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

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Abstract

Risk adjustment in Medicare Advantage aims to equalize the profitability across diverse beneficiary groups, preventing insurers from favoring inherently more profitable populations. However, this mechanism can be undermined by the strategic behaviors of MA firms, which design plans to attract individuals with specific private health information. This paper explores the interaction between endogenous plan design and beneficiary self-selection, revealing how MA firms exploit these strategies to attract the most profitable groups. This framework explains prevailing plan design trends and persistent issue of overpayment in MA. Counterfactual simulation shows that an additional generosity-specific capitation adjustment, designed to equalize profitability among beneficiaries, could improve consumer welfare by 11.01% and producer surplus by 34.60%.

Keywords: private information, self-selection, product design, risk adjustment
JEL Codes: L11, I13, I18, D22, D82

1 Introduction

Managed competition in health insurance markets is a common practice in countries such as Switzerland, the Netherlands, Germany, and the United States. In these systems, the government subsidizes health insurance plans offered by private firms to enhance competition. This competition is intended to improve the efficiency and quality of health insurance by requiring firms to vie for enrollees through various plan offerings. Given the diverse health statuses of individuals, governments often implement a risk adjustment mechanism in capitation payments to insurance firms. This mechanism, alongside other regulations, aims to ensure universal access to health insurance. However, no risk adjustment mechanism is perfect, and the strategic behavior of insurance firms can sometimes subvert the system's intentions as envisioned by policymakers.

This paper investigates the Medicare Advantage (MA) market in the United States, a prime example of managed competition in health insurance subsidized by the government. MA provides private health insurance plans to Medicare beneficiaries, offering an alternative to Traditional Medicare (TM) plans. Unlike TM, which is typically more comprehensive but also more costly, MA plans, designed by private insurance firms, offer a range of costs and benefits. These plans are usually more economical than their TM counterparts, attracting a growing number of enrollees each year. From 2007, where only 19% of Medicare beneficiaries chose MA plans, the participation has increased to 54% by 2024 (Freed et al., 2024), underscoring the substantial welfare impact and significant government expenditure involved.

MA plans operate under a subsidy program where the primary revenue for MA firms is not premiums paid by enrollees but capitation payments from the government. These payments are predetermined and based on risk adjustment calculations designed to predict average group health expenditures rather than individual costs. This system, inherently imperfect, does not accurately predict individual expenses, leading to scenarios where some beneficiaries incur higher costs than anticipated while others incur less. In a setting where beneficiaries can freely choose between MA and TM plans, they may use private information to guide their choice. Meanwhile, if MA firms anticipate that beneficiary choices depend on private information not captured by the risk adjustment models, they may strategically design plans to attract the most profitable enrollees. This self-selection and strategic plan design can introduce distortions not intended by policymakers, complicating the assessment and effectiveness of risk adjustment mechanisms and the overall MA market.

Assessing the impact of self-selection and strategic plan design on the MA market presents several challenges. First, private information about beneficiaries' health status is unobservable, complicating the precise measurement of self-selection effects on market outcomes. Second, the complexity of the MA bidding system—which influences how plans are priced and structured—adds another layer of difficulty in modeling the MA firm strategy. Finally, the endogeneity of plan design and selection, as well as the impact of changes to risk adjustment on plan design, poses an additional challenge.

To make progress, I first conducted preliminary analyses to examine the self-selection effect. The reduced-form empirical analysis confirms that consumers exhibit heterogeneous health expectations and make plan choices accordingly. The results indicate that individuals with a positive health perception are more likely to select MA plans in the subsequent year. Additionally, regardless of the plan chosen, these individuals typically incur lower health expenditures compared to those with a negative health perception, suggesting that advantageous selection contributes to the cost differences observed between TM and MA enrollees.

Building on this foundation, I developed a structural model to capture both self-selection and strategic plan design within the MA market. The model assumes that the government is the initial decision-maker, setting capitation payments based on observable individual characteristics. MA firms then decide on plan generosity and bid. Ultimately, individuals choose plans based on their health expectations and the attributes of the plans.

The demand model accounts for consumer heterogeneity in preferences for plan generosity, influenced by their private health information. I employed the Maximum Likelihood Estimation method to estimate the demand model, incorporating simulations of private health perceptions, which are assumed to follow a distribution centered around the prediction from the risk adjustment model. The findings reveal that, controlling for other factors, individuals with a positive health perception place less value on plan generosity compared to those with a negative health perception, making them more inclined to choose less generous but more economical MA plans.

Next, I modeled MA firms' behavior as a Bertrand-Nash competition, allowing them to decide on plan generosity and bid. This approach enabled the estimation of plan-level marginal costs and the contributions of various factors to these costs, including plan generosity. The estimated cost function suggests that as generosity increases, costs rise faster than the average capitation payment, making it less profitable for MA firms to offer more generous plans. This finding aligns with the intuition that when MA plans become more generous, they attract more individuals with negative health perceptions, increasing the plan-level marginal costs without full compensation by the risk adjustment model, which only accounts for observable characteristics. This explains why MA plans tend to be less generous than TM plans.

Finally, I evaluated a counterfactual policy scenario, introducing an additional capitation payment to equalize profitability across MA firms. Under this scenario, in the absence of selection effects, MA plans would be more generous and premiums higher. However, consumer welfare would increase by 11.01%, while producer surplus would decrease by 34.60%. Additionally, this policy would enhance the popularity of MA plans, with total government expenditures remaining nearly constant.

This paper contributes to the literature on risk adjustment and selection in health insurance markets. Theoretical frameworks by Shen and Ellis (2002) and Glazer and McGuire (2000) set the stage by outlining the challenges and goals of risk adjustment mechanisms. This is complemented by empirical evidence from (Lieberman and Ginsburg, 2023; CMS, 2021), which demonstrates how MA plans preferentially attract healthier individuals, and studies like (Geruso and Layton, 2020; Brown et al., 2014) that explore impacts of insurer behaviors such as upcoding. Additionally, research by (Aizawa and Kim, 2018; Keane and Stavrunova, 2016) further investigates how these dynamics influence insurer strategies and beneficiary choices, revealing patterns of advantageous selection.

This paper also enhances the literature on endogenous product design within the Medicare Advantage context. The seminal works of BLP model (Berry et al., 1995, 2004) , lays the foundational framework for understanding how product differentiation strategies are developed based on discrete-choice model. This is further explored by Nevo (2001), who examines the nuances of market structures influencing product differentiation. The methodological extensions provided by Goolsbee and Petrin (2004), Fan (2013) and Conlon and Gortmaker (2020) incorporate consumer response analyses, enriching the original BLP models by integrating endogenous product design elements into their analyses. The interplay between product design and consumer selection in health insurance markets is fundamentally influenced by theoretical models such as Rothschild and Stiglitz (1976), which explores market equilibrium under conditions of asymmetric information. This seminal theory provides a critical backdrop for understanding the dynamics of insurance markets, where insurers must design products that cater to a diverse range of consumer risk profiles without precise information about each individual's risk level. Empirical studies by Miller (2016) and Guglielmo (2015), alongside Borenstein and Rose (1994) and Hitt and Chen (2005) , examine how Medicare Advantage (MA) firms employ strategic design to attract specific consumer segments.

Finally, this paper contributes to empirical studies assessing the efficiency and policy impacts within the MA market. Foundational work by Town and Liu (2003), Newhouse et al. (2015) and Cabral and Mahoney (2019) discuss the welfare implications of Medicare-related markets, while studies by (Newhouse and McGuire, 2014; Dunn, 2010; Dafny, 2010) analyze coverage generosity value of MA plans. Further insights into beneficiary outcomes by Duggan et al. (2016) and Lustig (2007), as well as the impact of information sharing regulatory discussed by Vatter (2023), complemented by (Fahle et al., 2016), enrich our understanding of the broader implications of MA policies.

Overall. I bridge the gap between theoretical frameworks for risk adjustment mechanisms design and empirical literature on MA market dynamics. This study offers a novel perspective on the welfare implications of MA market by integrating the risk adjustment, endogenous product design, and self-selection to provide a comprehensive welfare analysis.

The rest of the paper is structured as follows. Section 2 provides an overview of the institutional background, suggestive evidence of self-selection and strategic plan design in the MA market. Section 3 describes the data used in the analysis. Section 4 presents a structual model where consumers choose Medicare plan based on their health expectation and the plan attributes, and the MA firms design the plan to maximize their profit. Section 5 discusses the estimation strategy and results. Section 6 presents the counterfactual analysis where an addtional captiation is introduced to ensure equal-profit condition for MA firms. Sectoin 7 concludes the paper.

2 Institutional Background

2.1 Medicare System

Medicare represents a fundamental component of the United States' social insurance system. It is administered by the Centers for Medicare & Medicaid Services (CMS), an agency within the Department of Health and Human Services (HHS). Established in 1965, Medicare's primary purpose is to provide health insurance coverage to individuals aged 65 and older, as well as to younger people with certain disabilities and diseases.

The funding for Medicare comes from three main sources: payroll taxes levied on workers and employers, premiums from beneficiaries, and contributions from the federal budget. This multifaceted funding structure ensures Medicare's operation and sustainability, supporting a wide range of healthcare services for its beneficiaries.

Medicare's financial significance is profound, accounting for a substantial portion of the federal budget with total expenditures reaching $905 billion in 2022. This reflects the program's broad impact, covering 65 million individuals, including both seniors and disabled persons (CMS, 2023). Notably, a significant number of beneficiaries choose Medicare Advantage (Part C) plans, indicating a strong preference for these private health plan options.

In the following section, I will delve into the specifics of Medicare Advantage, exploring its features and the role it plays in the broader Medicare ecosystem.

2.2 Medicare Advantage

Medicare is divided into several parts, with Traditional Medicare (TM) encompassing Part A (hospital insurance) and Part B (medical insurance), and Medicare Advantage (MA) offering an alternative way for beneficiaries to receive their Medicare benefits through private health plans. While TM is directly managed by the federal government, MA plans are offered by private insurers that contract with CMS to provide all Part A and Part B services.

MA was initiated in the Balanced Budget Act of 1997, MA's development, detailed by Mcguire et al. (2011), reflects a significant ideological and practical shift towards incorporating market mechanisms within Medicare. The introduction of MA was driven by a confluence of factors aiming to infuse the Medicare program with the efficiencies of market competition and the diversity of plan options.

The rationale behind MA's introduction centered on the belief that market competition could drive down costs, increase efficiency, and offer beneficiaries a wider array of health plan choices, each tailored to meet their unique healthcare needs. This strategy aimed to harness the organizational efficiencies of Health Maintenance Organizations (HMOs) and other provider networks to streamline healthcare delivery and outcomes. It represents a notable policy transition towards incorporating private sector dynamics into Medicare, intending to secure better healthcare results for beneficiaries at lower costs.

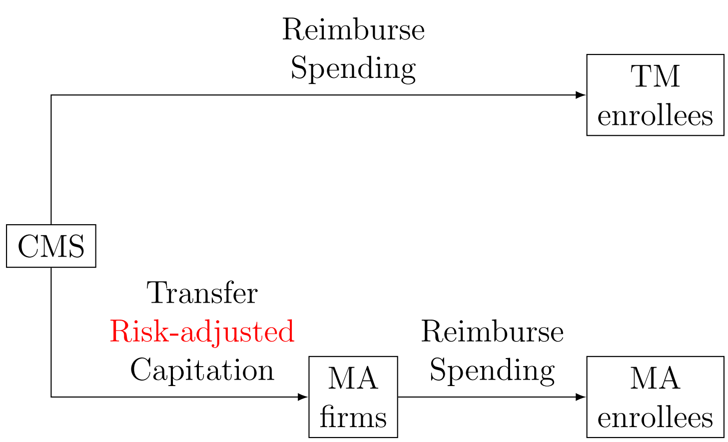

Figure 1: Medicare Market Structure

Note: CMS is the government agency, and MA firms are the private insurance companies. TM refers to Traditional Medicare (Original Medicare), and MA stands for Medicare Advantage.

As illustrated in Figure 1, the Medicare market structure delineates the choice for enrollees between Traditional Medicare (TM) and Medicare Advantage (MA), which are mutually exclusive options. MA firms primarily generate revenue through capitation payments from the government (CMS), supplemented by premiums charged to enrollees.

The relationship between TM enrollees and CMS is direct; CMS reimburses the cost of medical bills under the fee-for-service model for the basic Medicare coverage. In contrast, MA enrollees engage directly with private MA firms, where the firms are responsible for covering medical bills based on cost-sharing mechanisms. These cost-sharing requirements are mandated not to exceed the basic Medicare coverage standards, effectively shifting the Medicare benefits provider role from CMS to MA firms for enrollees opting for MA plans. Consequently, CMS compensates MA firms with capitation payments, transferring the requisite funds to support the enrollees' traditional Medicare coverage under the MA plans.

Notably, the capitation payments to MA firms are risk-adjusted to account for the varying health status of enrollees, and this transfer of funds is independent of the actual healthcare costs incurred by the enrollees during the MA plan year. If the actual costs exceed the capitation payments, the MA firm bears the financial burden; conversely, if the costs are lower, the firm retains the surplus.

2.3 Risk Adjustment

The introduction of risk adjustment mechanisms in MA plans aims to address a critical challenge: the mitigation of favorable selection, or "cream skimming." This issue arises as MA plans, under a uniform capitation payments for all enrollees, might pursue strategies to enroll predominantly healthier individuals. Such individuals represent lower healthcare costs, potentially enabling plans to maximize profits. This behavior not only undermines the equity and sustainability of the Medicare system but also contravenes the principle of social insurance by restricting access for high-cost patients and potentially leading to disproportionately high payments to MA plans relative to the actual cost of care provided.

Risk adjustment seeks to mitigate these incentives by adjusting capitations based on the health status of individual enrollees[1], aiming to dissuade plans from engaging in cream skimming. Despite these efforts, challenges may persist in fully neutralizing the financial incentives for selecting healthier individuals. The following discussion will explore the effectiveness of risk adjustment and the complexities involved in achieving its intended goals.

Risk adjustment utilizes the Hierarchical Condition Category (HCC) model to assign

[1] Unlike many risk adjustment mechanisms that are typically applied at the group level, risk adjustment in MA is fundamentally an individual-based process. Given the wide variety of observable health condition combinations among individuals, this adjustment is highly personalized. It takes into account the unique health profile of each enrollee, rather than applying a one-size-fits-all approach at the pool level. This individualized approach to risk adjustment in MA is a deliberate effort to enhance the precision of fiscal allocations.

risk scores based on beneficiaries' health conditions. This process enables the adjustment of payments to MA plans, ensuring they reflect the health status of enrollees.

2.3.1 HCC Model Overview

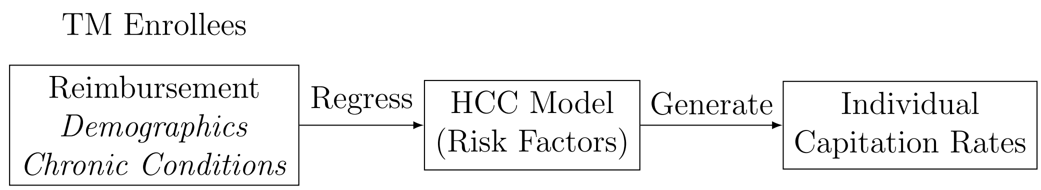

Figure 2: Process of HCC Coding

Figure 2 provides a simplified overview of the HCC risk adjustment system. Initially, the CMS gathers data on Fee-for-Service reimbursement records for Traditional Medicare enrollees, alongside information on their chronic conditions and demographics. Subsequently, CMS constructs the HCC model by regressing FFS reimbursements against these chronic conditions and demographic factors. Finally, the model generates individual capitation rates for MA enrollees based on their health conditions and demographics.

While the actual HCC model encompasses more complexity than this simplified description, it essentially serves to estimate the expected reimbursement for each individual based on their observable health status. Detailed components and workings of the HCC model are elaborated in the Appendix.

2.3.2 Limitations of HCC

While the HCC model plays a crucial role in risk adjustment within MA plans, its predictive capabilities are subject to certain limitations. A notable constraint is the model's modest R-squared value. As recorded by CMS (2021), the Version 22 CMS-HCC model employed during the dataset period of 2016-2018 reports an R-squared of 0.1189. This statistic suggests that the HCC model explains merely 11.89% of the variance in individual reimbursement amounts, indicating a significant gap in its ability to forecast individual healthcare costs accurately.

The crux of the challenge lies in the inherent difficulty of precise individual-level cost prediction. The HCC model, by design, estimates the average cost for groups of individuals with similar health conditions, as categorized into 86 HCCs (varying by model version). However, this simplification may not adequately capture the complex health status spectrum of Medicare beneficiaries. The diversity in actual healthcare costs among individuals with ostensibly similar conditions underscores the model's limitations in granularity.

Furthermore, the rationale behind the limited number of HCC categories is rooted in practicality. An overly complex model featuring thousands of HCCs would be cumbersome to implement and manage, thus detracting from its utility. It's important to recognize that the HCC model's effectiveness is evaluated on a group level rather than at the individual level. While it provides a reasonable estimation of average care costs for people within the same health category, its precision diminishes significantly when applied to predict costs for individuals.

The key insight here is that within groups having the same observable health conditions (the same HCCs), there can be significant discrepancies in their actual health status, yet CMS allocates the similar capitation to these individuals. This aspect is crucial for understanding how MA firms might engage in selection practices.

Ideally, a flawless risk adjustment mechanism would eliminate the incentives for favorable selection. However, the reality may diverge from this ideal.

2.4 Cream Skimming and Overpayment

Cream skimming within MA refers to the strategic enrollment of healthier individuals by MA plans, a practice that can lead to overpayment when capitation payments exceed the actual cost of care provided. This section explores the evidence of cream skimming, previous explanations for its occurrence, and how MA plans navigate the highly regulated environment to possibly engage in favorable selection.

Xu et al. (2023) highlighted the significantly higher profit margins in MA compared to other insurance markets, despite similar contract pricing with healthcare providers as evidenced by Trish et al. (2017) between MA and TM.

One potential driver of these higher margins is the practice of upcoding, where MA plans might encourage providers to report more severe diagnoses, inflating risk scores and subsequently, capitation payments. While Geruso and Layton (2020) noted that upcoding leads to excess public spending, it alone does not fully account for the observed overpayments, given the absence of systematic evidence that MA enrollees' risk scores are disproportionately higher than those in TM.

Jacobson et al. (2019), among others, highlights a pivotal aspect of MA plans: enrollees in MA tend to be healthier compared to their counterparts in TM, despite having *similar* risk scores. This discrepancy leads to a situation where MA plans receive overpayments, as the actual healthcare expenditures for these healthier individuals fall below the predicted costs.

Supporting evidence from Brown et al. (2014) and Lieberman and Ginsburg (2023) not only underscores the presence of significant overpayments attributed to this favorable selection but also clarifies that such selection refers to enrolling individuals who are healthier than their capitation predicted. Given that capitation is designed to reflect the average cost for individuals with similar observable health conditions, it inherently includes variability where some individuals' costs will exceed the average while others will fall below it. The insight from these studies suggests that, given a capitation rate, MA plans tend to select individuals whose expected costs are on the lower side of this average, thereby engaging in favorable selection.

Yet, a critical question arises: How do MA plans engage in favorable selection amidst stringent regulatory environments?

MA Market Regulations MA plans operate under tight regulations designed to ensure equitable access and treatment. These include mandates to offer identical premiums to all enrollees, prohibit discrimination based on health status, and enforce open enrollment periods during which any eligible individual can join an MA plan without the risk of being denied due to health conditions.

Despite these regulatory constraints, MA plans may manage to selectively enroll profitable individuals though some means. Aizawa and Kim (2018) points to advertising as a strategic and scalable tool that MA plans employ to attract demographics (e.g., race[2]) associated with lower-than-average healthcare costs for individuals with comparable chronic conditions (similar risk socre). This approach, while effective in achieving favorable selection, also skirts the edge of legal risk since it targets specific demographics.

This direct approach to favorable selection, aiming to enroll individuals whose healthcare costs are anticipated to be lower than the assigned capitations, encounters significant practical challenges. The regulatory environment, coupled with the inherent unpredictability of individual health outcomes, renders such targeted selection difficult to implement on a practical level.

In conclusion, while evidence indicating that MA plans engage in favorable selection, the feasibility of implementing such selection at the individual level—especially under the stringent MA regulations and considering the unpredictable nature of health outcomes—appears to be constrained. A significant observation in this context is that a majority of MA enrollees incur actual healthcare costs that are lower than their assigned capitations. This pattern could be interpreted more as a consequence of the favorable selection mechanism rather than evidence of MA plans directly targeting individuals whose actual costs are anticipated to be below their capitation rates.

[2]Race is not included as a factor in the HCC model.

Such an interpretation suggests a shift in perspective, proposing that the prevalent lower-than-expected healthcare expenditures among MA enrollees might stem from broader, systemic strategies employed by MA plans rather than explicit individual-level selection. This nuanced understanding, viewing favorable selection as an emergent property of strategic plan design and operational tactics, will be delved into in the subsequent sections.

2.5 Revising Favorable Selection in MA

Diverging from the conventional understanding by Brown et al. (2014), Aizawa and Kim (2018), Lieberman and Ginsburg (2023), and MedPAC (2023), this study seeks to enrich the discourse on favorable selection within MA plans. Traditional perspectives widely suggest or imply that the phenomenon of favorable selection observed in MA could be attributed to plans directly selecting individuals whose actual healthcare expenditures are lower than those predicted by risk adjustment models. However, considering the regulatory and practical challenges inherent to such direct individual-level selection, this approach seems implausible.

This research introduces a fresh perspective on the implementation of favorable selection within MA plans: the widespread occurrence of MA enrollees incurring lower healthcare costs than predicted is not evidence of direct selection by MA plans. Instead, it may represent the outcome of a different form of favorable selection. This alternative strategy relies on attracting individuals with positive health perceptions—those who perceive themselves to be healthier. This selection criterion is both practical and implementable, especially if we consider that an individual's health perception linearly influences their preference for plan generosity.

Such a strategy would naturally result in the same observed pattern: a majority of MA plan enrollees having lower actual healthcare costs than those projected by risk adjustment models. The underlying reason for this pattern may stem from the imperfections of the current risk adjustment model under the self-selection.

2.6 A Simplified Model of Risk Adjustment and Self-Selection

I present a simplified model to illustrate the strategic incentives for favorable selection within MA plans under imperfect risk adjustment and beneficiary self-selection. In this hypothetical scenario, individuals are divided into two age groups: 65-year-olds, where 80% are low spenders and 20% are high spenders, and 85-year-olds, where the distribution is reversed. High spenders incur higher healthcare spending (s^H) than low spenders (s^L), with $s^L < s^H$. An individual's spending type is private information, unknown to the government or insurers.

The government observes only age and compensates insurers based on average spending per age group. Let c^{65} and c^{85} denote the capitation payments for 65- and 85-year-olds, calculated as:

$$c^{65} = 0.8s^L + 0.2s^H > s^L, \quad c^{85} = 0.2s^L + 0.8s^H < s^H.$$

Thus, the capitation payment for 65-year-olds exceeds s^L, while that for 85-year-olds is less than s^H.

Although capitation payments match average expenditures by age, re-evaluating payments by spending type reveals disparities:

Low spenders incur s^L and consist of 80% 65-year-olds and 20% 85-year-olds. Their average capitation payment is:

$$c^L = 0.8c^{65} + 0.2c^{85} > s^L.$$

High spenders incur s^H and are 20% 65-year-olds and 80% 85-year-olds. Their average capitation payment is:

$$c^H = 0.2c^{65} + 0.8c^{85} < s^H.$$

This hypothetical case illustrates the profitability disparity between two types under a risk adjustment mechanism based on observable but imperfect indicators. Profit-maximizing insurers aim to attract low spenders and deter high spenders. Although direct consumer selection is prohibited, insurers can strategically design their plans—including cost-sharing generosity and premiums—to promote self-selection. Given an outside option (TM+Medigap) with fixed premium p_0 and generosity g_0, consumers, who privately know their spending type, choose the plan that maximizes their utility (u^L for low spenders and u^H for high spenders):

$$u^L = \alpha p + \beta^L g, \quad u^H = \alpha p + \beta^H g,$$

where $\beta^H > \beta^L > 0$ and $\alpha < 0$, indicating that high spenders value plan generosity more than low spenders.

To ensure self-selection, insurers must offer plans that satisfy the following inequalities relative to the outside option (p_0, g_0):

$$\begin{cases} \alpha p^* + \beta^L g^* > \alpha p_0 + \beta^L g_0, \\ \alpha p^* + \beta^H g^* < \alpha p_0 + \beta^H g_0, \end{cases}$$

ensuring that low spenders prefer the inside option and high spenders prefer the outside option. This leads to conditions $p^* < p_0$ and $g^* < g_0$, as shown in Figure 3. This strategic design attracts low spenders while deterring high spenders, who opt for the outside option. Consequently, the plan predominantly enrolls low spenders, resulting in an average overpayment of $c^L - s^L$, thereby improving insurer profitability.

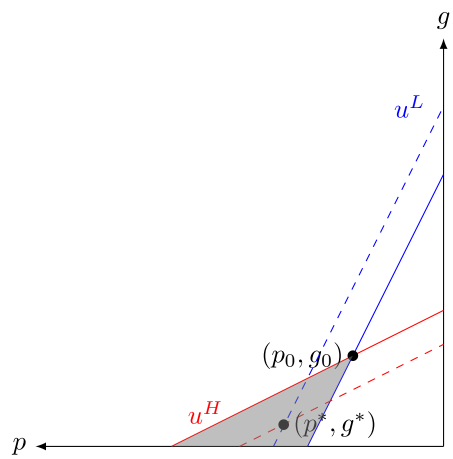

Figure 3: Indifference Curves with Reversed p axis

Note: The figure shows indifference curves for high spenders (red) and low spenders (blue) in the space of premiums p and generosity g. The point (p_0, g_0) represents the outside option. The shaded area indicates where low spenders prefer the inside option while high spenders prefer the outside option. Within this area, low spenders have higher utility than the outside option, whereas high spenders have lower utility. In the figure, the minimum level of generosity g does not represent zero but the lowest level allowed within the Medicare system.

3 Data

This study draws on two primary datasets. The first source is the Medicare Current Beneficiary Survey (MCBS), which provides comprehensive individual-level information, including demographics, health conditions, and beneficiaries' insurance choices, specifically between TM and MA. The dataset also enables identification of the exact MA plan [3] selected by each individual.

The second source is public data from the CMS, which includes detailed plan-level information, such as plan attributes, premiums, market shares, and other features of MA plans. The availability of MA plans varies across counties, which is captured in these datasets.

[3]MA plans offering defined at the county level, generally characterized by a hierarchical structure of firm-contract-plan. Within this framework, the contract ID specifies the provider network, while the plan ID delineates the distinctions among plans under the same network, primarily in terms of premiums, cost-sharing (generosity), and additional benefits, yet sharing a common network. Therefore, I define the product at the plan level for this analysis. My dataset enables the identification of the exact MA plan chosen by an individual, with specificity to the plan level.

Table 1: Summary Statistics of Consumers by Choices

	TM enrollee	**MA enrollee**	**Overall**
MA Enrollment	-	-	0.279
Age	73.887	74.283	73.997
Female	0.524	0.557	0.533
Income	70.203	50.484	64.697
Race:			
White	0.873	0.827	0.860
Black	0.062	0.098	0.072
Hispanic	0.008	0.020	0.011
Education:			
High	0.607	0.469	0.568
Medicare:			
Capitation	8.913	8.847	8.894
Reinbursement	8.340	6.012	7.692

Note: High education refers to a college degree or higher. Medicare capitation is the predicted reimbursement from the risk adjustment model, while reimbursement is the actual payment from the government if the individual enrolls in TM, or is the premium paid by the MA firms if the individual enrolls in MA. All the monetary values are in thousand dollars.

To match individual-level data with plan-level data, several steps were taken to refine and standardize both datasets. On the individual level, enrollees were filtered to include only those meeting certain criteria: community-dwelling, age-eligible beneficiaries, with dual-eligible status of Medicaid allowed. Individuals enrolled due to disability, End-Stage Renal Disease (ESRD), or other special conditions were excluded to maintain a consistent plan choice set. For plans, non-standard types, such as employee-group or special needs plans (SNP), were filtered out, focusing instead on Health Maintenance Organizations (HMOs) and Preferred Provider Organizations (PPOs), which represent the core MA plan market.

An important element of the dataset preparation involved the calculation of Hierarchical Condition Categories (HCC) risk scores for each individual, using data on chronic conditions and demographics available in the administrative records. The calculated risk scores approximated those from the official HCC model, as detailed in Appendix B.2. The summary statistics for beneficiaries and plans are presented in Tables 1 and 2, respectively.

Ultimately, after data cleaning there are 17,296 beneficiary-year observations for individual data and 463,25 plan-county-year observations for plan data. Using the sampling weights of MCBS, these individual observations are representative of the entire Medicare population. However, the data is limited to the 409 counties in the U.S. that offer MA plans, which are the focus of this study. More details on MCBS sample counties can be found in Appendix

Table 2: Summary Statistics of MA Plans

Variable	Mean	Std.Dev
Part A&B Coverage		
Annual Premium	0.240	0.327
Expected OOP	2.166	0.347
Network		
Rating (per star)	3.884	0.502
HMO	0.502	—
Additional Benefit		
Dental Comprehensive	0.519	—
Dental Preventive	0.794	—
Vision Exam	0.968	—
Vision Wear	0.639	—
Hearing Exam	0.698	—
Hearing Aid	0.594	—

Notes: Statistics are weighted by the plan county market share. Expected OOP is the expected out-of-pocket payment for a typical enrollee under specific health conditions. It is the official generosity measure of the plan by CMS.

Table 10.

4 Model

This section introduces a model that captures the interactions between consumers and private insurance firms within the Medicare Advantage (MA) market. Consumers choose plans that maximize their utility, informed by their private information, considering TM-Medigap as an available outside option. Given this, firms strategically design their offerings—setting price and generosity levels—to optimize profits while anticipating consumer self-selection behaviors.

The subsequent subsections elaborate on the structure of the model. Subsection 4.1 delineates the sequence of decisions involving the government, firms, and consumers. Subsection 4.2 describes the demand side, highlighting consumer variations in health perceptions and preferences. Subsection 4.3 explores the supply side, focusing on the Bertrand-Nash competition in price and generosity among MA plans.

4.1 Timing

As illustrated in Figure 4, the market operates on an annual cycle. Each year, firms design their plan offerings, which are made available to consumers during the open enrollment period. Generally, consumers can select or change their plans only once per year during this period, and the chosen plans remain effective for the entire subsequent year.

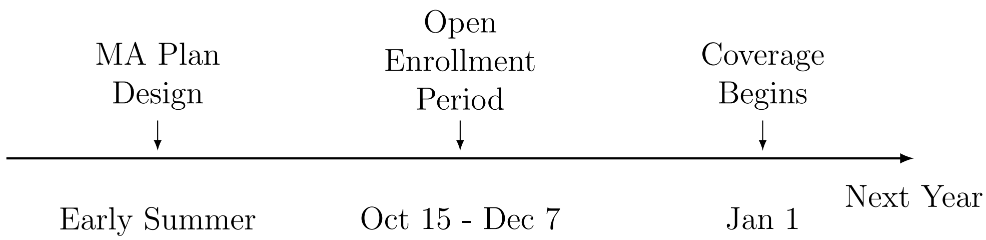

Figure 4: Annual Timeline

Government Sets Capitation CMS generates individual-level risk-adjusted capitation rates for each consumer based on observable health conditions. If a consumer enrolls in a MA plan, the corresponding capitation rate, intended to cover the costs of Traditional Medicare (TM) basic coverage, is transferred to the MA firm. The capitation rate is predetermined, independent of the subsequent decisions made by firms and consumers.

Stage 1: Firm Decision Given the plan offerings from all MA firms and the availability of the outside option, each firm strategically determines the pricing and generosity levels of its plans to maximize profits.

Stage 2: Consumer Decision Consumers assess the plan offerings and attributes from all available MA plans and outside options within their local market. Armed with their private information, they select the plan that best aligns with their preferences.

4.2 Demand

I model the demand for MA plans in the Medicare Advantage market, focusing on the influence of consumer private information on plan choice.

4.2.1 Consumer Private Information

Consumers with a self-perception of poor health tend to value plan generosity more highly, leading to heterogeneity in preferences across the consumer base. This perception, however, remains private and unobservable.

Given that capitation rates are risk-adjusted to reflect the average medical expenses of individuals with similar observable health conditions, I model an individual's subjective health perception as a distribution centered around their capitation. This assumption allows us to later estimate the parameters of this distribution.

Thus, in the model, each consumer is characterized by two variables:

- The observable risk-adjusted capitation rate (k_i), which serves as a proxy for the average expected health expenditure within a similar health cohort.
- The unobservable health perception (e_i), which directly influences their preference on plan generosity, and hence their plan choice.

The relationship between the capitation k_i and the self-assessed health perception e_i is formalized as

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

Here, τ_i signifies the discrepancy between the observable capitation and the unobservable self-assessed health perception. By employing the logarithmic transformation of e_i and k_i, it ensures that health perception is always positive.

4.2.2 Utility Specification

Consumer i in a specific county faces a choice set that includes various MA plans and an outside option. Each MA plan j is characterized by a premium p_j, a generosity measure g_j, [4] an MA indicator A_j, and other attributes X_j (including additional benefits and healthcare network attributes). The expected utility of consumer i from selecting plan j is expressed as

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

Here, ξ_{ij} reflects the unobserved quality of plan j, influencing consumer preferences beyond observable attributes. ε_{ij} captures the idiosyncratic preferences of consumer i towards plan j, assumed to follow an independent and identically distributed Type 1 Extreme Value (T1EV) distribution, as in Berry et al. (1995).

[4] The generosity measure, expected Out-of-Pocket (OOP) cost, is directly obtained from CMS, which is the official measure used to comprehensively assess plan generosity.

The utility from the outside option[5] is defined as

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

Consumers exhibit heterogeneity in their preferences for plan generosity, premiums, and the type of plan (MA or outside option). Preferences for plan generosity (β_i) are influenced by the consumer's health perception e_i

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

Preferences for plan premiums (α_i) are associated with the consumer's income level

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

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

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

Among these source of heterogeneity, only health perception e_i is an unobservable continuous variable. Other characteristics, including income level inc_i, education level edu_i, racial background white_i, Medicaid coverage Mcd_i, and employer-sponsored insurance coverage ESI_i, are observable and modeled as dummy variables.

4.2.3 Plan Choice Probability

Accordingly, the mean utility difference for an MA plan j, relative to the outside option, can be expressed as

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

Here, the variable δ_j captures the differential in mean utility between plan j and the outside option, anchored at zero for the latter. This differential reflects variations in plan generosity, premiums, exogenous characteristics, and unobserved quality, delineating the comparative appeal of MA plans.

Let μ_{ij} indicate the deviation of consumer i's utility from the mean utility difference δ_j

[5] Medigap, as a TM supplemental insurance, is government-designed and available in every market, making it the most popular supplemental insurance. For this analysis, I focus on the most popular Medigap Plan during the data period and TM combination as the outside option.

due to individual preferences

$$\mu_{ij} = \gamma \ln e_i(g_j - g_0) - \rho^{\text{inc}}\text{inc}_i(p_j - p_0) + (\rho^{\text{edu}}\text{edu}_i + \rho^{\text{white}}\text{white}_i + \rho^{\text{Mcd}}\text{Mcd}_i + \rho^{\text{ESI}}\text{ESI}_i)A_j. \quad (8)$$

To simplify the notation, the utility expression is

$$u_{ij} = \delta_j + \mu_{ij} + \varepsilon_{ij}. \quad (9)$$

Thus, the probability that consumer i, with health perception e_i, will choose plan j is given by the conditional logit model

$$s_{ij}(e_i) = \frac{\exp\left(\delta_j + \mu_{ij}(e_i)\right)}{\sum_{j'=0}^{J} \exp\left(\delta_{j'} + \mu_{ij'}(e_i)\right)}. \quad (10)$$

The overall demand for plan j, q_j, is the sum of individual choice probabilities weighted by the sampling weights w_i of each consumer i.[6]

$$q_j = \sum_i w_i \cdot s_{ij}(e_i) = \sum_i w_i \cdot \int s_{ij}(e)\, dF_e(e). \quad (11)$$

This segment introduces a demand model that accounts for the influence of private health perception on consumer choices among Medicare options. The model captures the heterogeneity in consumer preferences, reflecting the impact of health perception, income, and demographic characteristics on plan choice probabilities.

4.3 Supply

Following the approach of multi-product firm competition in existing literature (e.g., Berry et al. (1995); Petrin (2002)), this model conceptualizes the competition among MA firms as a Bertrand-Nash scenario. Here, firms strategically determine not only the price but also endogenous product attributes—specifically, generosity—which influence marginal costs (as discussed in Miller et al. (2023) and Fan (2013)).

In this model, all MA firms make decisions simultaneously, considering the strategic responses of their competitors. This paper specifically focus on short-run competition, where networks and plan offerings are assumed to be predetermined. Consequently, only price and generosity levels are endogenously determined, without modeling the entry and exit of products. This approach allows for a focused analysis of firm behavior in response to the

[6]The individual weights w_i are the sampling weights provided by MCBS, used to extrapolate from the MCBS survey sample to the overall Medicare population.

impact of risk adjustment and consumer self-selection.

4.3.1 Costs

This analysis concentrates on the marginal costs in the short term, treating fixed costs as sunk. I assume that marginal costs remain constant regardless of the number of enrollees. Let mc_j denote the marginal cost[7] of offering plan j. This cost is influenced by the plan's generosity level g_j and other observable exogenous attributes X_j. The marginal cost function can be divided into two distinct parts:

- A predetermined component $w^X \cdot X_j + \omega_j$, specific to each plan. This part includes the costs influenced by other observable attributes and cost shocks that do not vary with the plan's generosity level.
- A variable component $mc_j^g(g_j)$, which is dependent on the generosity level of the plan and can vary as the firm adjusts g_j.

Thus, the complete marginal cost function for each plan j is expressed as:

$$mc_j(g_j) = mc_j^g(g_j) + \underbrace{w^X \cdot X_j + \omega_j}_{\text{predetermined}}, \tag{12}$$

where ω_j represents the product-level shock on marginal cost. This function includes the generosity-dependent component, $mc_j^g(g_j)$, and a linear term for other attributes, $w^X \cdot X_j$. The linear treatment of $w^X \cdot X_j$ is justified because these variables are either dummies or discrete variables, such as star ratings, simplifying this analysis by focusing mainly on price and generosity rather than the broader plan attributes. Each plan, therefore, has a unique cost function, shaped by its specific attributes and cost shocks, leading to different marginal cost outcomes under given generosity levels.

4.3.2 Plan Design Problem

Firms optimize state-level profits by strategically setting bid and generosity levels, given their plan offerings across various counties within a state.

In the model, each plan must set a supplemental bid b_j and a generosity level g_j. The plan has two revenue sources: the capitation payment (which is the main part) and the supplemental bid. The capitation payment is based on the benchmark rate B_c from CMS in county c, which is the capitation rate for an individual with a risk score of 1. Since

[7] The marginal cost includes the medical reinbursement payment, the cost of additional benefits, and the administrative cost.

each individual's risk score varies, the actual capitation payments differ from the benchmark rate. The variations in the plan's average capitation rate due to individual risk scores are incorporated into the cost function $mc_j(g_j)$.

Here, the bid b_j is part of the revenue received by the MA firm, which differs from the premium that consumers actually pay. The difference, known as the premium reduction p^{reduc}, is determined by the firm and is subsidized through rebates. For simplicity and tractability in the model, I assume p^{reduc} is exogenous and fixed. Consequently, the premium paid by consumers is computed as $p_j = b_j - p_j^{\text{reduc}}$.

The profit for plan j in county c, with market size M_c, is then formulated as

$$\pi_j = (B_c + b_j - mc_j(g_j)) \cdot M_c \cdot s_{c,j}(g, b). \tag{13}$$

Here, $s_{c,j}(g, b)$ represents the market share of plan j in county c, derived from consumers' demand. This market share reflects the strategic responses to bid and generosity levels set by all competing MA firms within the market.

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

$$\pi_{f,c} = \sum_{j \in \mathcal{J}_{f,c}} \pi_j. \tag{14}$$

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

$$\pi_f = \sum_{c \in \mathcal{C}_f} \pi_{f,c}, \tag{15}$$

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

$$\max_{b_f, g_f} \pi_f = \sum_{c \in \mathcal{C}_f} \sum_{j \in \mathcal{J}_{f,c}} (B_c + b_j - mc_j(g_j)) \cdot M_c \cdot s_{c,j}(g, b). \tag{16}$$

The necessary condition for the profit maximization problem defined in Equation 16 is obtained by deriving the first-order conditions with respect to the bid b_j and generosity g_j levels:

$$\{b_j\}: \quad \sum_{c \in \mathcal{C}_f} M_c \left(s_{c,j} + \sum_{j \in \mathcal{J}_{f,c}} (B_c + b_j - mc_j) \cdot \frac{\partial s_{c,j}}{\partial p_j} \cdot \frac{\partial p_j}{\partial b_j} \right) = 0 \quad \forall j, \tag{17}$$

$$\{g_j\}: \quad \sum_{c \in \mathcal{C}_f} M_c \left(\frac{\partial mc_j}{\partial g_j} \cdot s_{c,j} - \sum_{j \in \mathcal{J}_{f,c}} (B_c + b_j - mc_j) \cdot \frac{\partial s_{c,j}}{\partial g_j} \right) = 0 \quad \forall j, \tag{18}$$

where $\frac{\partial p_j}{\partial b_j} = 1$. Each plan faces unique optimization conditions due to differences in plan offerings and the specifics of their marginal cost functions (see Equation 12). These distinctions necessitate tailored strategies for each plan to optimize its specific profit potential within the competitive market structure. Following the methodology of Berry et al. (1995), I define the $J \times J$ matrix Δ, which accounts for the interaction between the product choice probabilities within the same firm

$$\Delta^p_{i,jk} = \begin{cases} -\alpha_i s_{ij}(1 - s_{ij}), & \text{if } j = k \\ \alpha_i s_{ij} s_{ik}, & \text{if } j \neq k \text{ and both are produced by the same firm} \\ 0, & \text{otherwise,} \end{cases} \tag{19}$$

where $\alpha_i = \bar{\alpha} + \rho^{\text{inc}} \text{inc}_i$ denotes the consumer i's sensitivity to plan premiums.

$$\Delta^g_{i,jk} = \begin{cases} \beta_i s_{ij}(1 - s_{ij}), & \text{if } j = k \\ -\beta_i s_{ij} s_{ik}, & \text{if } j \neq k \text{ and both are produced by the same firm} \\ 0, & \text{otherwise,} \end{cases} \tag{20}$$

where $\beta_i = \bar{\beta} + \gamma \ln e_i$ represents the consumer i's preference for plan generosity.

These first-order conditions simplify to the matrix forms:

$$mc = B + b - (\Delta^p)^{-1} \cdot s, \tag{21}$$

$$\frac{\partial mc}{\partial g} = \frac{\Delta^g \cdot (B + b - mc)}{s}, \tag{22}$$

where Δ^p and Δ^g are the weighted summations of the Δ^p_i and Δ^g_i matrices across all consumers. These matrix-derived first-order conditions are utilized to recover the marginal costs of MA plans.

5 Estimation

This section outlines the empirical methods employed to identify the parameters of the model described in Section 4.

5.1 Demand Estimation

Adopting the two-step estimation approach as proposed by Goolsbee and Petrin (2004), I initiate this analysis with a weighted maximum likelihood estimation utilizing individual-level data from the Medicare Current Beneficiary Survey (MCBS). Consistent with my demand model, I decompose personal utility into two main components: the heterogeneity in consumer preferences μ_{ij}, as well as the mean utility for each plan δ_j which is constant across all consumers but varies between plans. Initially, I focus on estimating the parameters within the heterogeneity μ_{ij} while treating δ_j as an unknown constant.

Within each county c, this dataset comprises a sample of Medicare beneficiaries. I observe each beneficiary i's choice y_{cij} among the available MA plans or the outside option, alongside their personal characteristics. Each beneficiary is associated with a sampling weight w_{ci}, reflecting their representation within the whole Medicare population.

The demand model in subsection 4.2 allows us to derive the implied individual probability of selecting each plan j in county c, denoted as $s_{cij}(\vartheta)$, where ϑ encompasses the parameters of perference heterogeneity and mean utilities of MA plans. I aim to maximize the following weighted log-likelihood function

$$\begin{aligned} \max_{\vartheta} \; & \underbrace{\sum_c \sum_i w_{ci} \cdot \sum_{j \in \mathcal{J}_c} y_{cij} \cdot \ln(s_{cij}(\vartheta))}_{\text{Weighted log-likelihood}} \\ \text{s.t.} \quad & \underbrace{s^*_{cj} = \sum_i w_{ci} \cdot s_{cij}(\vartheta)}_{\text{Market share matching condition}} \qquad \forall j = 1, ...J, \quad \forall c, \end{aligned} \tag{23}$$

where s^*_{cj} is the observed market share of plan j in county c. This estimation step aims to find the set of parameters ϑ that maximizes the likelihood of the observed individual plan selections across counties, while ensuring that the implied market shares calculated from the model, s^*_{cj}, match the observed market shares.

Table 3 presents the estimation results from the first phase of this demand estimation. The parameter γ, associated with health perception, is significant positive, suggesting that individuals with poorer self-assessed health statuses place greater value on plan generosity. This result confirms the expected behavior that consumers who perceive their health as worse are more likely to prioritize plans offering more generous coverage.

Furthermore, individuals with higher income levels demonstrate decreased sensitivity to plan premiums, as reflected by the negative coefficient ρ^{inc}. This indicates a lower price elasticity among wealthier consumers. Regarding general preferences for Medicare Advantage (MA) plans, the analysis shows that individuals with education levels beyond high

Table 3: 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: Health Perception is measured in thousand dollars. A higher value indicates poorer health perception (which indicates a higher expectation of healthcare needs). ESI refers to Employer-Sponsored Insurance, which usually offers more generous coverage compared to MA plans.

school are less inclined to choose MA plans. In terms of racial preferences, white individuals are less likely to select MA plans compared to other races. Additionally, the presence of Employer-Sponsored Insurance (ESI) significantly deters individuals from choosing MA plans, as evidenced by the markedly negative coefficient ρ^{ESI}. Conversely, having Medicaid coverage appears to have only a minimal effect on the preference for MA plans.

Finally, the standard deviation of health perception σ_τ, quantifies the extent of heterogeneity in health perceptions among beneficiaries sharing the same capitation rate. These findings reveal significant heterogeneity, underscoring its critical role in capturing the variations in consumer private information.

Besides the parameter estimates already discussed, the estimation process also yields the plan mean utility δ_j for each Medicare Advantage (MA) plan. These mean utilities are pivotal for the subsequent supply side estimation as they reflect the overall attractiveness of each plan to beneficiaries, thereby influencing the market shares of the plans.

Instrument for Plan Mean Utility In the model, MA firms are privy to the unobservable plan quality ξ_j and the observable plan cost shocks ω_j when setting the plan's generosity and pricing. This knowledge can introduce endogeneity, potentially causing the choice variables to be correlated with these unobservable factors. To mitigate this issue, I employ instrumental variables (IV) derived from market-level demographic characteristics. This approach follows the methodology proposed by Fan (2013), ensuring robustness in addressing endogeneity in this model.

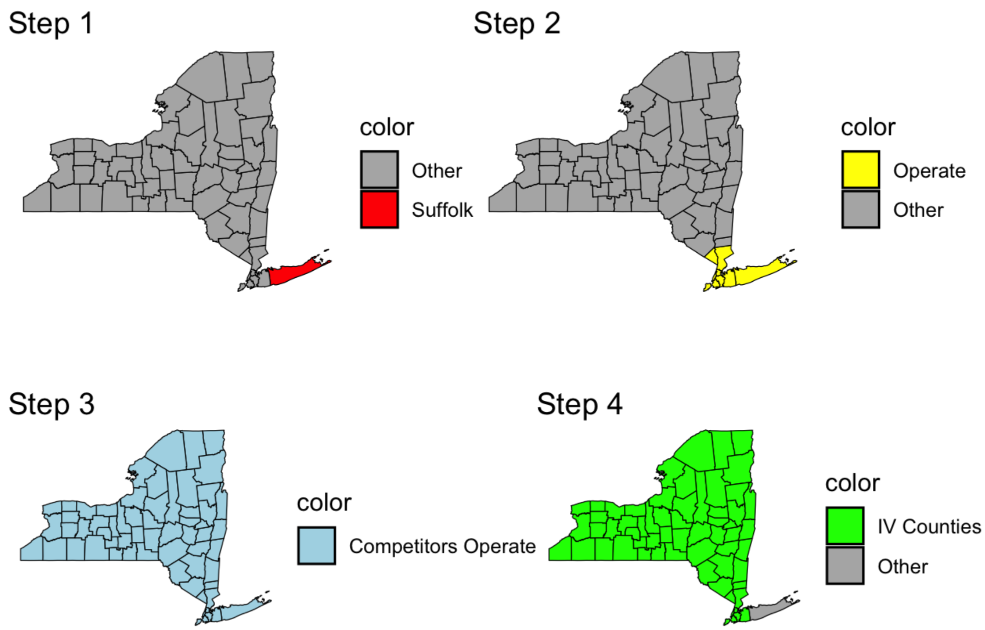

Figure 5: Illustration of the Instrumental Variable Construction Process

The fundamental concept behind the IV construction is to utilize markets where the plan of interest does not operate. In these markets, the demographics do not directly influence the plan of interest, but they do affect its competitors who are present. Although these demographic factors do not have a direct relationship with the plan of interest, they indirectly influence it through the competitive interactions in markets where both the plan of interest and its competitors operate. Consequently, these demographics can serve as effective IVs to isolate the impact of plan design on the plan's mean utility.

Figure 5 delineates the process of IV construction. For example, consider the MA Plan ID `H5521-120` offered by Aetna in Suffolk County, New York, in 2018. The initial step involves identifying all markets where this plan is active, encompassing eight counties: Suffolk, Nassau, Queens, Kings, Bronx, New York, Richmond, and Westchester. I then ascertain the presence of 21 competing plans across these counties. The demographic characteristics of markets where the plan of interest does not operate, yet its competitors do, are leveraged as instrumental variables for estimating the plan's mean utility.

Table 4 presents the estimation results from the second phase of demand estimation, which focuses on the plan mean utility, δ_j. Generally, MA plans are associated with a negative mean utility when compared to the outside option, suggesting that individuals

Table 4: Estimation Results of Plan Mean Utility

Variable	Parameter	Estimate	Std Error
Part A&B Coverage			
MA indicator	$\bar{\lambda}^A$	-1.917	(0.224)
Premium	$\bar{\alpha}$	-1.316	(0.354)
Generosity	$\bar{\beta}$	1.006	(0.388)
Network			
Rating (per star)	-	0.282	(0.028)
HMO	-	0.204	(0.029)
Additional Benefits			
Dental	-	-0.077	(0.033)
Vision	-	-0.015	(0.031)
Hearing	-	0.031	(0.034)

typically perceive the outside option as more favorable. As expected, premiums negatively affect the mean utility, while the generosity of the plan positively influences it, illustrating distinct consumer responses to cost versus benefits.

Furthermore, network quality positively impacts mean utility; each additional star rating increases the mean utility by 0.282, indicating the value beneficiaries place on higher-quality networks. HMO plans also show a positive mean utility relative to PPO plans, highlighting a preference for the network structure of HMOs. Conversely, additional benefits such as dental, vision, and hearing care have no significant effect on consumer utility. This is logical as these benefits tend to be basic and non-medical, and are often not primary concerns for the elderly demographic.

5.2 Supply Estimation

The supply side estimation builds upon the first-order conditions outlined in Subsection 4.3.2, incorporating consumers' responses to plan design as estimated from the demand side. Similar to the demand estimation, endogeneity issues arise on the supply side, as unobservable factors may correlate with the plan design variables. For instance, MA plans with lower cost shocks ω_j may be more likely to offer higher generosity θ_j with lower premiums p_j. However, these cost shocks are unobservable to researchers, leading to potential endogeneity concerns. To address this, I employ the same instrumental variable strategy used in the demand estimation.

Based on the profit-maximization problem of the MA plans, the implied markup averages \$1,022, representing 10.3% of the marginal cost before capitation. This figure aligns closely

Table 5: Estimation of Plan Marginal Cost

	I		II	
Variable	**Estimate**	**Std Error**	**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)
BCBS	-	-	0.104	(0.053)
Cigna	-	-	0.130	(0.063)
Humana	-	-	0.013	(0.027)
UHG	-	-	-0.079	(0.030)

Note: Regression I is estimated without firm fixed effects, while Regression II includes firm fixed effects. Generosity is quantified by the expected Out-Of-Pocket (OOP) cost for an individual in "poor" health, and is standardized to the range [-1, 0]. All monetary values are expressed in thousands of dollars.

with the markup rate reported by Vatter (2023) and Curto et al. (2021). Excluding plan generosity differences, the average marginal cost for enrolling a beneficiary in an MA plan is estimated at $10,409 per year prior to capitation, compared to an average capitation payment of $10,538. This finding explains why MA plans might offer very low premiums to attract enrollees.

Table 5 presents the supply side estimation results, highlighting how plan generosity, network quality, and additional benefits contribute to the marginal costs of MA plans. I perform a robustness check by comparing models with and without firm fixed effects. I include six national major MA firms and categorize all other smaller firms into a single group. The findings confirm that this estimation remains robust regardless of the inclusion of firm fixed effects. In terms of network effects, higher network ratings are positively correlated with plan costs, and Health Maintenance Organization (HMO) plans are associated with higher costs compared to Preferred Provider Organization (PPO) plans. Additional benefits, while considered, appear to have a relatively minor impact on plan costs compared to the substantial effects observed from plan generosity and network attributes.

Both the linear and quadratic terms of plan generosity are positive and significant, suggesting that the marginal cost of the plan increases with plan generosity at an accelerating rate. This could indicate a self-selection effect: as plan generosity increases, individuals with poorer health perceptions are more likely to enroll, who are then likely to be undercompensated by the risk adjustment mechanism, causing the plan's average cost to rise faster than what the risk adjustment can capture.

Table 6: Summary of Plan Costs Ranked by Generosity

Generosity Quartile	**Cost**	**Capitation**	**Capitation – Cost**	**Bid**
1st Quartile (Lowest)	9.136	9.560	0.424	0.556
2nd Quartile	9.629	9.931	0.305	0.701
3rd Quartile	10.364	10.495	0.134	0.900
4th Quartile (Highest)	12.516	12.168	-0.348	1.417

Note: Values are in thousand dollars. The capitation represents the subsidy received by MA firms from CMS. Bid refers to the supplementary bid that supposed to cover the cost of additional benefits. The difference between capitation and marginal cost is the profit margin of the plan without premium revenue.

Table 6 summarizes the relationship between per-capita capitation payments and costs across quartiles of plan generosity. The results reveal a consistent pattern: in the first three quartiles, per-capita capitation payments exceed the associated costs, demonstrating that capitation payments not only suffice to provide the traditional Medicare coverage as intended, but also significantly cover all marginal costs that are expected to be addressed by the supplementary bid. This positions the bid as a pure profit source for the MA plans.

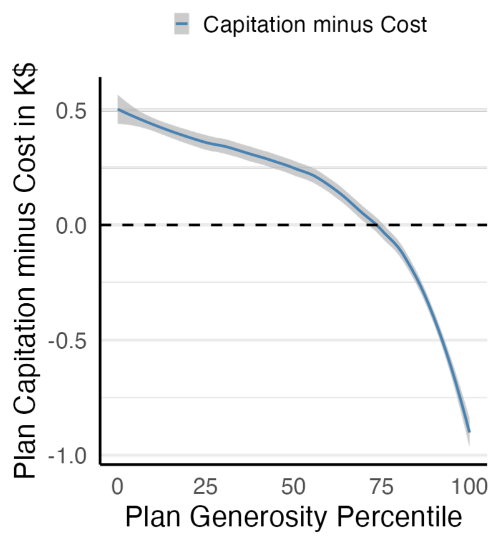

Figure 6: Capitation minus Cost by Plan Generosity Percentile

Note: The 95% confidence interval is depicted in the plot.

Figure 6 illustrates this pattern with a kernel density plot, offering a detailed view of the distribution. The plot indicates that the majority of MA plans set the generosity level at a point where the capitation payment is more than sufficient to cover all costs, thereby maximizing profits. Moreover, their premiums are significantly lower than the alternative Medigap option. This aligns with insights from the toy model described in Subsection 2.6, where MA plans strategically set low premiums and low generosity levels to attract low spenders and enhance their profitability.

6 Counterfactual Analysis

This section discusses the results of a counterfactual simulation under an equal-profit risk adjustment policy. In this hypothetical scenario, the government modifies capitation payments to Medicare Advantage (MA) firms. The policy aims to equalize the expected profit from each beneficiary across the plan pool, irrespective of the beneficiary's health status. This approach seeks to curb strategic plan design by MA firms and reduce the advantageous selection of healthier individuals.

To simluate this equal-profit policy, data on average total Medicare spending per county was sourced from the CMS dataset. This spending comprises payments made by both the MA firm and the Out-of-Pocket (OOP) expenses incurred by beneficiaries. The marginal cost

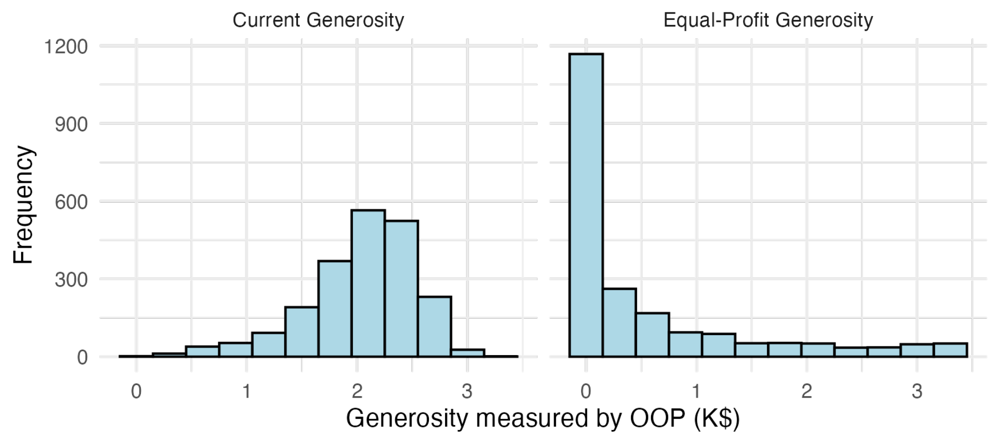

Figure 7: Comparison of Plan Generosity Choices

Note: The figure compares the plan generosity of the current policy and the equal-profit policy. The plan generosity is measured by the expected out-of-pocket cost of the enrollees. A higher expected out-of-pocket cost indicates a lower plan generosity.

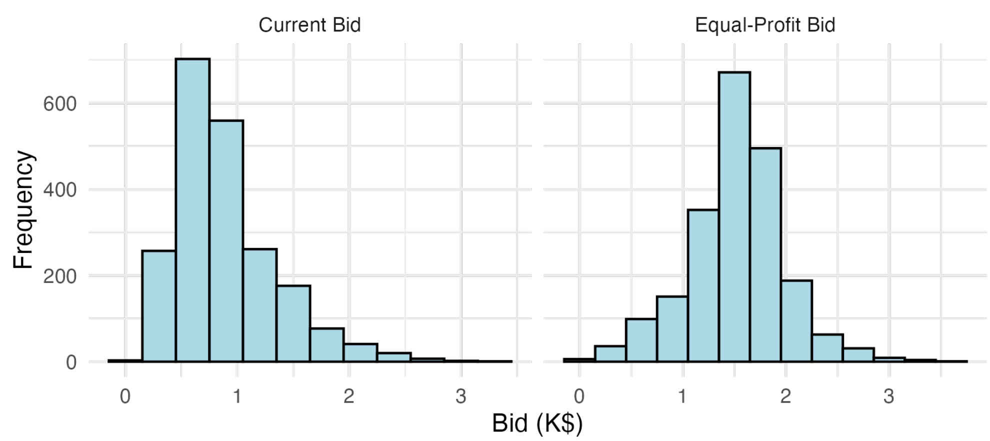

Figure 8: Comparison of MA Plan Bid Choices

Note: The figure compares the bids and premiums of the current policy and the equal-profit policy. The bids are the charge of MA plans to the government other than the capitation payment.

of plan generosity—defined as the difference between total Medicare expenditures and OOP costs—is determined by the generosity level of the given plan. Using supply-side estimations, I constructed a profit function for the equal-profit scenario, which removes the incentive for MA firms to select healthier individuals.

Under the revised profit function, MA firms re-solve the optimal plan design problem concerning both price and generosity. The outcomes of the counterfactual simulation are depicted in Figures 7 and 8, with the current market conditions serving as the benchmark for comparison against the equal-profit policy scenario. The simulation results indicate that MA firms are inclined to offer more generous plans under the equal-profit policy. Currently, MA firms tend to design plans that are less generous compared to the alternative option (TM+Medigap). In contrast, the equal-profit policy fosters a competitive environment where MA firms provide levels of generosity comparable to the outside option. Additionally, to offset the costs associated with these more generous plans, MA firms raise their bids. Despite these increased bids, the MA plans remain more affordable than the TM+Medigap combination.

Table 7: Counterfactual Simulation Results

Metrics	**Current**	**Equal-Profit**	**% Change**
Total MA share (%)	30.58	33.25	8.72%
Aggregate Consumer Surplus	22.08	24.51	11.01%
Aggregate 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.

Table 7 quantitatively summarizes the impacts of the equal-profit policy on market dynamics. The data reveal an increase in Total MA share, indicating a shift in beneficiary preference towards more generous MA plans under the new policy. Per capita consumer surplus rises from $382 to $423, and per capita producer surplus increases from $1,068 to $1,270, reflecting heightened consumer satisfaction and greater provider profitability.

On a national scale, both aggregate consumer and producer surpluses see substantial increases. Specifically, while total government expenditure on Traditional Medicare (TM) slightly decreases, spending on Medicare Advantage (MA) plans significantly increases. Implementing such a policy would necessitate adjusting capitation payments in addition to the current risk adjustment model to achieve the intended profit-equalization. This adjustment is projected to require an additional $0.95 billion, culminating in a marginal increase in overall government expenditure.

7 Conclusion

In recent years, Medicare Advantage (MA) has grown increasingly popular among Medicare beneficiaries, with a significant portion of government spending being channeled to private insurers through capitation payments. This study investigates the interactions among risk adjustment, plan design, and beneficiary selection within the MA market, utilizing data from 2016 to 2018. A structural model was developed to estimate the demand and supply responses to risk adjustment, accommodating endogenous plan design and beneficiary self-selection. The analysis specifically addresses the problem of selection effects in MA markets and quantifies these effects through model estimation.

The findings reveal that MA firms strategically design plans to attract healthier individuals, thereby inducing a selection effect that undermines the effectiveness of the risk adjustment mechanism. This strategic behavior is motivated by the higher profit margins associated with capitation payments for groups of beneficiaries who perceive themselves as healthier. These individuals, anticipating lower medical expenses, tend to choose plans offering less generous coverage but lower premiums to economize. The results of the estimation indicate that private health information significantly influences the choice between MA and Traditional Medicare (TM) plans.

Furthermore, the study demonstrates that a well-conceived risk adjustment policy can mitigate the selection effect and enhance the efficiency of the MA market. Absent incentives for gaming the system, MA firms would likely offer more generous plans to attract a wider array of beneficiaries across various health statuses, thereby improving overall welfare for the Medicare population. Properly implemented, risk adjustment would equalize profitability across different beneficiary groups. The counterfactual simulation suggests that an additional capitation adjustment, based on the generosity level of the plan, could significantly enhance consumer welfare and producer surplus.

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A Institutional Details

A.1 Profitability Variation among Individuals

Assured overpayment describes scenarios where individuals' actual healthcare costs consistently fall below their allocated capitation, independent of the specific capitation assigned. Imperfect risk adjustment is characterized by capitation adjustments based on observed health conditions that, nevertheless, fall short in precisely predicting individual healthcare costs.

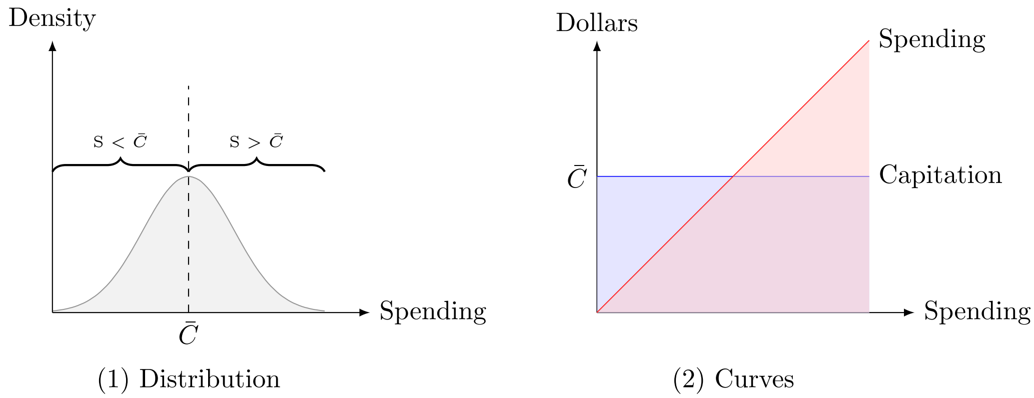
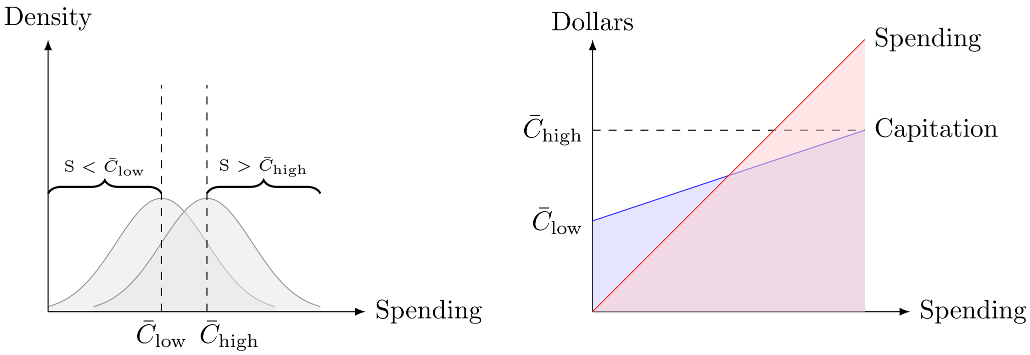


Figure 9: No Risk Adjustment

Note: Graph (1) displays the distribution of medical spending across individuals without risk adjustment. Graph (2) shows the corresponding curves for capitation (blue line) and spending (red line) as a function of cost. In a scenario without risk adjustment, approximately half of the population incurs spending lower than the capitation amount (overpaid), while the other half incurs higher costs (underpaid). This leads to profitability variation among individuals. If the capitation curve and marginal cost curve are parallel, the profitability variation disappears.

1. **No Risk Adjustment**: In this scenario, all enrollees are allocated the same capitation, denoted as $\bar{C}$. Actual healthcare spending exhibits a distribution around $\bar{C}$, leading to overpayment for individuals to the left of the distribution and underpayment for those to the right. This scenario uncovers the intrinsic selection incentive that risk adjustment seeks to mitigate.

2. **Imperfect Risk Adjustment**: In this scenario, capitations, $\bar{C}_{\text{low}}$ and $\bar{C}_{\text{high}}$, vary based on observed health conditions. Despite the variation, actual spending within each capitation group still centers around $\bar{C}_{\text{low}}$ and $\bar{C}_{\text{high}}$. Regardless of the capitation amount, individuals with actual spending lower than $\bar{C}_{\text{low}}$ are assuredly overpaid, and those with spending above $\bar{C}_{\text{high}}$ are assuredly underpaid,illustrating that assuredly overpaid enrollees remain prevalent under imperfect risk adjustment.



(1) Distribution (2) Curves

Figure 10: Conventional Risk Adjustment (Current)

Note: Graph (1) and (2) illustrate the case of an imperfect risk adjustment where individuals are assigned two different capitation rates based on their observed health conditions. Although the capitation curve becomes more tailored to spending, the pattern of the difference between spending and capitation remains similar as in the case of no risk adjustment in Figure 9. This pattern will also presist in the case of risk adjustment with more than two capitation rates (where $\bar{C}_{\text{low}}$ becomes the lowest capitation and $\bar{C}_{\text{high}}$ becomes the highest capitation). Therefore, profitability variation persists under imperfect risk adjustment.

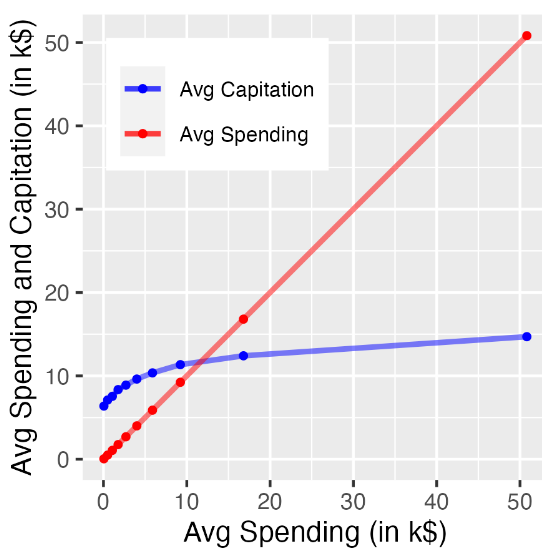


Figure 11: Avg Spending vs. Avg Capitation by Spending Deciles (from Data)

Note: This graph displays the average spending and capitation rates for each decile of spending, illustrating how capitation adjusts across different spending levels that derived from MCBS individual data (including TM and MA enrollees). This confirms profit variation among individuals under the current risk adjustment suggested by Figure 10 (2).

A critical insight from this analysis, viewed from an *ex post* perspective, is the enduring presence of assuredly overpaid enrollees regardless of any possible capitation rates. While imperfect risk adjustment aims to align capitations more closely with individual observable health conditions, it does not eliminate the selection incentives intrinsic to Medicare Advantage (MA) plans. Individuals significantly to the left of the spending distribution invariably receive overpayments, underscoring a persistent selection bias. Conversely, those significantly to the right face assured underpayments.

This *ex post* analysis underscores the limitations of imperfect risk adjustment models in fully mitigating selection biases within MA plans. However, the subsequent discussion will transition back to an *ex ante* perspective, exploring how prospective plan design adjustments and enrollee behaviors might influence, and potentially mitigate, these biases before they materialize.

Despite the complexities of reality, the underlying intuition of assured overpayment remains valid. In reality, the risk adjustment mechanism introduces more than just two levels of capitation rates, yet significant issues persist.

Firstly, a substantial variance in actual healthcare costs within the same risk score is observed, indicating a distribution of costs rather than uniform expenses across individuals (Brown et al., 2014). This variance suggests that the risk adjustment model, while sophisticated, cannot account for the full range of individual healthcare spending.

Secondly, the lowest possible capitation rate is significantly above zero, approximately around $4,000—a figure set for individuals without any HCCs, according to CMS (2021). Given that a considerable portion of individuals incur healthcare costs below this threshold, there remains substantial room for MA plans to benefit from assured overpayment.

These facts underscore a persistent incentive for MA plans to engage in selection strategies, specifically aiming to attract individuals with lower actual healthcare costs and deter those with higher costs. The analysis of this selection incentive, from an *ex post* perspective,acknowledges the outcomes of these strategies rather than merely their anticipation.

However, it is crucial to revisit this issue from an *ex ante* perspective as well. Before the actual healthcare costs materialize, MA plans face the challenge of not being able to precisely predict individual actual spending and would base their strategies on expected outcomes. The next section shifts back to an *ex ante* analysis, further exploring how MA plans might implement these strategies in anticipation.

A.1.1 Health Perception

Turning our focus back to an *ex ante* perspective, it's important to consider how beneficiaries' plan decisions are influenced by their perceptions of health prior to any engagement with healthcare services. Health perception, defined as an individual's subjective assessment of their health status, does not necessitate professional medical knowledge. Instead, it provides a personal insight into one's health that can significantly vary even among individuals categorized within the same observable health conditions (HCCs). Therefore, those with a positive health perception could often end up incurring very low healthcare spending across the entire Medicare population. As previously analyzed in Section A.1, these individuals are more likely to be categorically overpaid *ex post*.

In practice, consumers are typically unaware of their specific capitation rates, a detail reserved for transactions between CMS and MA plans. Consequently, plan choices are predominantly influenced by individuals' own health perception rather than by capitation rates or risk scores.

When a substantial proportion of beneficiaries who hold positive health perceptions consistently experience overpayment, it establishes a trend of overpayment at the group level—where the average capitation exceeds the group's average expected healthcare expenditure. This suggests that the existing risk adjustment mechanisms might unintentionally promote overpayments among those beneficiaries with good feeling of their health status. Recognizing this, MA plans can adopt strategic approaches to target such groups on a macro level, capitalizing on the collective health perceptions to enhance their profitability. This strategy allows MA plans not just to navigate but also to exploit the nuances of risk adjustment to their advantage.

A.1.2 Group Level Selection

MA plans operate on a principle that transcends individual capitation rates, focusing instead on attracting groups characterized by positive health perceptions while dissuading those with negative ones. This approach reflects a broader, more practical form of selection that aligns with how insurance firms inherently think—on a group level and from an *ex ante* perspective rather than individual level.

At the heart of this strategy lies the acknowledgment of inherent uncertainties at the individual level: a positive health perception does not invariably translate into low healthcare costs. In certain instances, individuals with a positive health outlook may incur unexpectedly high healthcare expenses. However, when considering the broader picture at the group level, these uncertainties tend to diminish. Collectively, a group with a predominantly positive health perception is likely to incur lower healthcare costs compared to a group with a negative health outlook. This predictability of group-level average profits underpins the MA firms' strategy, focusing on anticipated averages rather than individual discrepancies.

This strategic approach is corroborated by observations within MA plans mentioned earlier, where the bulk of beneficiaries exhibit healthcare expenditures significantly below the average for the broader Medicare population and below their respective capitations. This pattern predominantly arises because the majority of MA enrollees possess a positive health perception. Nonetheless, a minor segment within MA plans might have expenditures that exceed their capitation rates, underscoring that individual health perceptions are not infallible predictors of actual healthcare costs on a singular level. Despite these anomalies, the overarching trend in MA underscores that the average actual spending remains below the average capitation, enabling MA firms to secure substantial profit margins.

The feasibility of this group-level selection strategy hinges on specific conditions. These conditions, essential for the strategic alignment of MA plans with beneficiaries' health perceptions, will be elucidated in the subsequent section.

A.2 Plan Design Responsing to Self-Selection and Risk Adjustment

The implementation of this strategy hinges on meeting several conditions:

Influence of Health Perception on Plan Preferences The preferences of beneficiaries for certain plan attributes, particularly regarding the generosity of cost-sharing arrangements, are significantly influenced by their health perceptions. Here, "generosity" signifies the degree to which a plan mitigates out-of-pocket expenses for enrollees, a crucial factor for individuals with bad health perceptions who anticipate high healthcare utilization, but less so for those with positive health perceptions.

Plan Design Flexibility MA plans enjoy considerable latitude in shaping their offerings, especially in terms of generosity. This flexibility enables them to tailor plans that resonate with individuals harboring positive health perceptions.

Availability of an Outside Option The effectiveness of MA plans' selective appeal is contingent upon the availability of alternative options for those who find a particular MA plan's design unattractive. This condition ensures that individuals seeking more comprehensive coverage due to negative health perceptions have viable alternatives, thereby reinforcing the strategy's effectiveness.

With these conditions as a backdrop, we anticipate the following outcomes from this selective strategy:

MA plans are deliberately designed to attract beneficiaries with good health perceptions and deter those with bad ones. Consequently, individuals with good health perceptions will gravitate towards MA plans, while those with negative perceptions will seek alternatives. This alignment results in MA plans experiencing lower average actual healthcare expenditures than their average capitation rates, thereby augmenting MA firms' profit margins

A.3 Preliminary Checks

A.3.1 Plan Design Flexibility

MA plans operate under a distinctive framework that allows for considerable flexibility in annual plan offerings. As illustrated by the annual timeline for Medicare beneficiaries in Figure 4, MA firms have the opportunity each early summer to submit their forthcoming year's plan offerings to the CMS. These plans become available for beneficiaries to enroll in during the fall open enrollment period, effective for coverage in the subsequent year.

Central to the plan design process is the liberty MA firms have in selecting various plan attributes, with cost-sharing being notably influential. Cost-sharing not only determines a plan's overall generosity but also how expenses are split between the insurer and the beneficiaries. Unlike Traditional Medicare (TM), which offers partial coverage with beneficiaries responsible for a portion of their medical expenses (referred to as TM basic coverage), MA plans are required to at least match the essential services provided by TM. Regulations ensure that MA plans' cost-sharing does not exceed those set by TM basic coverage, hereby establishing a minimum baseline of coverage. However, beyond this baseline, MA firms can customize out-of-pocket (OOP) cost-sharing structures for additional coverage, providing a degree of autonomy in plan generosity.

Furthermore, the regulatory environment mandates uniform premium policies across all beneficiaries, alongside open enrollment periods that prohibit denying coverage based on health status or pre-existing conditions. For a comprehensive overview, see the appendix.

Despite constraints, MA firms maintain a level of flexibility in plan design, especially concerning plan generosity. This flexibility plays a pivotal role in how plans are tailored to attract specific beneficiary groups, a phenomenon we will explore in depth, demonstrating that MA plans often opt for lower generosity levels compared to the available outside option.

A.3.2 Medigap as Outside Option

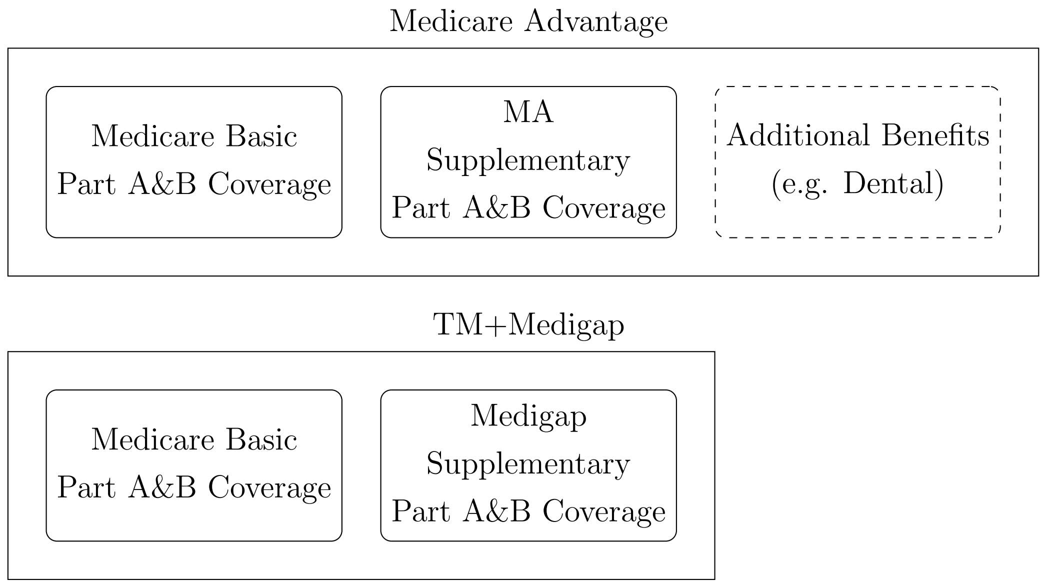


Figure 12: Benefits Structure of Medicare Options

The alternative to Medicare Advantage (MA) plans is remaining enrolled in Traditional Medicare (TM). As discussed earlier, TM's basic coverage inherently involves out-of-pocket (OOP) expenses, necessitating additional coverage for many beneficiaries. To mitigate these costs, over 90% of individuals in TM opt for supplemental insurance.

Among the supplemental insurance options, Medigap stands out as the most prevalent choice due to its universal availability. Medigap policies, standardized by the government and offered by private insurers, are designed specifically to cover the OOP costs associated with TM. Unlike MA plans, which are capitated by govenrment, Medigap policies employ age-based pricing, rendering them relatively costly.

For a detailed exploration of Medigap's structure and its role as a supplemental option, refer to the appendix.

Medigap's market presence is consistent across all regions and remains stable over the years, positioning it as a static alternative to MA plans. This stability establishes Medigap, combined with TM, as the benchmark against which MA plans are compared. As such, it serves as a crucial consideration for MA firms when designing their offerings, aware that beneficiaries have the option to opt for the TM and Medigap combination should it better suit their needs.

Given its standardized coverage and lack of yearly changes, Medigap represents a known quantity to both beneficiaries and MA firms. This knowledge allows MA firms to tailor their plans with an understanding of the competitive landscape, including how their offerings stack up against the consistent alternatives provided by TM and Medigap.

A.3.3 Comparison of Medicare Options

Following our analysis of the market conditions conducive to the strategic behavior of MA plans, we now examine the key differences between MA and Medigap plans. This comparison is necessary for understanding the subsequent consumer behavior patterns within these frameworks.

A concise summary of the fundamental distinctions between MA and Medigap plans is presented in Table 8. For those interested in a more detailed evaluation, including specific examples from Suffolk County's popular plans, please consult the appendix, which offers an in-depth comparison.

Plan Type	**Premium**	**Generosity**	**Network Restriction**	**Additional Benefits**
TM+Medigap	High	Good	No	No
MA	Low	Bad	Yes	Yes

Table 8: General Comparison of Madicare Options

The primary distinction drawn from this comparison is that MA plans typically come with lower premiums but offer less generous coverage than Medigap plans, which, though more costly, provide more comprehensive coverage. For instance, a significant proportion of popular MA plans feature a $0 monthly premium, and even among those that do charge, premiums rarely exceed $50. In contrast, premiums for favored Medigap plans typically surpass $300 and often incorporate age-based pricing, leading to higher costs as beneficiaries age.

Moreover, while MA enrollees must navigate provider networks, these plans often include non-medical benefits like dental, vision, and hearing care, albeit at a basic level, and some plans also cover prescription drugs.

Conversely, Medigap enrollees, operating under the Traditional Medicare (TM) system, face no network restrictions but lack these additional benefits. This discrepancy in offerings can be traced back to each plan's design and funding mechanism: MA plans, which receive capitated payments from the government and enjoy greater flexibility in plan design, versus Medigap plans, government-designed for higher generosity without capitation, necessitating higher premiums to cover costs.

These observed differences suggest that MA plans are typically more attractive to individuals with positive health perceptions, who expect lower healthcare needs and thus prioritize lower premiums over generous coverage. On the other hand, Medigap plans, with their higher premiums and more generous coverage, cater to those with more cautious health perceptions or those expecting greater healthcare expenses.

The consistent presence of Medigap as an alternative option provides a steady reference point for MA firms in their plan design efforts. As we delve into consumer behavior evidence, we will further investigate how private health perceptions distinctly influence the choice between these two Medicare options.

A.3.4 Consumer Behavior

This section leverages data from the Medicare Current Beneficiary Survey (MCBS) to delve into consumer behavior within the Medicare market, offering preliminary evidence to underpin our model.

The MCBS interviews, conducted in early fall as depicted in Figure 13, precede the annual Medicare open enrollment period. This sequencing furnishes an invaluable lens through which to view the impact of beneficiaries' prior health perceptions on their forthcoming plan selections.

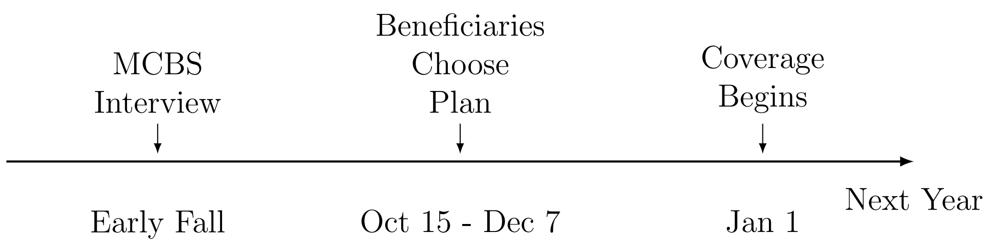


Figure 13: Interview and Plan Choice Timeline

During the interviews, articipants are asked to evaluate their health relative to others of the same age, allowing us to gauge their health perceptions. We classify these responses into two distinct groups: those who feel healthy and those who feel unhealthy. Although this binary classification might not capture the full nuance of participants' health statuses, it serves as a basis for preliminary analyses rather than for detailed model estimation.

Health Perception and Future Spending

The analysis is stratified by both health perception (positive or negative) and plan choice (MA or TM), resulting in four distinct groups for comparison.

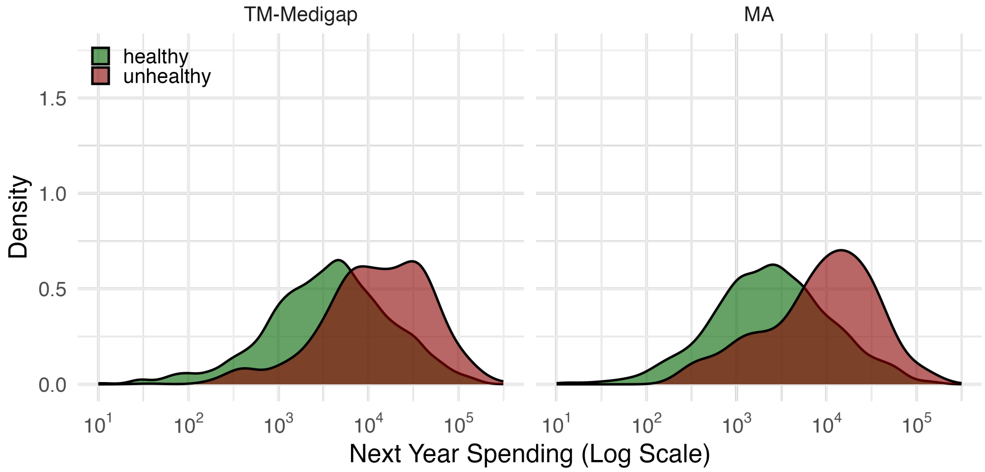


Figure 14: Next Year Spending Distribution by Health Perception and Plan Choice

Figure 14 suggests that individuals who feel healthy consistently incur lower healthcare expenses, regardless of their plan choice.

Health Perception on Plan Choice

The temporal sequence (Figure 13) of health perception assessment and plan choice offers a unique opportunity to study how beneficiaries' perceptions impact their decisions in the Medicare market. Given that health perceptions are evaluated prior to the open enrollment period, it's reasonable to infer a causal relationship between health perception and plan choice.

The analysis employs logistic regression, with MA enrollment of the next year as the dependent variable and health perception among other factors as independent variables. The regression results, summarized in Table 9, indicate a significant relationship between health perception and the likelihood of enrolling in MA plans.

Specifically, the negative and significant coefficient for "Feel Unhealthy" indicates that individuals with a bad perception of their health are less likely to enroll in MA plans, even after controlling for other demographic and socioeconomic factors. This finding underscores the influence of health perception on plan choice, aligning with our hypothesis that beneficiaries with better health perceptions are more inclined towards selecting MA plans, which are typically less generous but offer lower premiums, likely due to their perceived lower need for extensive healthcare services.

Table 9: Logistic Regression Result

	Next-Year MA Enrollment	
Variable	**Estimate**	**Std. Error**
Feel Unhealthy	-0.601^{***}	(0.167)
Income	-0.373^{***}	(0.031)
White	-0.401^{***}	(0.069)
Female	-0.033	(0.046)
Age	-0.012^{***}	(0.003)
High Education	-0.367^{***}	(0.049)
Constant	4.675^{***}	(0.428)
Observations	9,751	

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The dependent variable is a binary variable indicating whether the consumer will enroll in MA next year. "Feel Unhealthy" is a binary variable indicating whether the consumer feels unhealthy, which is self-reported.

A.3.5 Selection Effect in MA

Building on the insights from previous sections, this segment seeks to discern the extent to which the selection effect contributes to the observed lower average spending in Medicare Advantage (MA) plans. Based on the established premises that individuals with positive health perceptions are more inclined towards MA plans and consistently demonstrate lower healthcare expenditures across both MA and Traditional Medicare (TM), we infer a significant selection effect at play.

1. Previous analyses have elucidated the role of health perceptions in guiding plan choices and influencing future healthcare expenditures. Specifically, beneficiaries with positive health perceptions not only prefer MA plans but also, on average, incur lower healthcare costs.

2. Consequently, the aggregated lower spending observed in MA plans can, at least partially, be attributed to this selection effect.

While acknowledging the limitations of this analysis, the preliminary evidence presented herein suffices to underscore the selection effect as a plausible explanation for the lower average spending observed in MA plans. This preliminary evidence lays a solid foundation for further empirical modeling and estimation.

B Data Details

B.1 Data Sources

The Medicare Current Beneficiary Survey (MCBS) is a continuous survey of a national sample of Medicare beneficiaries. This study uses data from 2016 to 2018. The MCBS captures individual-level information about self-reported health status, medical service use, insurance plans, payments, and demographics. More about MCBS can be found on the MCBS website.

The MCBS data from 2016 to 2018 consists of two parts: the Survey File and the Cost Supplement. The Survey File provides demographic characteristics, health status, and healthcare use. The Cost Supplement, on the other hand, focuses on the healthcare expenses of the Medicare population. My analysis merges these two datasets to obtain a comprehensive view of the Medicare beneficiaries' information.

The public datasets used in this study are sourced from various official CMS (Centers for Medicare & Medicaid Services) databases. Most of the data can be directly downloaded via the provided links.

`benefit` MA plan additional benefits. Benefits Data

`contract` Contract and firm information. Monthly Enrollment by CPSC

`enrollment` MA enrollment. Monthly Enrollment by CPSC

`special_plan_enrollment` Enrollment of special plans. Monthly Enrollment by CPSC

`landscape` MA Plan star-ratings. MA Landscape Files

`penetration` Medicare-eligible population. MA State/County Penetration

`ratebook` County benchmark rates. Ratebooks & Supporting Data

`plan_OOP` Official MA Plan generosity measure. OOPC Resources

`Medigap_state_level` Medigap state level data. Medigap State Level

Notice that MA plans are not available in all counties, and the MCBS dataset only includes counties where MA plans are offered. Table 10 provides a summary of the MA markets that covered in the MCBS dataset.

Table 10: Sample Markets Summary for 2016

State	**All**	**MA**	**in Sample**	**State**	**All**	**MA**	**in Sample**
Alaska	23	0	0	Montana	56	39	0
Alabama	67	66	12	North Carolina	100	99	22
Arkansas	75	75	3	North Dakota	53	8	0
Arizona	15	15	6	Nebraska	93	18	0
California	58	39	17	New Hampshire	10	8	0
Colorado	64	33	7	New Jersey	21	21	14
Connecticut	8	8	5	New Mexico	33	29	5
D.C.	1	0	0	Nevada	17	10	2
Delaware	3	3	0	New York	62	62	26
Florida	67	66	20	Ohio	88	88	29
Georgia	159	156	18	Oklahoma	77	61	1
Hawaii	5	4	0	Oregon	36	36	1
Iowa	99	91	4	Pennsylvania	67	66	23
Idaho	44	39	0	Rhode Island	5	5	0
Illinois	102	88	10	South Carolina	46	45	6
Indiana	92	92	3	South Dakota	65	29	0
Kansas	105	39	3	Tennessee	95	92	13
Kentucky	120	117	11	Texas	254	229	33
Louisiana	64	63	6	Utah	29	19	1
Massachusetts	14	13	6	Virginia	134	132	9
Maryland	24	24	8	Vermont	14	14	1
Maine	16	16	0	Washington	39	29	8
Michigan	83	83	28	Wisconsin	72	71	14
Minnesota	87	84	13	West Virginia	55	54	7
Missouri	115	110	12	Wyoming	23	1	1
Mississippi	82	80	1	**Total**	**3136**	**2669**	**409**

Note: "All" refers to the total number of counties in the state, "MA" denotes the number of counties offering MA options, and "Sample" represents the number of counties covered in the MCBS sample that offer MA options. These counties are included in the estimation sample.

B.2 HCC Risk Score Calculation

The Hierarchical Condition Categories (HCC) model is a risk adjustment model used by CMS to adjust capitation payments to MA plans based on the health status of their enrollees. It assigns a risk score to each beneficiary based on their demographic characteristics and chronic conditions. The risk score is then used to adjust the capitation payment to the MA plan.

The MCBS dataset does not provide the HCC risk scores directly. However, it contains all the information needed to calculate the risk scores. The risk scores are derived from a regression of TM reimbursements against chronic conditions and demographic information. The coefficients from this regression are used to calculate the risk scores for each beneficiary. Table 11 lists the chronic conditions used in my calculation of the HCC risk scores.

Table 11: Chronic Conditions Employed in Deriving HCC Risk Scores

Condition	**Code**	**Condition**	**Code**
Physical - Cancer		***Physical - Others***	
Skin Cancer	OCCSKIN	Hysterectomy	HYSTEREC
Lung Cancer	OCCLUNG	Arteriosclerosis	OCARTERY
Colon Cancer	OCCCOLON	Hypertension	OCHBP
Breast Cancer	OCCBREST	Myocardial Infarction	OCMYOCAR
Uterine Cancer	OCCUTER	Angina Pectoris/CHD	OCCHD
Prostate Cancer	OCCPROST	Congestive Heart Failure	OCCFAIL
Bladder Cancer	OCCBLAD	Other Heart Conditions	OCHRTCND
Ovarian Cancer	OCCOVARY	Stroke	OCSTROKE
Stomach Cancer	OCCSTOM	High Cholesterol	OCCHOLES
Cervical Cancer	OCCCERVX	Emphysema/Asthma/COPD	OCEMPHYS
Brain Cancer	OCCBRAIN	Complete/Partial Paralysis	OCPPARAL
Kidney Cancer	OCCKIDNY	Amputation	OCAMPUTE
Throat Cancer	OCCTHROA	Enlarged Prostate/BPH	HAVEPROS
Blood Cancer	OCCBLOOD	Diabetes	OCBETES
Bone Cancer	OCCBONE	Overweight	BMI_CAT
Esophageal Cancer	OCCESOPH	Cataracts	ECATARAC
Gallbladder Cancer	OCCGALLB	Glaucoma	ECGLAUC
Laryngeal Cancer	OCCLARNX	Macular Degeneration	EMACULAR
Leukemia	OCCLEUK		
Liver Cancer	OCCLIVER	***Mental/Psychological***	
Lymphoma	OCCLYMPH	Intellectual Disability	OCMENTAL
Oral Cancer	OCCMOUTH	Alzheimer's Disease	OCALZMER
Pancreatic Cancer	OCCPANCR	Dementia	OCDEMENT
Rectal Cancer	OCCRECT	Depression	OCDEPRSS
Soft Tissue Cancer	OCCTISS	Non-depressive Mental Disorders	OCPSYCHO
Testicular Cancer	OCCTESTS	Parkinson's Disease	OCPARKIN
Thyroid Cancer	OCCTHYR	Tobacco Dependence	CIGNOW
Other Cancer Types	OCCOTHER	Alcohol Dependence	ALCNDAYU

Note: Code refers to the chronic condition code used in the MCBS datasets.

Combining the chronic conditions and demographic information (age, gender, Medicaid status, etc.), I calculated the HCC risk scores for each beneficiary in the MCBS dataset. Our calculation of the HCC risk scores yielded an R-squared of 11.07%, closely approximating the official HCC model's R squared of 11.89%.