Risk Adjustment, Self-Selection and Plan Design in Medicare Advantage

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Introduction

Data

Model

Estimation

Counterfactual

Medicare System

Medicare is a U.S. federal health insurance program mainly for individuals aged 65 and older, comprising two main components:

- **Traditional Medicare (TM)**: Usually combined with Medigap plans, offering generous coverage but higher premiums.
- **Medicare Advantage (MA)**: A managed competition system where the government subsidizes private insurers to provide plans with lower premiums and reduced coverage.

Medicare Advantage

- **Managed Competition**: The government provides fixed and predetermined subsidies to private insurance firms, which in turn offer insurance plans to beneficiaries.
- **Cream Skimming**: Firms strategically target healthier beneficiaries to maximize profits.
- **Risk Adjustment**: The government adjusts subsidy payments to insurers based on beneficiaries' observable characteristics.
- Can risk adjustment effectively neutralize insurers' incentives for cream skimming when beneficiaries have private information about their health status?

Simplified Risk Adjustment Scenario

- ▶ Equal numbers of young and old individuals:
  - ▶ **Young**: 80% healthy, 20% sick
  - ▶ **Old**: 20% healthy, 80% sick
- ▶ Cost of care: $1,000 for healthy individuals, $5,000 for sick individuals
- ▶ Age is observable to the government; health status is private information

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- ▶ Cost of care: \$1,000 for healthy individuals, \$5,000 for sick individuals
- ▶ Age is observable to the government; health status is private information
- ▶ Subsidy risk-adjusted by age:
  - ▶ **Young**: \$1,000 × 0.8 + \$5,000 × 0.2 = \$1,800
  - ▶ **Old**: \$1,000 × 0.2 + \$5,000 × 0.8 = \$4,200
- ▶ Average subsidy rate by health status:
  - ▶ **Healthy**: \$1,800 × 0.8 + \$4,200 × 0.2 = \$2,240 (**above** cost of \$1,000)
  - ▶ **Sick**: \$1,800 × 0.2 + \$4,200 × 0.8 = \$3,960 (**below** cost of \$5,000)
- ▶ **Firms still prefer healthy individuals even after risk adjustment**.

Self-Selection and Strategic Plan Design

▶ When beneficiaries have private information about their health status, they can engage in self-selection when choosing plans.

▶ Firms can strategically design their plans to attract healthier individuals through this self-selection (e.g., lower premiums, less generous coverages).

Motivation

► Medicare Advantage (MA) has gained popularity, with 54% of Medicare beneficiaries enrolled in MA plans as of 2024.

► Previous studies indicate that competition in MA markets can enhance welfare but often neglect the impact of self-selection based on private information.

► Current risk adjustment mechanisms fail to account for self-selection and endogenous plan design, potentially causing market distortions.

Research Questions

▶ How does self-selection influence plan design and market outcomes in MA market?

▶ What are the welfare implications of these interactions?

Methodology

- ▶ Develop a structural model of demand and supply that incorporates self-selection and endogenous plan design.
- ▶ Estimate the model using Medicare Advantage data.
- ▶ Conduct counterfactual simulation to analyze scenario where self-selection effects are neutralized.

Key Findings

Counterfactual simulation indicate that if the risk adjustment policy can neutralize self-selection effect:

- ▶ Consumer surplus increases by 11%
- ▶ Firm profits increase by 34.6%
- ▶ No significant change in government spending

Contributions

▶ **Theoretical**: Developed a managed competition model incorporating endogenous plan design and self-selection under private information.

▶ **Empirical**: Applied the model to Medicare Advantage data, evaluating the welfare implications of self-selection effects.

▶ **Policy**: Provided insights for enhancing risk adjustment payment policies to mitigate market distortions.

Data

- **Individual Level**: Medicare Current Beneficiary Survey (MCBS)
  - Contains detailed information on individual beneficiaries, including demographics and plan choice.
- **Plan Level**: Centers for Medicare and Medicaid Services (CMS) datasets on MA plans
  - Includes data on plan generosity levels, premiums, and other attributes such as network and additional benefits.

Summary Statistics

Table: Consumer Summary Statistics by Plan Type

Category	Variable	TM	MA	Overall
Demographics	Age	73.887	74.283	73.997
	Female	0.524	0.557	0.533
	Income	70,203	50,484	64,697
	White Race	0.873	0.827	0.860
	High Education	0.607	0.469	0.568
Medicare	Risk-Adjusted Subsidy	8913	8847	8894
	Spending	8340	6012	7692
	MA Enrollment	-	-	0.279

Note: The risk adjust subsidy is the capitated payment to the plan. The spending is the total spending on the consumer. The MA enrollment is the proportion of consumers enrolled in MA plans.

Timing

- ▶ **Government Sets Subsidy Rates:** Determines capitation payments using a risk adjustment formula.
- ▶ **Stage 1 - Firm Decisions:** Firms set the prices and generosity levels of their plans to maximize profit after accounting for subsidies.
- ▶ **Stage 2 - Consumer Choices:** Consumers choose plans (including the outside option) that best meet their needs, using their private information.

Demand: Private Information

Each consumer is characterized by two variables:

- ▶ An observable risk-adjusted capitation rate (k_i), which serves as a proxy for the average expected health expenditure within a cohort with similar observable characteristics.

- ▶ A private health perception (e_i), which directly influences their preference for plan generosity and, consequently, their plan choice.

$$\ln(e_i) = \ln(k_i) + \tau_i, \quad \tau_i \sim N(0, \sigma_\tau^2) \tag{1}$$

Demand: Utility

The utility of consumer i from plan j is given by

$$u_{ij} = \beta_i g_j - \alpha_i p_j + \lambda_i^A A_j + \lambda^X X_j + \xi_j + \varepsilon_{ij}. \tag{2}$$

- ▶ g_j and p_j are the generosity [1] and premium of plan j.
- ▶ A_j is MA type indicator
- ▶ X_j is a vector of other plan characteristics
- ▶ ξ_j is the unobserved plan-specific quality
- ▶ ε_{ij} is the idiosyncratic error term, following a T1EV distribution

The utilitiy of the outside option (TM + Medigap) is

$$u_{i0} = \beta_i g_0 - \alpha_i p_0 + \xi_0 + \varepsilon_{i0}. \tag{3}$$

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[1] Generosity is measured by expected OOP under a specific health condition

Demand: Hetereogeneity

Preferences for plan generosity (β_i) are influenced by health perception e_i

$$\beta_i = \bar{\beta} + \gamma \ln e_i. \tag{4}$$

Preferences for plan premiums (α_i) are associated with income level

$$\alpha_i = \bar{\alpha} + \rho^{\text{inc}} \text{inc}_i. \tag{5}$$

Preferences for the MA type (λ_i^A) relate to demographic factors and existing health coverage, including Medicaid eligibility and employer-sponsored insurance (ESI) coverage

$$\lambda_i^A = \bar{\lambda}^A + \rho^{\text{edu}} \text{edu}_i + \rho^{\text{white}} \text{white}_i + \rho^{\text{Mcd}} \text{Mcd}_i + \rho^{\text{ESI}} \text{ESI}_i. \tag{6}$$

Demand: Plan Mean Utility

The mean utility of plan j relative to the outside option is

$$\delta_j = \bar{\beta}(g_j - g_0) - \bar{\alpha}(p_j - p_0) + \bar{\lambda}^A A_j + \lambda^X X_j + \xi_j - \xi_0, \tag{7}$$

and let the $\mu_i j$ denote the individual-specific deviation from δ_j, we can rewrite the utility function as

$$u_{ij} = \delta_j + \mu_{ij} + \varepsilon_{ij}. \tag{8}$$

Demand: Plan Choice Probability

Considering the T1EV distribution of ε_{ij}, the probability that consumer i chooses plan j is given by

$$s_{ij}(e_i) = \frac{\exp\left(\delta_j + \mu_{ij}(e_i)\right)}{\sum_{j'=0}^{J} \exp\left(\delta_{j'} + \mu_{ij'}(e_i)\right)}. \tag{9}$$

The market share of plan j is given by the weighted sum of the individual choice probabilities

$$q_j = \sum_i w_i \cdot s_{ij}(e_i) = \sum_i w_i \cdot \int s_{ij}(e)\, dF_e(e). \tag{10}$$

- ▶ w_i is the sampling weight of consumer i

Supply: Competition Setting

▶ **Bertrand-Nash Competition**: Firms compete on prices and plan generosity levels, considering plan offerings and other exogenous attributes, with each plan having specific cost functions.

▶ **Multi-Product, Multi-Market**: Firms operate as multi-product entities competing across multiple submarkets.

▶ **Short-Run Focus**: The model does not account for the entry and exit of plans.

▶ **Selection Effect**: The cost of plans is influenced not only by the plan's generosity level but also by the health status of the individuals who select the plan, which is itself affected by the plan's generosity.

Supply: Costs

The cost of a plan is influenced by its generosity level g_j and other observable exogenous attributes X_j. The marginal cost function is expressed as:

$$mc_j(g_j) = mc_j^g(g_j) + \underbrace{w^X \cdot X_j + \omega_j}_{\text{predetermined}}, \tag{11}$$

- ▶ ω_j represents the unobserved plan-specific cost shock.
- ▶ Each plan has a unique cost function due to the predetermined components.
- ▶ Higher generosity in plans increases costs both directly, through more generous coverage, and indirectly, by attracting more sick individuals, which adds further expenses to the plan (the **Selection Effect**).

Supply: Plan Design Problem

The total profit for a firm in county c is the aggregate of profits from all its offered plans

$$\pi_{f,c} = \sum_{j \in \mathcal{J}_{f,c}} \pi_j. \tag{12}$$

The state-level profit for MA firm f is then the sum of profits across all counties c where firm f operates

$$\pi_f = \sum_{c \in \mathcal{C}_f} \pi_{f,c}, \tag{13}$$

where $\mathcal{C}_f$ denotes the set of counties in which firm f is active.

The firm's plan design problem can be formulated as maximizing state-level profit by strategically setting bid and generosity levels for each plan

$$\max_{b_f, g_f} \pi_f = \sum_{c \in \mathcal{C}_f} \sum_{j \in \mathcal{J}_{f,c}} (b_j - mc_j(g_j)) \cdot M_c \cdot s_{c,j}(g, b), \tag{14}$$

Supply: Necessary Optimality Conditions

The first-order conditions for the firm's plan design problem are

$$\{b_j\}: \quad \sum_{c \in \mathcal{C}_f} M_c \left(s_{c,j} + \sum_{j \in \mathcal{J}_{f,c}} (b_j - mc_j) \cdot \frac{\partial s_{c,j}}{\partial b_j} \cdot \frac{\partial b_j}{\partial p_j} \right) = 0 \quad \forall j, \qquad (15)$$

$$\{g_j\}: \quad \sum_{c \in \mathcal{C}_f} M_c \left(\frac{\partial mc_j}{\partial g_j} \cdot s_{c,j} - \sum_{j \in \mathcal{J}_{f,c}} (b_j - mc_j) \cdot \frac{\partial s_{c,j}}{\partial g_j} \right) = 0 \quad \forall j, \qquad (16)$$

where $\frac{\partial b_j}{\partial p_j} = 1$.

Each firm faces unique optimization conditions due to differences in plan offerings and the specifics of their cost functions (see Equation 11).

Estimation: Consumer Heterogeneity

Table: Estimation Results of Consumer Preference Heterogeneity

Variable	Parameter	Estimate	Std Error
Generosity Preference			
Health Perception	γ	0.115	(0.052)
Premium Preference			
High Income Level	ρ^{inc}	-0.473	(0.248)
MA Type Preference			
High Education Level	ρ^{edu}	-0.275	(0.203)
White Race	ρ^{white}	-0.173	(0.280)
Medicaid Coverage	ρ^{Mcd}	0.039	(0.244)
ESI Coverage	ρ^{ESI}	-2.543	(0.404)
Private Information Distribution			
SD of Health Perception	σ_τ	3.983	(2.733)

Note: ESI stands for employer-sponsored insurance.

Plan Costs

Table: Estimation of Plan Marginal Cost

Variable	I Estimate	Std Error	II Estimate	Std Error
Coverage				
Generosity	1.353	(0.171)	1.367	(0.174)
Generosity^2	0.160	(0.020)	0.140	(0.021)
Network				
Rating (per star)	0.150	(0.019)	0.157	(0.020)
HMO	0.237	(0.022)	0.247	(0.023)
Additional Benefits				
Dental	0.170	(0.023)	0.158	(0.025)
Vision	0.039	(0.055)	0.045	(0.055)
Hearing	0.095	(0.026)	0.118	(0.027)
Firm Fixed Effect				
Aetna	-	-	-0.017	(0.033)
Anthem	-	-	-0.181	(0.049)
UHG	-	-	-0.079	(0.030)

"Equal-Profit" Risk Adjustment

▶ **Objective**: Neutralize self-selection effects.

▶ **Method**: Adjust payment to plans to ensure identical profit across all beneficiaries, regardless of their health status. (i.e. healthy and sick individuals have the same expected profits for the firm)

▶ **Outcome**:
  ▶ Ensures plan costs depend only on generosity, not on enrollees' health status.
  ▶ Eliminates cost distortions caused by beneficiaries' self-selection.

Welfare Comparison

Table: Welfare Comparison Between Current and Equal-Profit Risk Adjustment

Metrics	Current	Equal-Profit	% Change
Total MA share (%)	30.58	33.25	8.72%
Total Consumer Surplus	22.08	24.51	11.01%
Total Producer Surplus	14.45	19.45	34.60%
Gov Spending on TM	370.26	357.46	-3.46%
Gov Spending on MA	163.51	176.31	7.82%
Capitation Adjustment	-	0.95	-
Total Gov Spending	533.77	534.72	0.18%

Note: The monetary values are in billion dollars. The capitation adjustment is the change in the total capitation payment from the government to MA firms, compared to the current policy. The total government spending is the sum of government spending on TM and MA.

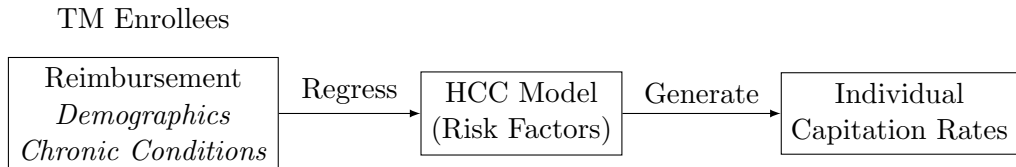*Thank You!*

Appendix

Appendix: Risk Adjustment Generation

TM Enrollees

Figure: Capitation Rate Generation Process
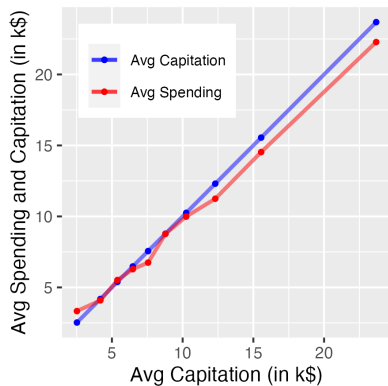
Appendix: Risk Adjustment Outcomes

Figure: Conditional on Capitation Deciles
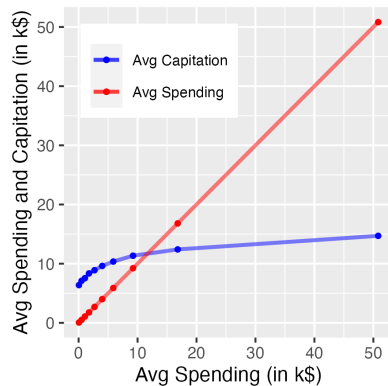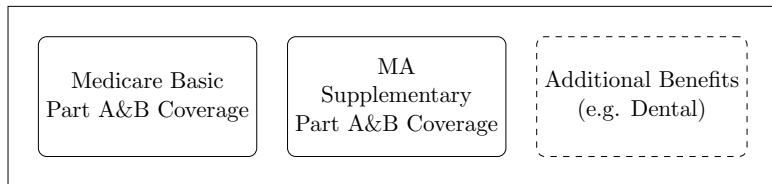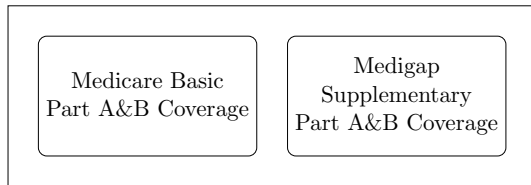

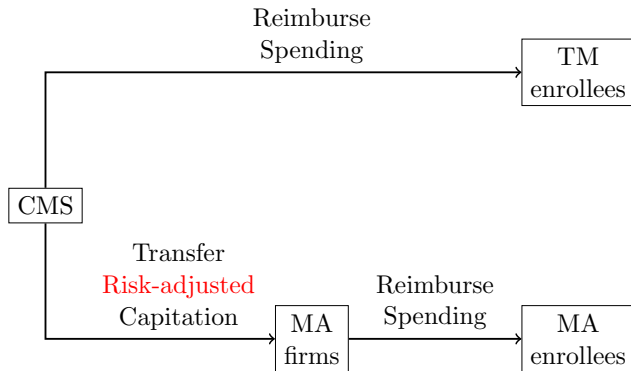Figure: Conditional on Spending Deciles

Appendix: Benefit Structure

Medicare Advantage

| Medicare Basic Part A&B Coverage | MA Supplementary Part A&B Coverage | Additional Benefits (e.g. Dental) |

TM+Medigap

| Medicare Basic Part A&B Coverage | Medigap Supplementary Part A&B Coverage |

An Example: Medicare Advantage

- ▶ Traditional Medicare (TM) is FFS.
- ▶ Medicare Advantage (MA) is managed competition.
- ▶ Beneficiaries choose between TM and MA.