatment[a]	158–226	5.9–8.4	76–101	2.0–2.7
Administrative complexity	107–389	4.0–14.4	267	7.0
Pricing failure	84–178	3.1–6.6	231–241	6.1–6.3
Fraud and abuse	82–272	3.0–10.1	59–84	1.6–2.2
Total	558–1,263	20.7–46.8	760–935	20.0–24.6

[a] Care delivery, care coordination, and overtreatment are the components of *clinical waste*.
[b] 2019 shares are based on projected 2019 national health spending.
[a, b] Numbers based on Berwick and Hackbarth, 2012; Shrank and colleagues, 2019; and National Health Expenditure Account data extracted from the Peterson-KFF Health System Tracker.

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Consider a patient with chronic heart failure

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Providers Incentives:

- The choice is between a $200 profit and a $100 loss.
- There is **no financial incentive to avoid the duplicate test.**

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- Each provider is still paid with FFS system.
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- Medicare rewards the ACO with 50% of these savings ($500).

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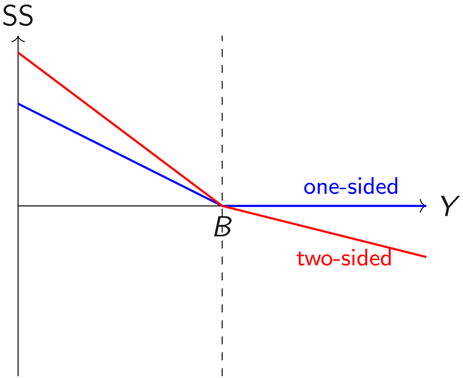

- Under one-sided contract:
  - If $Y < B$, **ACO's reward** $SS = 0.5 \cdot (B - Y) > 0$
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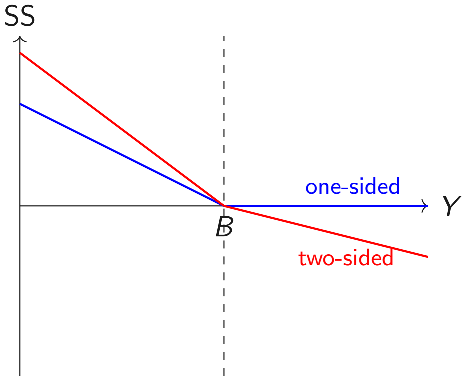

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- **Ratchet Effect (RE):** incentives to delay $Y_{it} \downarrow$ to keep high benchmark.

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The Benchmark Formula and its issues: Adverse Selection

- **Regionally Adjusted Benchmark:**

Medicare Regional Average Spending

$$B_{it+1} = Y_{it}^{H} + \underbrace{\lambda\left(Y_{it}^{R} - Y_{it}^{H}\right)}_{\text{Regional Adjustment (RA)}} \qquad \text{with} \qquad \lambda \in [0,1]$$

The Benchmark Formula and its issues: Adverse Selection

- **Regionally Adjusted Benchmark:**

Medicare Regional Average Spending

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- **ACOs' selection incentive:**

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- **ACOs' selection incentive:**
  - If $Y_{it}^{FFS} < Y_{it}^{R} \Rightarrow RA > 0 \Rightarrow$ Earn SS for free since $B_{it} > Y_{it}^{FFS} \Rightarrow$ **select in (stay)**

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  - If $Y_{it}^{FFS} > Y_{it}^{R} \Rightarrow RA < 0 \Rightarrow$ Do not earn SS even if $Y_{it} < Y_{it-1}^{H} \Rightarrow$ **select out (exit)**

The Benchmark Formula and its issues: Adverse Selection

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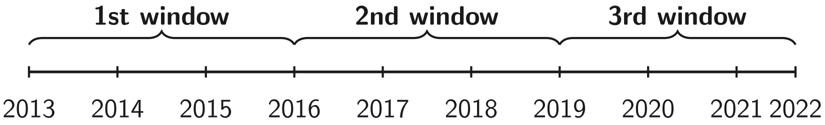
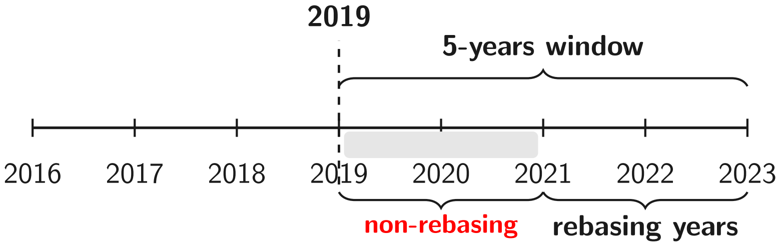
- **Adverse Selection (AS):** ACOs that are ex-ante more efficient than the region ($Y_{it}^{FFS} < Y_{it}^{R}$) are more likely to join the MSSP since they can earn SS without $Y_{it} \downarrow$.

back

Pre-2019 rule: 3-year long windows; all years count for rebasement



2019+ rule: 5-year long windows; first 2 years do not count for rebasement



Ratchet Effect - Results

back

Table 1: Ratchet Effect: Two Way Fixed Effects Regressions

	Full sample	Entry year < 2019
Non-Rebasing Year	0.943***	0.907***
	(0.210)	(0.227)
Observations	4,519	4,133
R-squared	0.180	0.186
Mean	2.324	2.235
SD	4.173	4.207

Dependent Variable: CMS Savings Rate $= (B_{it} - Y_{it})/B_{it}$.

Year FE, ACO FE and Agreement Period (AP) are included.

Standard errors are clustered at ACO level.

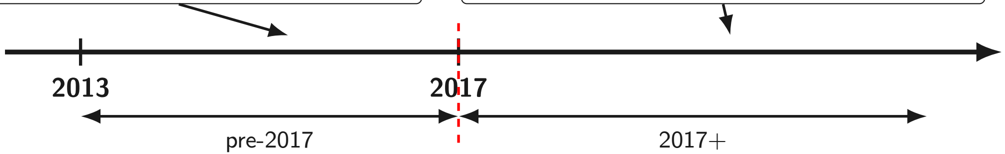
Adverse Selection - Identification Strategy ⏩ back

Rolling windows starting before 2017

- No regional adjustment
- Full rebasement $B_{it+1} = Y_{it}^{H}$

Rolling windows starting in 2017 or later

- Regional adjustment: $+\lambda(Y_{it}^{R} - Y_{it}^{H})$
- $B_{it+1} = \lambda \cdot Y_{it}^{R} + (1-\lambda) \cdot Y_{it}^{H}$



- **Identification:** Exploit quasi-experimental variation in RA Policy.
  - $\text{RA}_{it} = \mathbb{1}\{\text{RA is applied to ACO } i \text{ in year } t\}$ + staggered rollout across ACO cohorts
  - $\text{RA}_{it}^{+} = \mathbb{1}\left\{B_{it+1} > Y_{it}^{H} \text{ due to } \text{RA}_{it} > 0\right\}$ + sign depends on pre-policy factors

Adverse Selection - Results ⏩ back

Table 2: Adverse Selection: Logistic Regressions

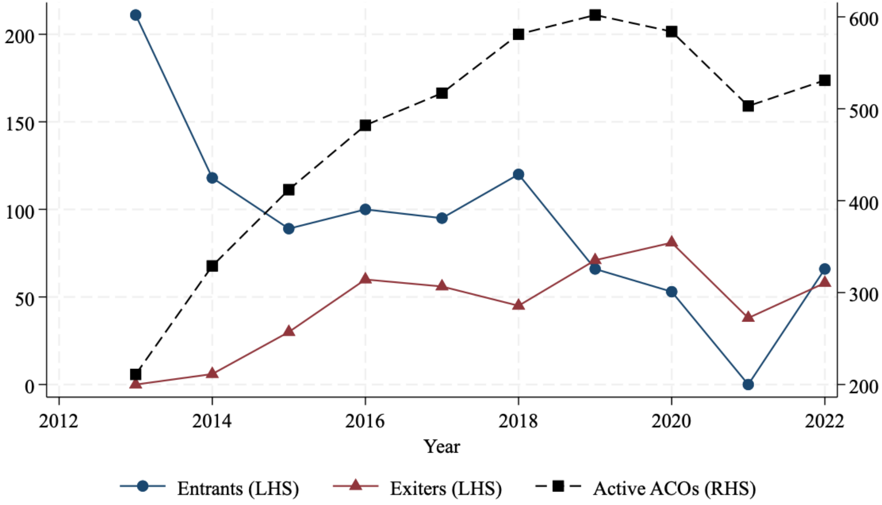
	(1)	(2)	(3)	(4)
Regional Adj	3.641**	3.693***	3.735*	3.773***
	(1.159)	(0.739)	(2.615)	(0.740)
Positive Adj	0.257***	0.266***	0.299**	0.296***
	(0.077)	(0.036)	(0.146)	(0.037)
McFadden R^2	0.157	0.155	0.141	0.139
AP FE	Yes	No	Yes	No
Year FE	Yes	Yes	No	No

Dependent Variable: Indicator for Exit from MSSP

Coefficients represents the odds ratio of Exit

AP FE stands for agreement period (windows) fixed effects

Participation in the MSSP



Data Source: CMS - MSSP Performance Data 2013-2022

Appendix: Participation condition

- At the beginning of period t, the ACO observes current benchmark B_{it} and decides whether to participate in MSSP.
- Let
$$V_{it}^{MSSP}(B_{it}) = \max_{e_{it} \geq 0} \left\{ \pi_{it}^{MSSP}(e_{it}) + \delta\, \mathbb{E}[V_{it+1}(B_{it+1})] \right\}$$
denote the value from participation, and let
$$V_{it}^{FFS}$$
denote the value from remaining under FFS.
- Participation decision:
$$d_{it} = 1 \iff V_{it}^{MSSP}(B_{it}) > V_{it}^{FFS}$$

back

Appendix: Dynamic effort choice

- Conditional on participation, effort solves

$$e_{it}^* = \underset{e_{it}\geq 0}{\operatorname{argmax}} \left\{ \pi_{it}^{MSSP}(e_{it}) + \delta\, \mathbb{E}[V_{it+1}(B_{it+1})] \right\}.$$

- First-order condition:

$$\frac{\partial \pi_{it}^{MSSP}}{\partial e_{it}} + \delta\, \mathbb{E}\left[\frac{\partial V_{it+1}}{\partial B_{it+1}} \cdot \frac{\partial B_{it+1}}{\partial e_{it}} \right] = 0.$$

- Interpretation:
  - **Marginal benefit today:** more effort lowers current spending and raises current shared savings.
  - **Marginal loss tomorrow:** more effort may lower future benchmark B_{it+1} through rebasement, reducing future rents.
- This is the source of the **ratchet effect**: current cost reduction can worsen future incentives. ◂ back

Appendix: Spending process

- MSSP spending equals counterfactual FFS spending minus effort:

$$Y_{it}^{MSSP} = Y_{it}^{FFS} - e_{it}, \qquad e_{it} \geq 0.$$

- Counterfactual FFS spending evolves as

$$\ln Y_{it}^{FFS} = \ln Y_{it-1}^{FFS} + \ln \mathrm{tf}_{it} + \ln \mathrm{rr}_{it} + u_{it},$$

  where:
  - tf_{it} is the inflation / utilization trend factor,
  - rr_{it} is the risk ratio,
  - $u_{it} \sim N(0, \sigma_i^2)$ is an idiosyncratic spending shock.

- Interpretation:
  - Y_{it}^{FFS} is the spending level absent MSSP effort.
  - Effort shifts actual MSSP spending below this counterfactual.

◂ back

Appendix: Per-period MSSP profits

- Per-period profits under MSSP are

$$\pi_{it}^{MSSP}(e_{it}) = SS(Y_{it}^{MSSP}, B_{it}) - C(e_{it}) - F_i.$$

- Shared savings are generated when spending falls below benchmark:

$$SS(Y_{it}^{MSSP}, B_{it}) = s_i \cdot \max\{B_{it} - Y_{it}^{MSSP}, 0\}.$$

- Variable effort cost:

$$C(e_{it}) = \frac{1}{2}\gamma_i \frac{e_{it}^2}{Y_{it}^{FFS}},$$

  where $\gamma_i > 0$ governs the curvature of the cost of cost-reduction effort.

- F_i are fixed costs of participation in MSSP:

back

Likelihood Function

- Let $\theta = (\beta_C, \alpha_C, \beta_F, \alpha_F, \rho)$.

Likelihood Function

- Let $\theta = (\beta_C, \alpha_C, \beta_F, \alpha_F, \rho)$.
- I observe $\{(d_{it}, y_{it})\}_{t=1}^{T_i}$ and $\{\Omega_{it}\}_{t=1}^{T_i}$.

Likelihood Function

- Let $\theta = (\beta_C, \alpha_C, \beta_F, \alpha_F, \rho)$.
- I observe $\{(d_{it}, y_{it})\}_{t=1}^{T_i}$ and $\{\Omega_{it}\}_{t=1}^{T_i}$.
- The likelihood function for ACO i:

$$L_i(\theta) = \sum_k q_{ik} \left[\prod_{t=1}^{T_i - 1} \phi(y_{it}, \Omega_{it}, k; \theta) \Pr(d_{it} = 1 | \Omega_{it}, k; \theta) \right] \times \Pr(d_{iT_i} = 0 | \Omega_{iT_i}, k; \theta)$$

where q_{ik}s are the unobserved type probabilities , and

$$\phi(y_{it} | \Omega_{it}, k) = \frac{1}{\sqrt{2\pi\sigma_{it}^2}} \exp\left(-\frac{(y_{it} - \mu_{it} - e_{it})^2}{2\sigma_{it}^2} \right), \quad \mu_{it} = y_{it-1}^{FFS} \cdot \eta_{it} \cdot rr_{it}$$

and

$$Pr(d_{it} = 1 | \Omega_{it}, k; \theta) = \frac{1}{1 + \exp(v_{it}^F - v_{it}^M)}$$

back

Likelihood Function

- Let $\theta = (\beta_C, \alpha_C, \beta_F, \alpha_F, \rho)$.
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and

$$Pr(d_{it} = 1 | \Omega_{it}, k; \theta) = \frac{1}{1 + \exp(v_{it}^F - v_{it}^M)}$$

back

- I estimate θ with an EM algorithm (Arcidiacono Miller 2011).

Expectation Maximization

- Expectation Step:
  - Use Bayes' Rule to update q_{ik}
  - Update the population probability of each type, w_k
  - Using $\theta^{(m)}$ and $p^{(m)}$, update the CCP

$$p_1^{(m+1)} = \frac{1}{1 + \exp\left[v_{it}^F(\Omega_{it}, k; p^{(m)}, \theta^{(m)}) - v_{it}^M(\Omega_{it}, k; p^{(m)}, \theta^{(m)})\right]}$$

back

Expectation Maximization

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  - Use Bayes' Rule to update q_{ik}
  - Update the population probability of each type, w_k
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$$p_1^{(m+1)} = \frac{1}{1 + \exp\left[v_{it}^F(\Omega_{it}, k; p^{(m)}, \theta^{(m)}) - v_{it}^M(\Omega_{it}, k; p^{(m)}, \theta^{(m)})\right]}$$

- Maximization Step: simulated value function

$$\theta^{(m+1)} = \underset{\theta}{\operatorname{argmax}} \sum_i \sum_k q_{ik} \log L_{ik}(\theta | q_{ik}^{(m+1)}, p_1^{(m+1)}, \Omega_{it}, k))$$

back

Simulated Value Function

To evaluate v_{it}^M, we use forward simulation to simulate S paths of participation effort, spending and profits

$$v_{it}^M \approx \frac{1}{S} \sum_{s=1}^{S} \sum_{h=0}^{H} \delta^h \pi_{i,t+h}^{(s)}$$

Simulated Value Function

To evaluate v_{it}^M, we use forward simulation to simulate S paths of participation effort, spending and profits

$$v_{it}^M \approx \frac{1}{S}\sum_{s=1}^{S}\sum_{h=0}^{H}\delta^h \pi_{i,t+h}^{(s)}$$

Given some value of the parameters θ, each simulated path uses:

- d_{it} draws from Kernel probabilities $\hat{\Pr}(d_{it} = 1|\Omega_{it})$
- e_{it} from the Euler equation euler equation
- y_{it} from the spending equation
- $\tilde{y}_{it}$ and b_{it} move forward according to the MSSP rules. back

Counterfactual: Turning off RE

- Prevent Y_{it} from affecting B_{it+1}

$$B_{it+1} = Y_{it}^{H} + \lambda \left(Y_{it}^{R} - Y_{it}^{H} \right) \quad \text{where} \quad Y_{it}^{H} = \frac{Y_{it}^{MSSP} + Y_{it-1}^{MSSP} + Y_{it-2}^{MSSP}}{3}$$

set $\lambda = 1$
to turn off RE

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- Y_{it} no longer affects B_{it+1} $\Rightarrow$ **No more RE**

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- Y_{it} no longer affects $B_{it+1} \Rightarrow$ **No more RE**

- **Full Regional Benchmark**

$$B_{it+1} = Y_{it}^{R}$$

$\Rightarrow$ AS as is at its strongest.

Estimation Results: Variable Costs

	K=1	K=2	K=3	K=4
Risk Score	0.541**	0.493***	0.435*	0.451***
	(0.156)	(0.137)	(0.053)	(0.061)
Beneficiaries	−0.241***	−0.193***	0.135*	0.173***
	(0.059)	(0.039)	(0.035)	(0.040)
Hospital	1.641**	1.523**	1.735**	1.613**
	(0.316)	(0.358)	(0.415)	(0.421)
Type 1		0.302***		
		(0.045)		
Type 2		0.217***	0.134**	
		(0.052)	(0.043)	
Type 3		0.147**	0.094**	0.056
		(0.042)	(0.028)	(0.053)
GOF	0.852	0.881	0.936	0.904

(i) Coefficients = Δ$ in the marginal cost of reducing spending by 1%.
(ii) Standard errors computed via bootstrapping, with 1000 resampling.

back

Estimation Results: Fixed Costs

	K=1	K=2	K=3	K=4
Beneficiaries	0.142**	0.194**	0.136**	0.154**
	(0.059)	(0.039)	(0.042)	(0.041)
Hospital	0.640**	0.554**	0.637**	0.643**
	(0.116)	(0.158)	(0.135)	(0.121)
Type 1		0.252***		
		(0.045)		
Type 2		0.253***	0.216***	
		(0.052)	(0.043)	
Type 3		0.247**	0.214**	0.156*
		(0.068)	(0.057)	(0.083)
GOF	0.852	0.881	0.936	0.904

(i) Coefficients = percentage change in fixed cost for a unit increase in x.
(ii) Standard errors computed via bootstrapping, with 1000 resampling.

Counterfactual: Turning off AS

- Remove the Regional Adjustment

$$B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$$

↑

set $\lambda = 0$
to turn off AS

Counterfactual: Turning off AS

- Remove the Regional Adjustment

$$B_{it+1} = Y_{it}^{H} + \lambda (Y_{it}^{R} - Y_{it}^{H})$$

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- RA does not enter $B_{it+1} \Rightarrow$ **No more AS**

Counterfactual: Turning off AS

- Remove the Regional Adjustment

$$B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$$

set $\lambda = 0$
to turn off AS

- RA does not enter $B_{it+1} \Rightarrow$ **No more AS**
- **Fully Rebased Benchmark**

$$B_{it+1} = Y_{it}^{H}$$

$\Rightarrow$ RE as is at its strongest.

New Benchmark Design: Conditional Regionalization

- Status quo benchmark: $B_{it+1} = \underbrace{Y_{it}^{H}}_{\substack{\text{rebased}\\\text{benchmark}}} + \underbrace{\lambda \cdot (Y_{it}^{R} - Y_{it}^{H})}_{\substack{\text{regional}\\\text{adjustment}}}$

  Issue: RA is applied independently from the ACOs' spending behavior during the MSSP.

New Benchmark Design: Conditional Regionalization

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  Issue: RA is applied independently from the ACOs' spending behavior during the MSSP.

- **Conditional Regionalization:**

Historical vs. Regional spending	Current vs Historical spending **Saving:** $Y_{it} < Y_{it}^H$	 **Loss:** $Y_{it} \geq Y_{it}^H$
More efficient $Y_{it}^H < Y_{it}^R$	**Regionalize** $B_{it+1} = Y_{it}^H + \lambda(Y_{it}^R - Y_{it}^H)$	**No regionalization** $B_{it+1} = Y_{it}^H$
Less efficient $Y_{it}^H \geq Y_{it}^R$	**No regionalization** $B_{it+1} = Y_{it}^H$	**Regionalize** $B_{it+1} = Y_{it}^H + \lambda(Y_{it}^R - Y_{it}^H)$

Case 1: More efficient than the region + real savings $\Rightarrow$ **RA is applied**.

back

New Benchmark Design: Conditional Regionalization

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- **Conditional Regionalization:**

Historical vs. Regional spending	**Current vs Historical spending**	
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Case 2: More efficient than the region + no real savings $\Rightarrow$ **RA is not applied**.

back

New Benchmark Design: Conditional Regionalization

- Status quo benchmark: $B_{it+1} = \underbrace{Y_{it}^{H}}_{\text{rebased benchmark}} + \underbrace{\lambda \cdot (Y_{it}^{R} - Y_{it}^{H})}_{\text{regional adjustment}}$

  Issue: RA is applied independently from the ACOs' spending behavior during the MSSP.

- **Conditional Regionalization:**

Historical vs. Regional spending	**Current vs Historical spending** — **Saving:** $Y_{it} < Y_{it}^{H}$	**Loss:** $Y_{it} \geq Y_{it}^{H}$
More efficient $Y_{it}^{H} < Y_{it}^{R}$	**Regionalize** $B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$	**No regionalization** $B_{it+1} = Y_{it}^{H}$
Less efficient $Y_{it}^{H} \geq Y_{it}^{R}$	**No regionalization** $B_{it+1} = Y_{it}^{H}$	**Regionalize** $B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$

Case 3: Less efficient than the region + real savings $\Rightarrow$ **RA is not applied**.

back

New Benchmark Design: Conditional Regionalization

- Status quo benchmark: $B_{it+1} = \underbrace{Y_{it}^{H}}_{\text{rebased benchmark}} + \underbrace{\lambda \cdot (Y_{it}^{R} - Y_{it}^{H})}_{\text{regional adjustment}}$

  Issue: RA is applied independently from the ACOs' spending behavior during the MSSP.

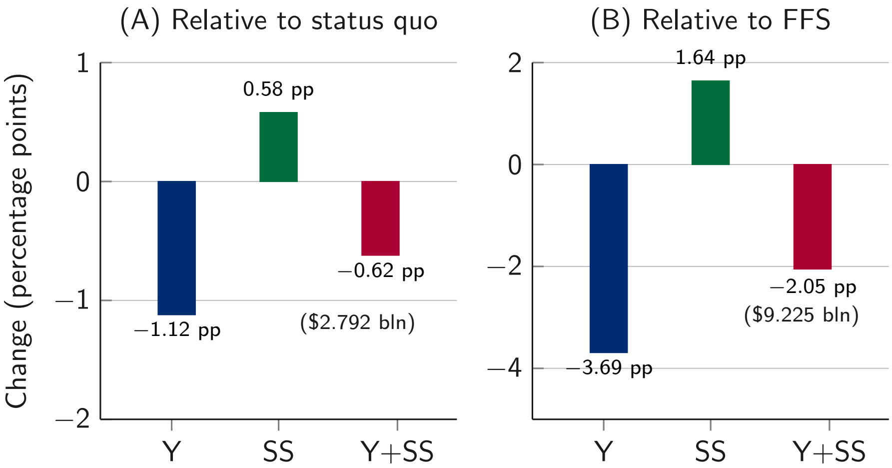
- **Conditional Regionalization:**

Historical vs. Regional spending	Current vs Historical spending: **Saving:** $Y_{it} < Y_{it}^{H}$	Current vs Historical spending: **Loss:** $Y_{it} \geq Y_{it}^{H}$
More efficient $Y_{it}^{H} < Y_{it}^{R}$	**Regionalize** $B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$	**No regionalization** $B_{it+1} = Y_{it}^{H}$
Less efficient $Y_{it}^{H} \geq Y_{it}^{R}$	**No regionalization** $B_{it+1} = Y_{it}^{H}$	**Regionalize** $B_{it+1} = Y_{it}^{H} + \lambda(Y_{it}^{R} - Y_{it}^{H})$

Case 4: Less efficient than the region + no real savings $\Rightarrow$ **RA is applied**.

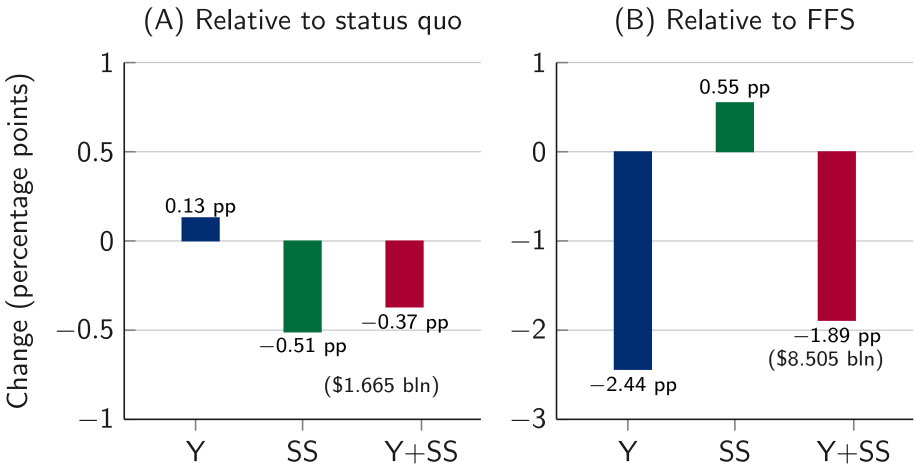
back

Scenario w/out RE vs. Status Quo and FFS



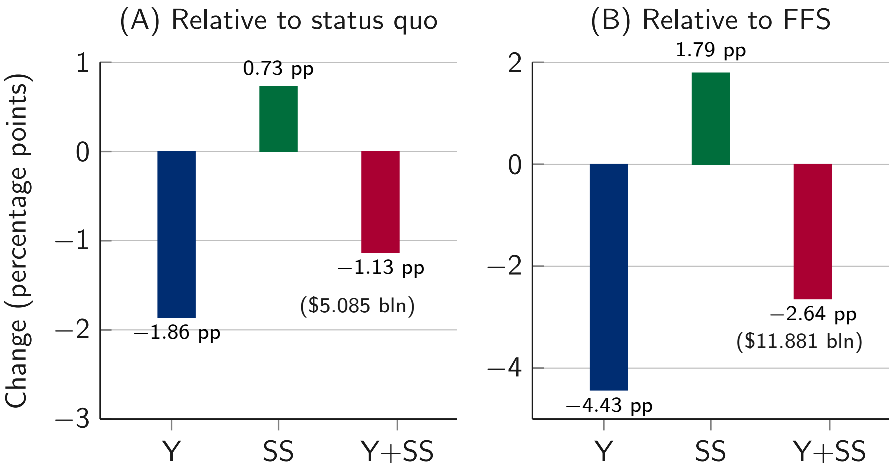
Net Spending (Y), Shared Savings (SS), Total Spending (Y + SS). back

Scenario w/out AS vs. Status Quo and FFS



Net Spending (Y), Shared Savings (SS), Total Spending (Y + SS). back

Conditional Regionalization vs. status quo and FFS



Net Spending (Y), Shared Savings (SS), Total Spending (Y + SS). back