Strategic Auto-Enrollment and Health Insurance Market Design

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Abstract

Default rules are typically viewed as demand-side tools to steer behavior and increase take-up among passive consumers. We argue that in health insurance markets with supply-side competition, defaults yield matching and strategic competitive effects, shaping firms' incentives to compete on price and quality. We develop a framework for analyzing optimal "strategic defaults" that highlights a central tradeoff between two effects: a matching effect (assigning passive consumers to plans that fit their needs) and a competition effect (the strength of pricing induced by the assignment rule). We apply this framework to automatic enrollment in Massachusetts' pre-ACA subsidized health insurance exchange, where roughly one-third of below-poverty enrollees are passively assigned across competing plans with differentiated provider networks. Leveraging quasi-random assignment across plans, we show meaningful matching effects: enrollees defaulted into plans covering nearby hospitals use more physician care and are substantially less likely to switch out. A structural model of active and passive enrollees shows that a more price-sensitive allocation rule yields lower premiums without worsening passive enrollees' welfare. Overall, this paper shows that default rules can discipline competition without harming enrollee matching.

1 Introduction

Auto-enrollment is often thought of as a demand-side tool to raise take-up across many settings, including retirement saving, organ donation, green energy and health insurance (Madrian and Shea, 2001; Choi et al., 2004; Chetty et al., 2014; Johnson and Goldstein, 2003; Abadie and Gay, 2006; Ebeling and Lotz, 2015). The literature has largely focused on auto-enrollment as a nudge for consumers to participate in these programs. In practice, many social programs involve markets and competition; pension plans auto-enroll savers into one of several competing funds, and Medicare Part D auto-enrolls low-income beneficiaries into one of several competing drug plans (Decarolis, 2015). Thus, when policymakers use auto-enrollment in markets, it matters not only for enrollment but also for competitive incentives and outcomes.

Understanding how auto-enrollment affects competition is important for health insurance markets specifically. About 70 percent of Medicaid enrollees are in managed care plans, and in the median state roughly 45 percent of them did not choose their plan and were auto-enrolled by the state (Ndumele and Wallace, 2021).[1] Medicare Part D auto-enrolls low-income beneficiaries into benchmark plans (Decarolis, 2015), several ACA marketplaces auto-enroll people who lose Medicaid into a marketplace plan, and the Massachusetts exchange we study auto-enrolled a third of its below-poverty enrollees (Shepard and Wagner, 2025). Understanding the tradeoffs of auto-enrollment policies is important, given the ubiquity of auto-enrollment policies across multiple health insurance markets.

In this paper, we argue that auto-enrollment policies create matching effects and strategic effects for enrollees and insurers. We develop a framework of an insurance market with competing insurers, in which the social planner determines how to allocate passive enrollees across insurers. In contrast to the standard selection model, each insurer faces two consumer segments: active enrollees—whose choices respond to prices—and passive enrollees—whose allocation responds to insurer prices through the allocation rule. A more price-sensitive allocation rule rewards a lower-priced insurer with more passive enrollees, and vice-versa for a less price-sensitive rule. The key competition effect is that the allocation rule affects insurer markups by changing the aggregate demand elasticity faced by the insurer.

From a matching perspective, a more price-sensitive rule sorts passive enrollees toward cheaper plans that might be of lower value to enrollees. However, enrollees might also value the cheaper plans, in which case a more price-sensitive rule improves match quality by assigning more of them to the plans they prefer. Whether matching and competition are

[1] Ten of the 37 states responding to KFF's 21st annual Medicaid budget survey incorporate quality into their algorithm for auto-assigning enrollees, for policies in place as of July 1, 2021 (Hinton et al., 2022). Ndumele and Wallace (2021) add that none assigns on plan cost.

a tradeoff therefore depends on the correlation between plan prices and passive enrollees' valuations, and characterizing the optimal policy is the central empirical goal of this paper.

Our setting is Massachusetts' Commonwealth Care (CommCare), the state's pre-ACA subsidized insurance exchange, in which insurers with differentiated hospital networks set bids annually for both active and passive enrollees (Shepard, 2022). CommCare auto-enrolled below-poverty enrollees who did not choose a plan. In 2009, a third of new below-poverty enrollment, were allocated to insurers at random within each service area. The allocation rule declines in insurer bids (Shepard and Wagner, 2025). An insurer's bid therefore set the premiums of above-poverty enrollees and simultaneously determines how many passive enrollees it receives through the auto-enrollment rule.

We use the policy's random assignment of passive enrollees to insurers to estimate the matching effects of enrollees to different insurance plans. With CommCare enrollment and claims data, we show that poorly matched passives—passive enrollees that are assigned to a plan that does not cover their nearest hospital—switch out more often and use less care. In contrast, well-matched passives switch out less. Well-matched passives also record about a quarter more PCP visits than the mean, while poor-matched passives record 29 percent fewer. Overall, this shows that matching matters to passive enrollees.

We then estimate a structural model of plan demand and insurer costs in which insurers compete on bids for active and passive enrollees. An active enrollee's utility from a plan depends on its premium, with a price sensitivity that varies with the enrollee's income and health, and on the value of its hospital network to the enrollee. Enrollees in different income groups face the same plans at different premiums, which identifies how much a dollar of premium shifts choice. Insurers set bids after the social planner sets the price sensitivity of the auto-enrollment rule, and each bid determines an insurer's active enrollment through premiums and its passive enrollment through the allocation rule.

Price endogeneity is a standard concern in estimating plan demand, since insurers set bids knowing their plans' unobserved quality. Plan-by-region fixed effects absorb unobserved quality, and the price coefficient is identified from enrollees in different income groups who face the same plans in the same region at different premiums. The price sensitivity of the auto-enrollment rule is estimated from the share of passives each plan received at each bid rank. Costs are recovered from realized claims: each enrollee's cost in any plan is her observed cost rescaled by plan cost effects from Jaffe and Shepard (2020), such that selection occurs entirely through enrollee health. Passive enrollees do not choose and we assign each passive enrollee the valuation of an active chooser with the same region, health and demographics, estimated from the choices active enrollees make among the same plans. This follows Bernheim and Rangel (2009).

Our simulations show that the auto-enrollment rule Massachusetts adopted in fiscal year 2008 responded to bids at one tenth of the price sensitivity rate of active choosers.

Passives are a third of new enrollment and are healthier than active choosers in the same income group, with mean monthly claims of $228 against $400. Each insurer therefore received low-cost passive enrollees at a price sensitivity that is inelastic relative to active enrollees.

We then solve for equilibrium bids across a range of price sensitivities in allocating passive enrollees—from allocating enrollees at random regardless of bids to allocating them more price sensitively than active choosers. Relative to a market with no auto-enrollment, auto-enrollment at the same price sensitivity as the observed Massachusetts policy in 2009 raises the average bid from $378 to $402, or 6.3 percent. The bid increase is thus a markup increase: the passive segment makes the aggregate demand each insurer faces more inelastic, and insurers raise bids. Since the state's subsidy equals the bid less a fixed enrollee contribution, higher bids raise above-poverty premiums proportionally. Above-poverty active choosers thus lose $3.7 million a year in consumer surplus, while insurers gain more profits.

Raising the price sensitivity of the auto-enrollment rule reverses this result. Under a rule as price sensitive as active choosers, the bid falls to $365 and the margin from $92 to $58. Relative to the observed policy, that rule generates $5.75 million a year in consumer surplus for active choosers and saves the state $3.5 million a year in payments for passive enrollees, while insurers' profit falls by $10.0 million. Importantly, intensifying price competition for passive enrollees does not worsen their match, since outside Boston the highest bidder is also the plan passive enrollees value least.

Having shown the benefits of a more price-sensitive allocation rule, we next examine whether—holding competition fixed—the social planner can deliver matching gains to passive enrollees relative to allocating them randomly across plans. Holding each insurer's passive count fixed, we assign each passive to the plan an active chooser with her region, health and demographics values most, and the share of passives in their predicted first-choice plan rises from 37 to 92 percent. The gain averages $6.01 per member-month, a tenth of the premium an above-poverty active chooser pays and 2 percent of what the state pays for a passive enrollee's coverage. Gains are largest outside Boston, where the narrow networks diverge, and rise with health risk.

Overall, we show that auto-enrollment can discipline competition through the price sensitivity of its allocation rule, and improve matching through the composition of each insurer's share. We show two key results. First, the observed rule was far from its optimum: raising its price sensitivity to that of active choosers lowers premiums and state spending without lowering passive enrollees' match quality. Second, most passive enrollees in this market value the cheaper plans more than the highest-bid plan. This implies that a rule that rewards low bids sorts them toward the cheaper plans and yields matching gains.

However, an important caveat is that these results are specific to a market in which the cheaper plans are simultaneously the plans passive enrollees value.

Related Literature. This paper contributes to two strands of the literature. The first studies auto-enrollment and inertia in insurance choice: participation, inertia and the welfare of defaults (Madrian and Shea, 2001; Handel, 2013; Handel and Kolstad, 2015; Bernheim et al., 2015; Ho et al., 2017; Shepard and Wagner, 2025). Closest is Buitrago et al. (2026), who show in Colombia's regulated-premium system that insurers respond to the auto-enrollment rule by changing the breadth of their provider networks, and that ignoring this response reverses the welfare ranking of rules. We study the price margin that their setting fixes by regulation: with benefits fixed, the rule enters each insurer's demand elasticity and therefore its markup. Our contribution is to separate the competition effect from the matching effect of an auto-enrollment rule and to measure both.

The second literature studies competition and regulation in subsidized exchanges, in the same setting: hospital networks (Shepard, 2022), price-linked subsidies (Jaffe and Shepard, 2020), subsidy design (Finkelstein et al., 2019), cost sharing (Chandra et al., 2014) and risk adjustment (Kong et al., 2024). Closest are Shepard and Wagner (2025) and Shepard and Wagner (2022), who study passive enrollees in CommCare on the demand side. We add the supply side by showing how the auto-enrollment rule affects equilibrium bids.

The paper proceeds as follows. Section 2 presents the theory. Section 3 describes the setting and data. Section 4 presents the reduced-form evidence on match quality. Section 5 develops the structural model and estimation. Section 6 presents the counterfactual and welfare analysis. Section 7 concludes.

2 Theory

To illuminate the impact of automatic assignment rules on market competition and consumer welfare, we build upon a standard framework of horizontally differentiated product competition. The key innovation in our setting is to allow the regulator to directly assign the plan choices of a subset of individual consumers (whom we refer to as "passives"). How these passive consumers are assigned directly affects their outcomes, but also the overall demand curves firms face, and thus market competition. The model yields a decomposition of each firm's markup into an active and a passive component, and a welfare function whose first-order condition in the assignment rule separates a matching effect from a competition effect.

2.1 Model Setup

We model a regulated insurance market where firms $j = 1, ..., J$ compete by offering differentiated products ("plans") to consumers. Each firm offers a single product with benefits X_j and price P_j. Consumers (indexed by i) vary in their attributes Z_i (income, location, and medical conditions) which determine both their private valuation for plans, $V_{ij} = V(X_j; Z_i)$, and their expected costs to the firm if enrolled, $C_{ij} = C(X_j; Z_i)$.[2] We assume plan benefits X_j are fixed by regulation, and firms compete only on prices. We suppress dependence on X_j beyond this point. Notably, value and costs can vary across consumers for the same plan, while prices do not. This is consistent with the defining feature of a "selection market" (Einav and Finkelstein, 2023). Since costs vary across consumers, which consumers a rule assigns to a firm changes that firm's average cost.

Subsidies are a standard policy in regulated insurance markets. In our model, the subsidy amount $S_{ij} = S_{g(Z_i)}(P_j)$ reduces the net-of-subsidy *premium* paid by consumers, such that consumer i pays $\phi_{ij} = P_j - S_{ij}$ for plan j. We allow for price-linked subsidies, since these are a key feature of many health insurance settings, including our own. The subscript $g(Z_i)$ allows the subsidy function to differ across a subset of individual characteristics, the *income group* of individual i in our setting. The subsidy function determines the pass-through of a firm's price to the consumer, $\partial\phi_{ij}/\partial P_j$. In our setting, consumers below the poverty line face $\phi_{ij} = 0$ for every plan. For these consumers a firm's price affects enrollment only through the assignment rule. Consumers above the poverty line pay an income-based contribution for the lowest-priced plan and the full price difference for a higher-priced plan, and for them a firm's price affects enrollment through both channels.

2.1.1 Consumer Types and Behavior

We divide a unit mass of consumers into two groups.

1. **Active Enrollees.** Consumers in the market can choose among competing plans. A key feature of our setting is that only a share $\theta_A < 1$ of consumers do so; we refer to those as *active* consumers. We denote the demand function for plan j among active consumers by $D_j(P_j; P_{-j})$, which gives the share of actives choosing plan j, given P_j and the prices of other plans P_{-j}. Active consumers choose the plan that maximizes $V_{ij} - \phi_{ij}$. D_j therefore falls in P_j, and its slope measures the price sensitivity of active consumers.

2. **Passive Enrollees.** The remaining share $\theta_P = 1 - \theta_A > 0$ of consumers who do not make a choice are *passive*.[3] Instead of making a choice, passive consumers are enrolled

[2] This cost is inclusive of any risk adjustment payments made to the firm.

[3] We assume that whether a given consumer i is active or passive is determined exogenously, motivated by evidence from prior work studying our setting (Shepard and Wagner, 2025).

in a default plan according to an automatic assignment rule. The rule generates a rule-based quasi-demand function, which we denote $R_j(P_j; P_{-j})$, giving the share of passives being assigned to plan j. The social planner decides this function, and its slope in P_j is therefore a policy parameter.

2.1.2 Firm Behavior

Firm j faces a total demand curve given by

$$D_j^{Tot}(P_j) = \theta_A \cdot D_j(P_j) + \theta_P \cdot R_j(P_j) \tag{1}$$

where $D_j(P_j)$ and $R_j(P_j)$ are the conditional demand functions among active and passive enrollees, defined above. A firm's price therefore enters two segments through two mechanisms, consumer choice and the assignment rule.

The firm's costs depend on the identities of the consumers it enrolls. It is useful to define a firm's average cost (per enrollee), denoted

$$AC_j(P) = \frac{1}{D_j^{Tot}(P)} \cdot \sum_i \left[C_{ij} \cdot D_{ij}^{Tot} \right] \tag{2}$$

where D_{ij}^{Tot} is the individual-specific probability of being enrolled in plan j. Similarly, we define the firm's marginal cost, denoted

$$MC_j(P) = \frac{1}{\partial D_j^{Tot} / \partial P_j} \cdot \sum_i \left[C_{ij} \cdot \frac{\partial D_{ij}^{Tot}}{\partial P_j} \right] \tag{3}$$

which gives the mean cost among marginal consumers who switch away from enrolling in j for a small increase in price. Firms set prices to maximize profits,

$$\pi_j = \left(P_j - AC(P_j) \right) \cdot D_j^{Tot}(P_j) \tag{4}$$

The firm's first order condition can be expressed as

$$P_j^* = MC_j + \frac{D_j^{Tot}}{-\partial D_j^{Tot} / \partial P_j} \tag{5}$$

Price equals the cost of the marginal enrollee plus a markup. The markup is the inverse of the price sensitivity of total demand, and a firm facing less price sensitive demand therefore charges more. This can be decomposed into a share-weighted mean of active and passive

specific marginal costs and markup terms,

$$P_j^* = (1-\sigma)\left[MC_j^A + \frac{D_j}{-\partial D_j/\partial P_j}\right] + \sigma\left[MC_j^P + \frac{R_j}{-\partial R_j/\partial P_j}\right] \tag{6}$$

where $\sigma = \theta_P \times \frac{\partial R_j/\partial P_j}{\partial D_j^{Tot}/\partial P_j}$ is the share of marginal enrollees who are passive, and MC_j^A and MC_j^P are the mean costs of the marginal active and passive enrollee, respectively. The share σ is the fraction of the enrollees a firm loses from a dollar of price increase who are passive. It rises with the price sensitivity of the assignment rule and equals zero when the rule ignores price. Equation (6) thus states how the rule affects firm markups—through the slope of the passive segment and through the share of the firm's margin that passives make up.

2.2 The Assignment Rule

The social planner sets the assignment rule. We parameterize it by a single price responsiveness $\alpha^{AA} \leq 0$, which governs how strongly the passive share of each plan rewards a low price,

$$R_j(P;\, \alpha^{AA}) \;=\; \frac{\exp(\alpha^{AA} P_j)}{\sum_k \exp(\alpha^{AA} P_k)} \qquad \text{with} \qquad \frac{\partial R_j}{\partial P_j} \;=\; \alpha^{AA}\, R_j\,(1-R_j) \tag{7}$$

At $\alpha^{AA} = 0$ the rule assigns passives to every plan in equal shares regardless of price. As $\alpha^{AA} \to -\infty$ the lowest-priced plan receives every passive. The observed Massachusetts schedule of Figure 2 is a step function in price rank, and equation (7) is its smooth approximation. Since passives are assigned rather than self-selected, the passives a firm gains or loses at the margin are drawn from the same distribution as those it holds, $MC_j^P = AC_j^P$, and passive enrollment carries no selection margin. Now, consider two examples of equation (7).

A uniform rule ($\alpha^{AA} = 0$) assigns passives in equal shares across plans, regardless of prices. Then $\partial R_j/\partial P_j = 0$ and $\sigma = 0$, and the passive block enters equation (6) as enrollment with zero slope,

$$P_j^* \;=\; \underbrace{MC_j^A + \frac{D_j}{-\partial D_j/\partial P_j}}_{\text{price without passives}} \;+\; \underbrace{\frac{\theta_P R_j/\theta_A}{-\partial D_j/\partial P_j}}_{\text{extra markup}} \tag{8}$$

A firm keeps its assigned enrollees at any price. It therefore raises its markup over active choosers by the ratio of its passive to its active enrollment, regardless of how low passives' costs are.

A bid-weighted rule ($\alpha^{AA} < 0$) rewards a lower price with a larger passive share. Then $\sigma > 0$, and the markup in equation (6) falls in $|\alpha^{AA}|$. Whether the rule raises or lowers

the markup relative to a market without passives depends on how its semi-elasticity compares with active demand's. The passive share's own semi-elasticity under equation (7) is $|\alpha^{AA}|(1 - R_j)$, and auto-enrollment raises plan j's markup above its no-assignment level when

$$|\alpha^{AA}|\,(1 - R_j) \;<\; |\eta_j^A| \tag{9}$$

where $\eta_j^A = \partial \ln D_j / \partial P_j$ is the active semi-elasticity, and lowers it when the inequality is reversed (Appendix A). Auto-enrollment raises markups when the rule is less price sensitive than active choosers and lowers them when it is more price sensitive.

2.3 Welfare

We evaluate the auto-assignment rule under a consumer welfare standard. The planner values the surplus of active consumers, the valuation passive consumers receive from their assigned plan, and government spending at the marginal cost of public funds λ,

$$W(\alpha^{AA}) \;=\; \underbrace{\sum_{i \in \mathcal{A}} CS_i\big(P^*\big)}_{\text{active consumers}} \;+\; \underbrace{\sum_{i \in \mathcal{P}} \sum_j R_{ij}\big(P^*;\, \alpha^{AA}\big)\, V_{ij}}_{\text{passive consumers}} \;-\; \lambda\, \underbrace{G\big(P^*;\, \alpha^{AA}\big)}_{\text{government}} \tag{10}$$

where $CS_i(P)$ is the consumer surplus of active consumer i in dollars at premiums ϕ_{ij}. Passive consumers do not choose, and their surplus is the valuation V_{ij} generated from the rule $\sum_j R_{ij} V_{ij}$. G is government spending, and $P^* = P^*(\alpha^{AA})$ is the vector of equilibrium prices, the solution to equation (6) for every insurer.

Government spending is the subsidies paid for active consumers and the full price paid for passive consumers,

$$G(P;\, \alpha^{AA}) \;=\; \underbrace{\sum_{i \in \mathcal{A}} \sum_j D_{ij}(P)\, S_{ij}(P_j)}_{\text{subsidies to actives}} \;+\; \underbrace{\sum_{i \in \mathcal{P}} \sum_j R_{ij}(P;\, \alpha^{AA})\, P_j}_{\text{payments for passives}} \tag{11}$$

where D_{ij} is active consumer i's choice probability for plan j. The state pays part of an active consumer's price and, since passive consumers are below the poverty line, all of a passive consumer's.

Differentiating equation (10) in the responsiveness of the rule separates the two channels,

$$\frac{dW}{d\alpha^{AA}} \;=\; \underbrace{\sum_{i \in \mathcal{P}} \sum_j \frac{\partial R_{ij}}{\partial \alpha^{AA}} \left(V_{ij} - \lambda P_j^*\right)}_{\text{matching effect}} \;+\; \underbrace{\sum_j \frac{dP_j^*}{d\alpha^{AA}} \frac{\partial W}{\partial P_j}}_{\text{competition effect}} \tag{12}$$

The matching effect is the value of re-sorting passives across plans. Under the logit rule, $\partial R_j / \partial \alpha^{AA} = R_j\,(P_j - \bar{P})$ with $\bar{P} = \sum_k R_k P_k$ the passive-weighted mean price. A more

responsive rule therefore shifts passives out of plans priced above the mean. The matching effect is positive when enrollees are auto-assigned into plans they value.

The competition effect is captured by the value of a price change the auto-assignment rule induces. A price increase costs an active consumer her enrollment probability times the share of the increase her premium passes through, $\partial CS_i/\partial P_j = -D_{ij}\,\partial\phi_{ij}/\partial P_j$, and the value of a dollar off plan j's price is

$$-\frac{\partial W}{\partial P_j} = \underbrace{\sum_{i\in\mathcal{A}} D_{ij}\,\frac{\partial \phi_{ij}}{\partial P_j}}_{\text{premiums of actives}} + \lambda \underbrace{\sum_{i\in\mathcal{P}} R_{ij}}_{\text{payments for passives}} + \lambda \underbrace{\sum_{i\in\mathcal{A}}\sum_{k} S_{ik}\,\frac{\partial D_{ik}}{\partial P_j}}_{\text{subsidies, re-sorting}} \tag{13}$$

A dollar off plan j's price is worth the premiums its active choosers save, the payments the state saves on its passives, and the subsidies the state saves or pays as active choosers re-sort, up to the terms in which subsidies and the rule's own assignment respond to P_j (Appendix A).

Perfect Competition and Perfect Risk Adjustment. Consider first a market in which active demand is perfectly elastic. The markup in equation (5) is zero and prices equal marginal cost, $P_j^* = MC_j$.[4]

$$\frac{dW}{d\alpha^{AA}} = \sum_{i\in\mathcal{P}}\sum_{j}\frac{\partial R_{ij}}{\partial \alpha^{AA}}\left(V_{ij} - \lambda\, MC_j\right) \tag{14}$$

The planner's problem reduces to placing each passive in the plan that maximizes her valuation net of the government cost. Active consumers drop out of the problem entirely, since prices do not respond to the rule. In other words, under perfect competition, the default design reduces to a matching problem.

Imperfect Competition. With differentiated plans each firm prices above marginal cost, and the markup in equation (6) depends on the rule through the slope of the passive share. Let $\mu_j = P_j^* - MC_j$ denote the markup. Holding active demand and costs fixed, the equilibrium price responds to the rule's responsiveness by

$$\frac{dP_j^*}{d\alpha^{AA}} = \mu_j\,\frac{\sigma_j}{|\alpha^{AA}|} > 0 \tag{15}$$

[4]In a selection market the competitive benchmark is usually price equal to average cost, since the marginal enrollee is cheaper or costlier than the average one. For the passive segment the two coincide, since assignment has zero selection margin. For the active segment they differ, and the argument of this paragraph goes through with AC_j in place of MC_j: prices are pinned by costs, and the rule affects them only through the cost of the enrollees it assigns.

where σ_j is the share of plan j's marginal enrollees who are passive, from equation (6) (Appendix A). A more responsive rule, a more negative α^{AA}, lowers every price, and it lowers prices more where the markup is larger and where passives make up more of the margin. Substituting equations (13) and (15) into equation (12), the planner's first-order condition under imperfect competition is

$$\frac{dW}{d\alpha^{AA}} = \underbrace{\sum_{i\in\mathcal{P}}\sum_{j} R_{ij}\left(P_j^* - \bar{P}\right)\left(V_{ij} - \lambda P_j^*\right)}_{\text{matching effect}} - \underbrace{\sum_{j}\mu_j \frac{\sigma_j}{|\alpha^{AA}|}\left[\sum_{i\in\mathcal{A}} D_{ij}\frac{\partial\phi_{ij}}{\partial P_j} + \lambda\sum_{i\in\mathcal{P}} R_{ij} + \lambda\sum_{i\in\mathcal{A}}\sum_{k} S_{ik}\frac{\partial D_{ik}}{\partial P_j}\right]}_{\text{competition effect}} \tag{16}$$

The competition effect is a gain from a more responsive rule: lower prices for every active consumer and lower payments for the state. The matching effect is the surplus passives gain or lose as the rule sorts them toward cheaper plans. It is a gain when the cheaper plans are the plans passives value, and a loss when they are not. The optimal responsiveness sets equation (16) to zero.

Matching and Competition Effects. The competition effect of a more price sensitive rule is nonnegative, since equation (15) lowers every price. The sign of the matching effect depends on the correlation between plan prices and passive consumers' valuations. A more price sensitive rule sorts passives toward the plans priced below the passive-weighted mean $\bar{P}$; the matching effect is positive when these are the plans passive consumers value, and negative when they are not. Whether the two effects reinforce or offset is therefore an empirical question.

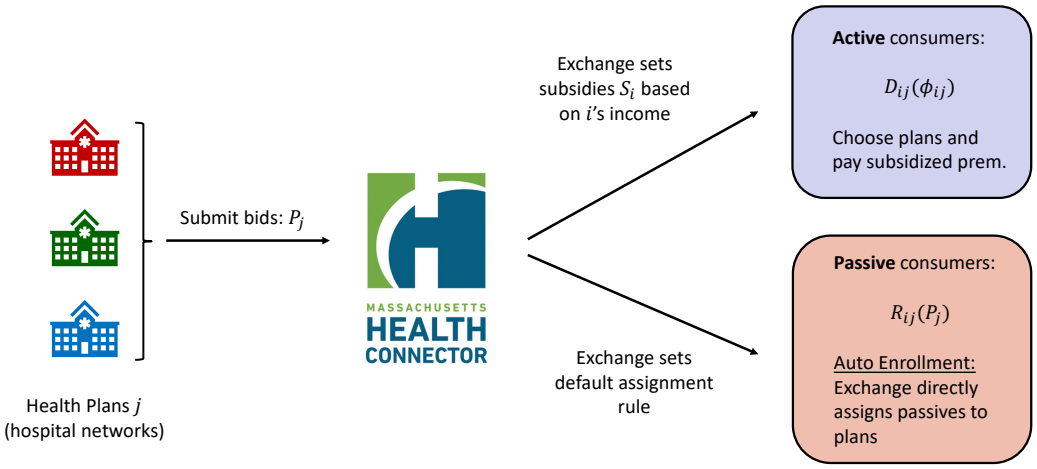
3 Background, Data and Setting

We study Commonwealth Care ("CommCare"), the subsidized Massachusetts health insurance exchange that operated from 2007 to 2013. CommCare combines two features that make it a suitable setting for this paper. First, insurers compete on annual bids in a regulated exchange, so insurer prices respond to strategic incentives. Second, the exchange enrolled a large population of passive consumers through a default rule that rewarded low bids with larger shares of auto-assigned enrollees. The same bid therefore competes for two types of enrollees: actives who choose plans, and a mechanical assignment rule that allocates passives. Figure 1 summarizes this structure.

3.1 CommCare

CommCare was established under Massachusetts' 2006 health reform and provided subsidized coverage to state residents with incomes below 300 percent of the federal poverty

Figure 1: CommCare Market Structure and Enrollment Channels



Note: The figure depicts the CommCare market. Health plans j, differentiated by hospital networks, submit annual bids P_j to the Massachusetts Health Connector. For active consumers, the exchange sets income-based subsidies S_i, and consumers choose plans and pay subsidized premiums. For passive consumers, the exchange sets a default assignment rule $R_{ij}(P_j)$ that allocates enrollees directly to plans as a function of their bids.

level (FPL) who lacked access to Medicaid, Medicare, or employer coverage. Several other papers have studied the same setting (Chandra et al., 2014; Finkelstein et al., 2019; Jaffe and Shepard, 2020; Shepard, 2022).

The market featured four competing insurers in 2008-09, each offering a single plan with standardized cost-sharing rules. Plans were differentiated primarily in their networks of covered hospitals and physicians. Three statewide insurers, BMC HealthNet (BMC), Neighborhood Health Plan (NHP), and Network Health (Network), offered comparably broad but differentiated networks, while Fallon was a regional carrier operating only in central Massachusetts.

Insurers chose whether to participate each year through a process run by the Massachusetts Health Connector. We use the term "bid" to refer to this pre-subsidy price, which determines both what the exchange pays the insurer and the plan's rank in the auto-assignment rule. While "premium" for the post-subsidy amount enrollees pay, which is the bid net of the income-based subsidy. Conditional on participating, insurers competed on bids that determined premiums annually at the start of each fiscal year. Premiums vary by income and regions. Insurers selected which of the state's service areas to operate in, generating variation in the set of available plans across areas that we exploit throughout the paper[5].

[5]Regions and service areas are distinct geographic units: premiums are set at the region level, while insurer participation vary across the state's 38 finer service areas

Subsidies vary across income groups. Above-poverty enrollees (100–300 percent FPL) paid an income-varying premium for the cheapest plan and progressively larger shares of the bid gap for more expensive plans. Below-poverty enrollees, the population we study, were fully subsidized. Every available plan cost $0 in every year. For this group, active below-poverty enrollees select plans based on their preferences, and an insurer's bid affects its below-poverty enrollment only through the auto-assignment rule we describe next.

Risk adjustment transfers between insurers were implemented throughout our sample period. Each enrollee carried a risk score based on age and diagnoses, and an insurer that bid P_j and enrolled members with average risk score $\bar{\phi}_j$ received $\bar{\phi}_j P_j$ per member-month rather than its bid. The transfers weaken the link between an insurer's profit and the risk mix it attracts, but the adjustment was coarse. CommCare's risk-score model was retrospective, scoring continuing enrollees on prior-year diagnoses and new enrollees on age–sex factors alone, and it explains 5.9 percent of the variance in costs against 26.8 percent for the concurrent HHS-HCC model used in the ACA marketplaces (Kong et al., 2024).

Explicit price regulation postdates our sample. Insurers submitted bids through the Connector's annual request-for-proposals process, and the price floors and ceilings the Connector later imposed—floors under rules requiring bids to be "actuarially sound," ceilings intended to limit price growth—were introduced in the fiscal year of 2010. During fiscal 2008–2009, bids therefore responded to demand and to the auto-assignment rule rather than to binding floor or ceiling constraints.

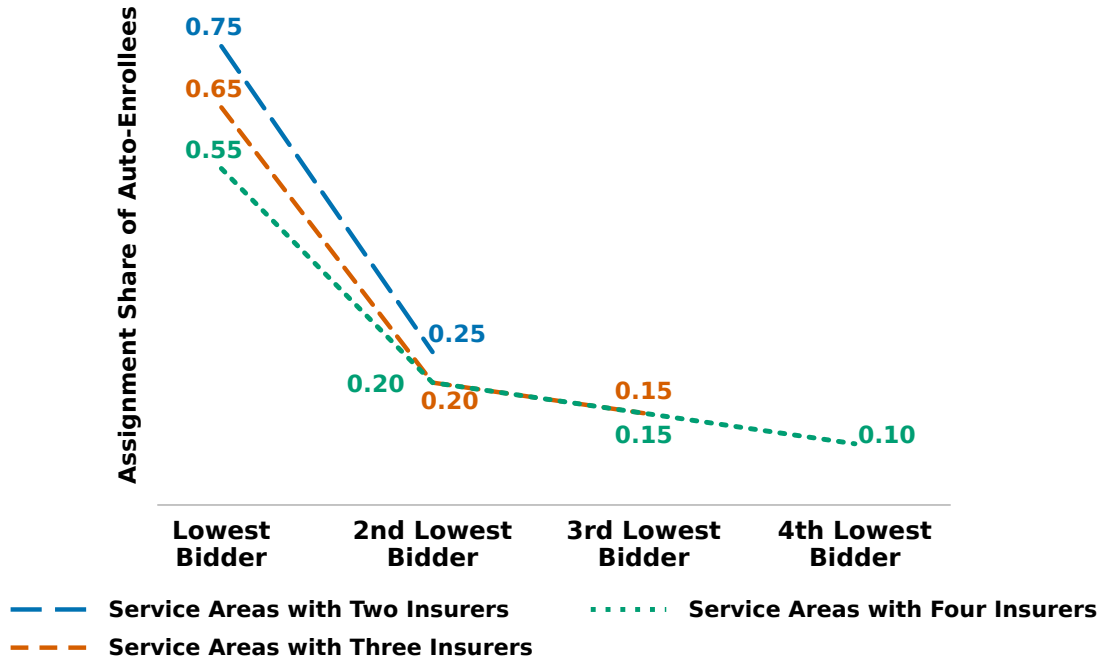
3.2 Auto Enrollment and Bidding Policies

Enrollment into CommCare involved two steps. Individuals first applied for eligibility by submitting income and demographic information. Approved individuals were then mailed a letter listing available plans and were asked to choose one by phone, mail, or online. Applicants who did not respond within 14 days were enrolled by default into a plan selected by the exchange. This auto-enrollment policy applied only to below-poverty enrollees, for whom all plans were free. Passive enrollees accounted for 34 percent of new below-poverty enrollment during fiscal years 2008–2009 (Shepard and Wagner, 2025). The passive segment is therefore large enough that insurers have a direct financial incentive in securing the passive enrollees.

The assignment rule differs depending on whether passives had prior enrollment spells with Commcare. Those with prior enrollment in the previous 12 months, whether in CommCare or Medicaid, were assigned back to that insurer. All other passive enrollees were randomly assigned to the plans operating in their service area, with assignment shares that rewarded lower bids. Figure 2 plots the assignment share schedule by bid rank. The lowest bidder received 75 percent of auto-assignees in service areas with two insurers, 65 percent with three insurers, and 55 percent with four, with the remaining shares declining in

bid rank. The steepness of the schedule is the central policy lever in this paper: moving from second-lowest to lowest bidder roughly triples an insurer's share of the passive segment.

Figure 2: Auto-Assignment Shares by Bid Rank



Note: The figure plots the share of auto-assigned enrollees allocated to each plan by the rank of its bid, separately for service areas with two, three, and four participating insurers. The lowest bidder receives the largest share in every configuration, and the reward to being lowest is steepest in two-insurer areas.

The auto-enrollment policy also has a well-defined timeline that fixes our analysis window. The policy operated from 2007 through fiscal year 2009, was suspended at the start of fiscal year 2010 amid recession-driven budget pressure, was briefly reinstated in the final months of fiscal 2010, and was permanently canceled in 2011 (Shepard and Wagner, 2022). We exclude fiscal 2007, when the state auto-converted a large population from its pre-reform uncompensated care pool under different procedures. Fiscal years 2008–2009 are therefore the steady-state period in which the bid-weighted assignment rule operated as designed, and they define the sample for our reduced-form and structural model.

4 Reduced Form

This section provides reduced-form evidence on the potential gains from matching passive enrollees to specific plans. Auto-assignment randomly allocates passive enrollees to plans through a bidding rule rather than enrollee choice. This randomization allows us to

compare switching, enrollment length, and health care utilization among passive enrollees assigned to plans that differ in how well they cover nearby hospitals. If poorly matched enrollees switch out more often, remain enrolled for shorter spells, and use less care, this suggests potential gains from matching passive enrollees.

We restrict the sample to new enrollees below 100 percent FPL who were auto-assigned to plans in 2008 and 2009. We remove service areas whose realized auto-assignment shares do not align with CommCare's stated auto-assignment policies. In such areas, the lowest-bid firm does not receive the highest share of passive enrollees.[6] These service areas account for 31.8 percent of enrollees between 2008 and 2009. We further restrict to service areas where both BMC and Network operated in 2008, and where BMC, Network, and NHP operated in 2009.

Table 1 compares passive and active enrollees along observables that plausibly correlate with health risk or plan preference. Column 1 reports sample means for the below-poverty analysis sample. Columns 2 and 3 report coefficients from OLS regressions of each characteristic on a Network plan dummy relative to the BMC baseline, controlling for service area by plan month fixed effects, estimated separately for passive and active enrollees. The fixed effects ensure that differences between Network and BMC enrollees reflect sorting between the two plans within a service area and month, rather than differences in plan availability, market composition, or auto-assignment policy across areas and over time.

Among passive enrollees (Column 2), differences between Network and BMC assignees are small relative to sample means and imprecise across all five characteristics. Among active enrollees (Column 3), we see the opposite pattern. Enrollees who choose Network over BMC are 0.417 years older, 2.5 percentage points more likely to be female, 1.2 percentage points less likely to be immigrants (mean 0.085), and 1.1 percentage points more likely to live within two miles of a hospital covered exclusively by BMC.

The contrast between the two columns shows the randomization. Passive assignment produces balance on observables, while active enrollees sort into plans on the same observables. The absence of imbalance in the passive column supports treating plan assignment among passive enrollees as orthogonal to enrollee characteristics.

For enrollee i auto-assigned in service area s at plan month t, we estimate outcome-specific linear regressions of enrollee outcomes on plan indicators interacted with proximity to hospitals covered exclusively by one plan. Let $P_i \in \{B, N\}$ denote the enrollee's plan, with B denoting BMC and N denoting Network. D_{is}^B and D_{is}^N are indicators for whether enrollee i resides within two miles of a BMC-only or Network-only hospital, respectively. We estimate:

[6] For 2008, this includes Fall River, New Bedford, Plymouth, and Taunton. For 2009, this includes Lawrence, Lowell, Lynn, Malden, Brockton, New Bedford, Wareham, and Springfield.

Table 1: Balance Table of Passive and Active Enrollees

Variables	**Sample Mean** (below poverty)	**Coeff. on Plan Dummies** **Network rel. to BMC**	
		Randomly Assigned (Passive Enrollees)	Self-Selecting (Active Enrollees)
	(1)	(2)	(3)
Age	34.953	0.0754	0.417**
		(0.194)	(0.175)
Female	0.460	-0.00420	0.0246***
		(0.00748)	(0.00636)
Immigrant	0.085	0.00219	-0.0123***
		(0.00445)	(0.00336)
Near BMC-only hospital	0.074	0.00106	0.0106***
		(0.00507)	(0.00400)
Near Network-only hospital	0.058	0.00193	0.00480
		(0.00337)	(0.00310)
Observations		24,790	48,324

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample includes new enrollees in FPL Group 1 (poorest) for years 2008 and 2009, restricting to service areas where both BMC and Network were available in 2008, or where BMC, Network, and NHP were available in 2009. "Near BMC-only hospital" is a binary variable equal to 1 if the enrollee lives within 2 miles of a hospital covered by the BMC plan but not the Network plan, and vice versa for "Near Network-only". Columns (2) and (3) report coefficients from an OLS regression of enrollee characteristics on a Network plan dummy (relative to the BMC baseline), controlling for service area $\times$ plan month fixed effects. The coefficients indicate the difference in characteristics for those with the Network plan relative to BMC.

$$
\begin{aligned}
Y_{ist} = & \underbrace{\beta_W^B \, \mathbb{1}\{P_i = B\} \, D_{is}^B}_{\text{BMC well-matched}} + \underbrace{\beta_P^B \, \mathbb{1}\{P_i = B\} \, D_{is}^N}_{\text{BMC poor-matched}} \\
& + \underbrace{\beta_W^N \, \mathbb{1}\{P_i = N\} \, D_{is}^N}_{\text{Network well-matched}} + \underbrace{\beta_P^N \, \mathbb{1}\{P_i = N\} \, D_{is}^B}_{\text{Network poor-matched}} \\
& + \gamma_1 \, \mathbb{1}\{P_i = N\} + \gamma_2 \, D_{is}^B + \gamma_3 \, D_{is}^N + \alpha_{st} + \varepsilon_{ist},
\end{aligned}
\tag{17}
$$

where Y_{ist} denotes an enrollee-level utilization or spending outcome averaged over the last 12 months, and α_{st} denotes service area by plan month fixed effects. The coefficients of interest are β_W^B, β_W^N, β_P^B, and β_P^N. β_W^B and β_W^N capture well-matched passive enrollees, who live within two miles of a hospital covered by their auto-assigned plan. β_P^B and β_P^N capture poor-matched passive enrollees, who live within two miles of a hospital covered exclusively by the other plan. The remaining terms absorb plan-level differences (γ_1), local hospital availability (γ_2, γ_3), and area-by-month heterogeneity (α_{st}). Identifying variation comes from within–service-area–plan-month differences in enrollee plan assignment and proximity to plan-exclusive hospitals.

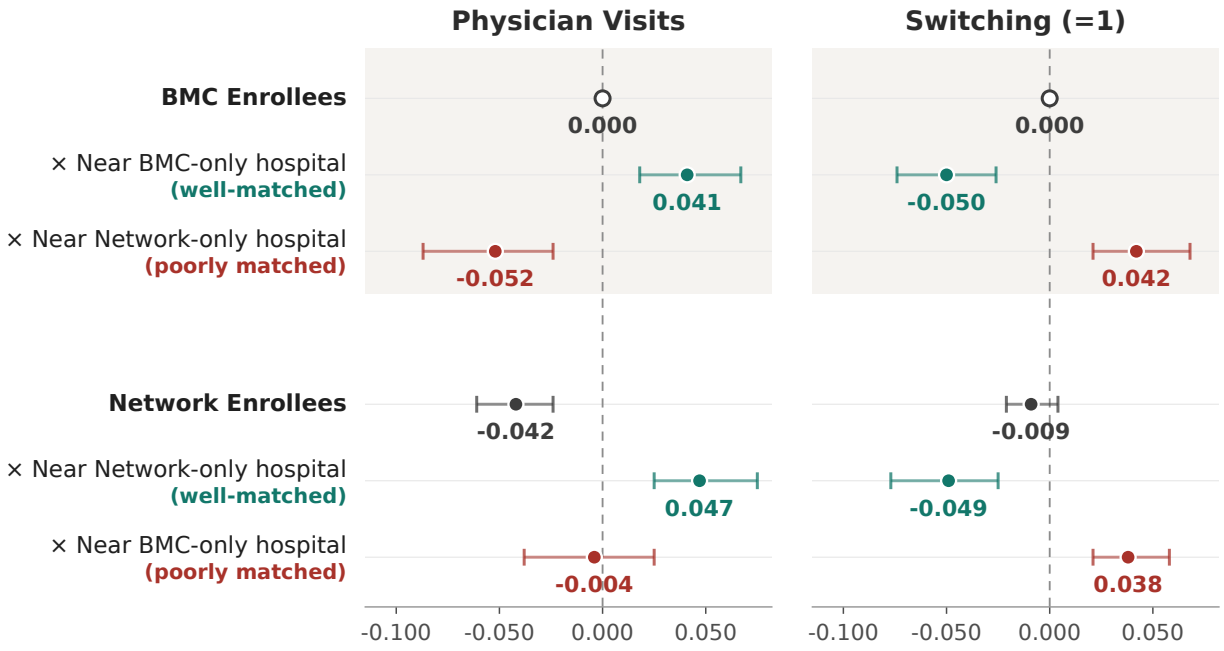
Figure 3 plots the coefficients for switching and physician visits. If proximity proxies for match quality, well-matched enrollees should remain with their assigned plan and use more care, while poor-matched enrollees should switch out and use less. Table 2 tabulates these coefficients alongside other set of outcomes.

Column 1 shows that against a mean switching rate of 9.0 percent, well-matched enrollees switch out 5.0 percentage points less often under BMC and 4.9 points less under Network, while poor-matched enrollees switch out 4.2 and 3.9 points more. Moving an enrollee from a poorly matched to a well-matched plan closes a gap of roughly 9 percentage points, roughly the size of the mean switching rate. Column 2 shows a similar pattern in enrollment spells, though less sharply. Against a mean spell of 11.6 months, well-matched Network enrollees stay 0.6 months longer and poor-matched Network enrollees 0.4 months shorter, but both coefficients are imprecise and the BMC coefficients are smaller and noisier.

Match quality also shapes health care utilization. Utilization outcomes are measured per member-month over the first 12 months of the spell. Mean PCP visits are 0.181, and well-matched enrollees record 23 percent (BMC) and 26 percent (Network) more visits than this mean, while poor-matched BMC enrollees record 29 percent fewer. Well-matched BMC enrollees record 24 percent more ER visits against a mean of 0.060, and generate 37 percent more ER spending against a mean of $18.13; well-matched Network enrollees generate 28 percent more ER spending, and poor-matched BMC enrollees 29 percent less, though this last coefficient is less precisely estimated. Total paid claims (Column 6) point in the same direction for three of the four match cells but are noisy throughout, suggesting that total spending is a noisier outcome than visit counts or ER costs.

Overall, these results suggest that assigning passive enrollees to the plan covering their closest hospital matters for retaining enrollees and health care. The welfare implications though, are ambiguous. Matching reduces switching and increases health care utilization, but it also increases spending.

Figure 3: Match Quality, Physician Visits, and Switching



Note: Coefficients from Equation 17 for physician visits (Column 3 of Table 2) and switching (Column 1). Each panel plots plan indicators and their interactions with proximity to plan-exclusive hospitals, relative to the BMC enrollee baseline. All regressions include service area by plan month fixed effects.

5 Structural Model and Estimation

The reduced-form estimates show that the auto-assignment rule placed passive enrollees nearly independently of bids and that passives are healthier than active choosers in the same income group. These estimates do not say how bids would change under a rule that responded to price, or what passives lose from being placed without regard to their preferences. How much did the observed rule raise premiums, and how much would matching passives to plans gain them? To answer this, we estimate a structural model of insurance plan choice, enrollee-level insurer costs, and auto-assignment, and combine it with a model of price competition. The demand model follows Shepard (2022) closely, and the cost model combines realized claims with plan cost effects estimated in Jaffe and Shepard (2020). The key feature is the auto-assignment component for passive enrollees.

Table 2: Matching Effects on Average Outcomes (Last 12 Months)

	(1) Switching	(2) Spell Length	(3) PCP Visits	(4) ER Visits	(5) Paid ER	(6) Tot. Paid
BMC Enrollees	ref.	ref.	ref.	ref.	ref.	ref.
Network Enrollees	-0.00881	0.933***	-0.0422***	-0.00647*	-5.037***	-48.81**
	(0.00543)	(0.214)	(0.00681)	(0.00371)	(1.301)	(20.29)
Well-Matched						
BMC Enrollees ×	-0.0500***	0.305	0.0411***	0.0143**	6.697***	6.183
Near BMC-only hospital	(0.00911)	(0.358)	(0.0114)	(0.00622)	(2.181)	(34.03)
Network Enrollees ×	-0.0491***	0.605*	0.0473***	0.00285	5.084**	54.25
Near Network-only hospital	(0.00914)	(0.360)	(0.0115)	(0.00624)	(2.190)	(34.16)
Poor-Matched						
BMC Enrollees ×	0.0422***	0.0616	-0.0522***	-0.00926	-5.284*	-11.31
Near Network-only hospital	(0.0114)	(0.447)	(0.0142)	(0.00776)	(2.723)	(42.47)
Network Enrollees ×	0.0385***	-0.391	-0.00422	-0.00124	0.770	12.49
Near BMC-only hospital	(0.00759)	(0.298)	(0.00951)	(0.00518)	(1.817)	(28.35)
Mean of Outcome	0.090	11.622	0.181	0.060	18.130	177.812
N	24790	24790	24790	24790	24790	24790
R^2	0.037	0.026	0.027	0.019	0.022	0.013
Area × Month FEs	X	X	X	X	X	X

Notes: Coefficients are from linear regressions of specific outcomes on insurance plan indicators and their interactions with hospital proximity measures. *Well-Matched* enrollees are individuals whose insurance plan aligns with nearby hospital availability. Specifically, "Near BMC-only hospital" is an indicator equal to one if the enrollee resides within 2 miles of a hospital covered by the BMC plan but not the Network plan; "Near Network-only hospital" is defined analogously for Network-exclusive hospitals. *Poor-Matched* enrollees are those whose insurance plan does not align with nearby hospital availability. All regressions include service area by plan month fixed effects. Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.1 Demand

Demand comprises two groups of enrollees for each plan. Active choosers select a plan from the menu available in their service area. Passive enrollees do not make choices and are assigned to a plan by the program. The two groups face the same menu and the same premiums, but the mapping from premiums to plan enrollment differs.

Active Choosers. We model enrollees' plan choices as a function of premiums and plan attributes interacted with enrollee characteristics. We estimate a multinomial logit choice model on choice instances, the points at which an enrollee newly enrolls, re-enrolls after a break in coverage, or faces open enrollment as a continuing enrollee, in fiscal years 2008 to 2013. At each instance the enrollee chooses among the CommCare plans available in her service area-year (Appendix B). The utility that enrollee i receives from enrolling in plan j at time t is

$$u_{ijt} = \underbrace{-\alpha(Z_{it}) \cdot P_{ijt}^{cons}}_{\text{Subsidized Premium}} + \underbrace{f(X_{jt}, Z_{it}; \beta)}_{\text{Plan Attributes}} + \underbrace{\xi_j(W_{it})}_{\text{Unobs. Diffs. (Plan FE)}} + \varepsilon_{ijt} \qquad j = 1, \ldots, J \quad (18)$$

where P_{ijt}^{cons} is plan j's post-subsidy premium for enrollee i in year t, which depends on her income group and region. Price sensitivity $\alpha(Z_{it}) = Z_{it}\alpha$ varies with income bins, medical diagnoses, demographics, and risk scores. The function $f(X_{jt}, Z_{it}; \beta)$ captures the value of each plan's hospital network to the enrollee, interacted with her characteristics, and inertia.

Inertia enters as an indicator for the plan a continuing enrollee held before open enrollment, interacted with her income, risk score, demographics and diagnoses; the indicator is zero for new enrollees, who hold no prior plan. Plan fixed effects $\xi_j(W_{it})$ absorb unobserved plan differences and are allowed to vary across enrollee groups W_{it}. The idiosyncratic term ε_{ijt} is distributed type-I extreme value.

Identification. Each parameter is identified by a distinct source of variation. The price coefficients $\alpha(Z_{it})$ are identified by within plan premium variation across income groups. Below-poverty actives pay zero premiums for any plan, while higher-income groups pay positive premiums that differ across plans by amounts the contribution schedule sets. Enrollees in different income groups facing the same plans (with different premiums) thus reveal how much a dollar of premium shifts choice. The network coefficients in $f(\cdot)$ are identified by variation across enrollees in their previous use of hospitals, interacted with which plan covers those hospitals. Inertia is identified by continuing enrollees' tendency to remain with their prior plan at open enrollment relative to new enrollees facing the same menu and premiums. The plan fixed effects absorb what remains of each plan's appeal within each enrollee group.

Price endogeneity is a standard concern that arises. Specifically, an insurer that expects a region's enrollees to favor it might bid higher, and premiums would then rise with the

taste shock, which biases α toward zero. The fixed effects remove most of this channel, since a plan's appeal to each enrollee group is absorbed and the premium variation that remains is the difference across income groups in what the same bid costs the enrollee. The subsidy schedule sets that difference.

Passive Enrollees. The program assigns passive enrollees to plans according to a bid-based rule. For these enrollees, the mapping from premiums to enrollment works through the auto-assignment rule rather than enrollee choice. We model the assignment rule as a simple logit over plan premiums. For a passive enrollee in service area a at time t, the probability of assignment to plan j is

$$s_{jt}^{AA} = \frac{\exp\left(\alpha^{AA} \cdot b_{jt}\right)}{\sum_{k \in \mathcal{J}_{at}} \exp\left(\alpha^{AA} \cdot b_{kt}\right)} \qquad j \in \mathcal{J}_{at} \tag{19}$$

where b_{jt} is plan j's gross premium bid, $\mathcal{J}_{at}$ is the set of plans participating in service area a, and $\alpha^{AA} \leq 0$ governs how strongly assignment responds to price. In the equilibrium simulations we apply a common plan set to all passive enrollees rather than service-area-specific menus.

In reality, passive enrollment shares are stepwise functions of plan bids. We approximate this mapping with the logit in equation (19) and estimate α^{AA} by a conditional logit of passive enrollees' plan assignments on plan bids. This approximation allows us to map assignment shares to premium bids in a continuous and differentiable function to compute equilibrium responses. The estimated auto-assignment price sensitivity is -0.0040 while the mean price sensitivity among above-poverty active choosers in the simulation sample is -0.0396. This implies that the assignment rule responds to premiums at one tenth the rate of the average active chooser.

Estimation. We estimate equation (18) by maximum likelihood on the choice instances of fiscal years 2008 to 2013, and α^{AA} by the conditional logit described above on new auto-assigned enrollees in fiscal year 2009. Appendix Table B1 shows the estimated and calibrated parameters of the model.

5.2 Costs and Risk Adjustment

We model the monthly cost of enrollee i in plan j as the product of an individual health component θ_i and a plan cost effect ϕ_j. Selection therefore occurs entirely through θ_i. We recover θ_i from the enrollee's realized claims under the plan she was in, and take the plan cost effects from Jaffe and Shepard (2020), 0.98 for BMC, 1.14 for NHP and 0.92 for Network. The program scales each plan's revenue per member-month by a risk score r_i that rises with the enrollee's realized cost at an elasticity of $\lambda = 0.95$. Plans are thus undercompensated for their most expensive enrollees and retain incentives to avoid them. We normalize risk

scores to a pooled mean of one across active and passive enrollees, which holds the market's total risk-adjusted revenue equal to the total of bids. Appendix B gives the cost projection, the risk-score formula and the normalization.

Passive Enrollees. Passive enrollees' cost components and risk scores are specified similarly, with θ_i from their realized claims under the assigned plan. Passive enrollees are substantially less costly than active choosers in the same income group: Table 3 compares below-poverty new enrollees by enrollment type. Passive enrollees' mean monthly claims are \$228 against \$400 for below-poverty active choosers, their median claims are \$27 against \$107, and 43 percent of passive enrollees generate no claims at all, against 28 percent of active choosers. The gap is consistent with sicker enrollees having stronger stakes in plan choice and therefore selecting into actively choosing.

Table 3: Costs by Enrollment Mode and Plan Cost Effects

	Active Choosers	Passive Enrollees
Enrollees	57,130	18,325
Enrollment months (mean)	5.21	5.31
Monthly paid claims (\$):		
Mean	399.73	228.22
Median	106.85	27.21
Share with zero claims	0.278	0.431
Plan cost effects, ϕ_j		
BMC	0.980	
NHP	1.137	
Network	0.919	

Note: Sample includes new enrollees in fiscal year 2009. The active column covers below-poverty active choosers; the passive column covers all auto-assignees, who are exclusively below poverty. Monthly paid claims are per-month averages over the choice instance (c_i^{obs}). Plan cost effects are the multiplicative plan components of equation (23), estimated by Jaffe and Shepard (2020).

5.3 Firm Profits

Each insurer submits a single bid b_j, and that one bid prices both segments of the market: it determines active choosers' subsidized premiums P_{ij}^{cons} through the program's contribution schedule, and it determines passive assignment probabilities s_j^{AA} through the auto-assignment rule of equation (19). Thus, a lower bid attracts price-sensitive active choosers and a larger share of passive enrollees. We simulate this game using the fiscal year 2009 data. We model a single bid per plan, corresponding to the plan's enrollment-weighted average bid, which ranged from \$363 to \$391 across plans.

Subsidies and Premiums. We hold each active chooser's subsidy fixed at its observed level. The Connector sets the enrollee's contribution for each plan by income group and

region, and the subsidy is the gap between the plan's bid and that contribution. This implies that the model reproduces every observed premium at observed bids and passes a change in plan j's bid through to its enrollees' premiums one for one. In other words, the state's outlay on an active chooser does not vary with bids, and a bid increase is borne entirely by the insurer's above-poverty active choosers (Appendix B).

Each enrollee carries m_i months of enrollment, measured as realized months over the choice instance, and all revenue and cost flows accrue per member-month. We hold m_i fixed across counterfactual bids. Plan j's profit is

$$\pi_j(b) \;=\; \underbrace{\sum_{i\in\mathcal{A}} s_{ij}(b)\, m_i \left(b_j\, r_i \;-\; \phi_j\, \theta_i\right)}_{\text{active choosers}} \;+\; \underbrace{s_j^{AA}(b) \sum_{i\in\mathcal{P}} m_i \left(b_j\, r_i \;-\; \phi_j\, \theta_i\right)}_{\text{passive enrollees}} \tag{20}$$

where $\mathcal{A}$ and $\mathcal{P}$ denote the sets of active and passive enrollees, $s_{ij}(b)$ is the choice probability from equation (18) evaluated at the anchored premiums, and $s_j^{AA}(b)$ is the assignment probability from equation (19).

Table 4 tabulates the demand semi-elasticities and average cost slope across enrollee types. Panel (a) reports own-price semi-elasticities. Among above-poverty active choosers, new enrollees' overall semi-elasticity is -0.018 and continuing enrollees' is -0.004, while passive assignment responds at -0.003. Among new enrollees the response is largest for Network (-0.023) and NHP (-0.020) against BMC (-0.014), and largest in the 100–150 percent of poverty group (-0.021) against -0.012 above 200 percent of poverty. Continuing enrollees respond at roughly a fifth of new enrollees' rate in every plan and income group. This is driven by inertia: a continuing enrollee's utility carries the indicator for her prior plan, and a bid change shifts few of them off it.

The passive column takes a single value across plans and income groups. This is driven by the assignment rule rather than by enrollees. Under equation (19) every passive enrollee faces the same assignment probabilities, and the semi-elasticity of assignment to plan j is $\alpha^{AA} s_j(1 - s_j)$ regardless of the enrollee's income or health. The rule therefore responds to a dollar of bid at one sixth of new enrollees' rate and at close to continuing enrollees' rate.

Panel (b) reports the change in a plan's average cost per dollar of its bid. For new enrollees the slope is 0.836, and for continuing enrollees 0.271. This is driven by selection on the price margin: the new enrollees a plan loses when it raises its bid are cheaper than those who stay, and its average cost rises. The passive slope is exactly zero. This is driven by the assignment rule, which reallocates passive enrollees in proportion to their numbers: the marginal passive enrollee is the average one, and passive enrollment carries no selection margin. The zero slope concerns selection and not cost levels, since passive enrollees' average cost is well below active choosers' (Table 3). This implies that passive enrollment adds volume at a cost that bid-invariant.

Table 4: Implied Demand Semi-Elasticities and Average Cost Slopes by Enrollee Type

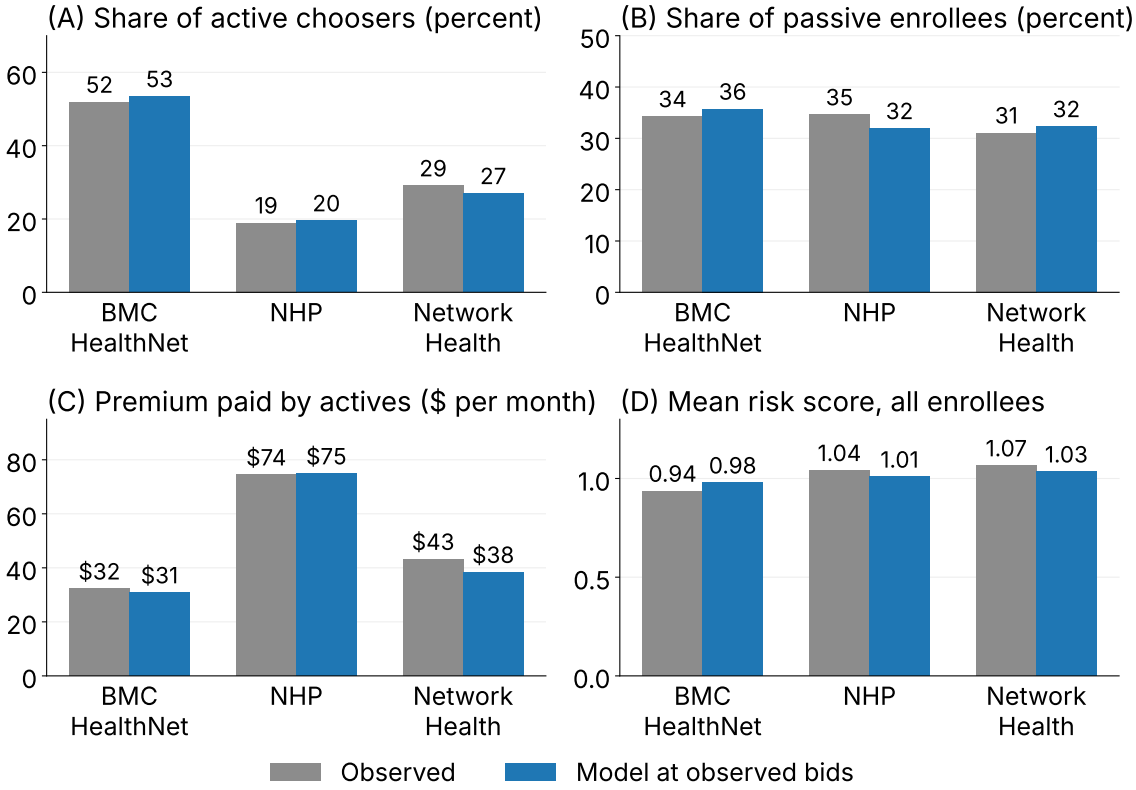
	(a) Demand Semi-Elasticity			(b) Avg. Cost Slope (dAC/dP)		
	New	Continuing	Passive (rule)	New	Continuing	Passive (rule)
Overall	**−0.018**	**−0.004**	**−0.003**	**0.836**	**0.271**	**0.000**
By Plan						
BMC	−0.014	−0.003		0.423	0.164	
NHP	−0.020	−0.008	−0.003	0.881	0.663	0.000
Network	−0.023	−0.003		1.591	0.259	
By Income Group						
Below 100 percent of poverty	–	–		–	–	
100–150 percent of poverty	−0.021	−0.004	−0.003	0.903	0.238	0.000
150–200 percent of poverty	−0.017	−0.003		0.934	0.250	
200–250 percent of poverty	−0.012	−0.004	–	0.614	0.443	–
250–300 percent of poverty	−0.012	−0.003	–	0.821	0.275	–

Note: Own-price semi-elasticities are $\sum_i \partial s_{ij}/\partial b_j \,/\, \sum_i s_{ij}$, weighted by enrollment months, evaluated at observed fiscal year 2009 premiums for active choosers and at statewide mean Plan Type II bids for passive enrollees. New and Continuing columns cover above-poverty active choosers in the full choice data; New includes re-enrollees after coverage breaks. Below-poverty active choosers are excluded since their premiums do not vary with bids. The passive columns are evaluated under equation (19) and take one value across plans and income groups. Average cost slopes are $\eta_j(AC_j - MC_j)$, computed without risk adjustment, where η_j is the positive semi-elasticity, AC_j the enrollment-weighted average projected cost, and MC_j the derivative-weighted marginal cost. The Overall row weights plan-specific values by plan shares.

Simulation Sample. We simulate the pricing game for the full set of new enrollees in fiscal year 2009, 36,080 above-poverty active choosers and 18,325 passive enrollees, and solve for pure-strategy Nash equilibria with bids restricted to $350 to $500 (Appendix B). We restrict the simulation to new enrollees since auto-assignment applies only at enrollment—every passive enrollee is a new enrollee.

Model Fit. Figure 4 compares the model to fiscal year 2009 at observed bids. The model reproduces active choosers' plan shares within two percentage points, at 53.5 percent (BMC), 19.6 percent (NHP) and 27.0 percent (Network) against 51.9, 19.0 and 29.1 percent observed, and the average premium paid by above-poverty active choosers within $2, at $41 against $43 (Panels A and C). Passive shares are within three percentage points and mean risk scores within 0.04 (Panels B and D).

Figure 4: Model Fit at Observed Bids, Fiscal Year 2009



Notes: Observed moments are computed on the simulation sample: above-poverty active new enrollees and auto-assigned new enrollees in fiscal year 2009, Fallon excluded. Simulated moments evaluate the model at each plan's observed fiscal year 2009 bid under the estimated assignment rule. Panels (a) and (b): enrollment-month-weighted shares. Panel (c): premium paid per month by above-poverty active choosers under the subsidies of Section 5.3. Panel (d): risk scores r_i of Appendix equation (25), normalized to a pooled mean of one. Appendix Table B2 reports the same moments at the equilibria of the $500 and $700 games and without auto-assignment.

6 Counterfactuals

We now use the estimated model to ask how the design of the auto-assignment rule shapes equilibrium bids. The rule Massachusetts used approximates to one tenth the price sensitivity of the average active chooser. We consider a range of alternatives, from a price-insensitive rule that spreads passive enrollees evenly across plans, to rules more responsive than active choosers. As a benchmark, we also solve the game with no auto-assignment and removing the passive segment from the market. We then examine the possible gains from matching enrollees to specific plans while holding the count of passive enrollees fixed at the observed amount across insurers.

6.1 Varying Auto-Assignment

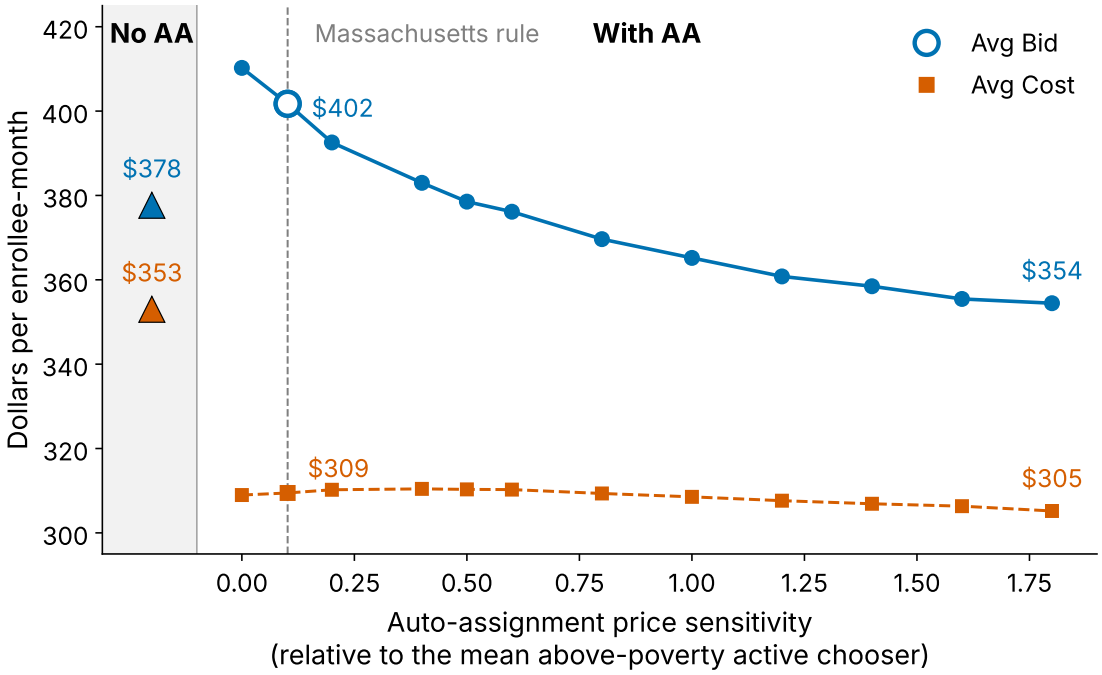
The demand estimates show that the observed auto-assignment rule responded to bids at one tenth the price sensitivity of above-poverty active choosers. Here, we quantify how equilibrium bids respond to the price sensitivity of the assignment rule while holding the risk-adjustment rule, the subsidy schedule and insurers' cost structure fixed. Specifically, we solve the bidding game at each level of auto-assignment responsiveness and decompose the equilibrium bid into insurers' average revenue and average cost. We then trace which insurers compete for the passive pool, and report enrollee surplus and government cost under each rule.

Equilibrium Bids. Figure 5 plots the average bid, weighted by the enrollment months of all enrollees, against the responsiveness of the assignment rule. The rule is expressed relative to the mean price sensitivity of above-poverty active choosers. The open circle marks the observed rule, and the triangles at the left mark the benchmark with no auto-assignment.

At the observed policy, auto-assignment raised premiums. The average bid is $402 under the observed rule and $378 with no auto-assignment. This represents a gap of $24 or 6.3 percent of the no-assignment benchmark. The bid falls as the rule becomes more responsive, crosses the no-assignment benchmark at a responsiveness of approximately 0.55, and reaches $354 at 1.8 times the price sensitivity of the average active chooser.

Costs and Markups. Moving from the left to the right of the auto-assignment scenario, costs are flat while bids fall. Average cost is $309 per member-month under the observed rule and $305 at a responsiveness of 1.8, while the bid falls from $402 to $354 over the same range. Average cost falls from $353 to $309 when passive enrollees enter the market. This is driven by passives being healthier than active choosers in the same income group (Table 3). The margin between average revenue and average cost rises from $75 with no

Figure 5: Equilibrium Bids and Costs by Auto-Assignment Price Responsiveness



Note: Each point is the equilibrium at the indicated responsiveness of the auto-assignment rule, relative to the mean price sensitivity of above-poverty active choosers. Bids and costs are weighted by the enrollment months of all enrollees; average cost is the projected plan cost. The no-auto-assignment benchmark covers active choosers only. The open circle marks the estimated Massachusetts rule.

auto-assignment to $92 under the observed rule and falls to $50 at a responsiveness of 1.8 (Table 5, Panel A). Appendix Figure D1 plots average revenue alongside the bid and average cost.

The premium increase is driven by increasing markups. Under the observed auto-assignment rule, passive enrollees respond to price at one tenth the rate of active choosers. Auto-assignment at the observed rule thus raised bids by lowering the aggregate price sensitivity of demand across actives and passives, with no change in insurers' costs. Importantly, increasing auto-assignment's price sensitivity to bids can further reduce markups: a rule 1.8 times as responsive as active choosers lowers the margin to $50, two thirds of its level with no auto-assignment at all.

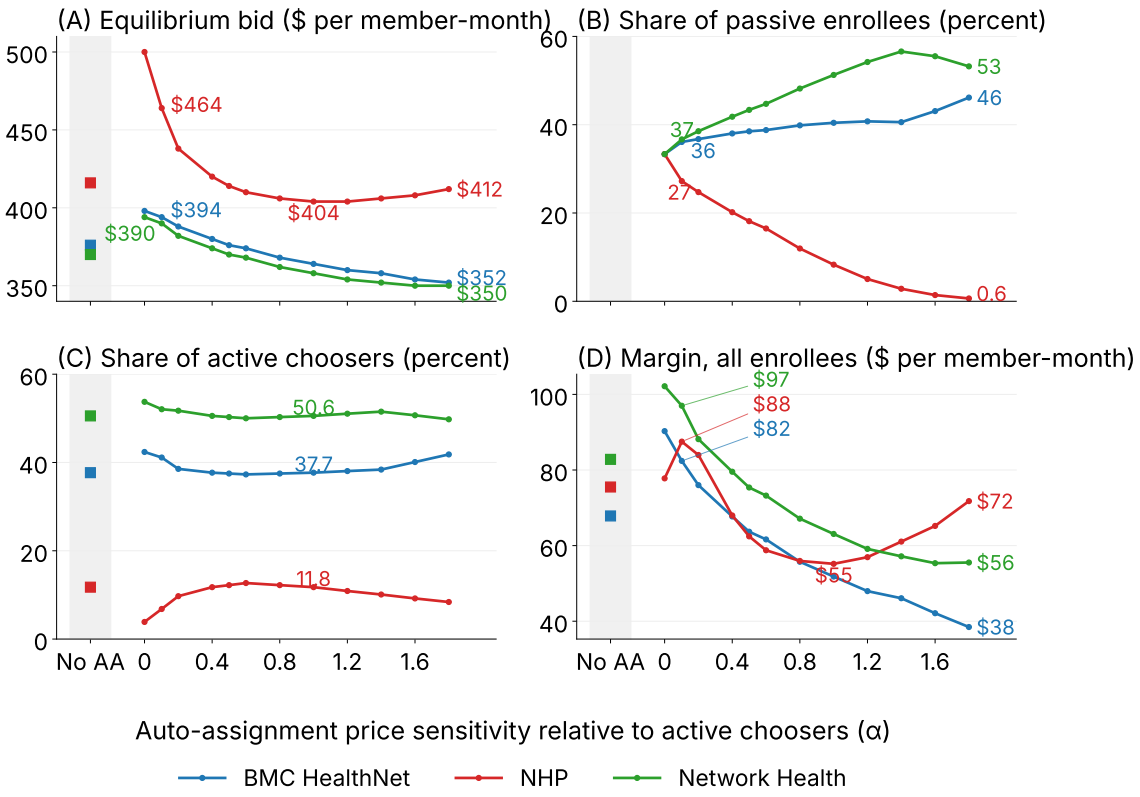
Competition for the Passive Pool. Figure 6 plots each insurer's bid, share of passive enrollees, share of active choosers and margin along the sweep. BMC and Network compete for the passive pool while NHP concedes it. BMC and Network lower their bids from $394 and $390 under the observed rule to $352 and $350 at a responsiveness of 1.8, and their shares of passives rise from 36 to 46 percent (BMC) and from 37 to 53 percent (Network). NHP lowers its bid from $464 to $404 at a responsiveness of 1.0 and raises it to $412 at 1.8, while its share of passives falls from 27 percent to under one percent. At a responsiveness of zero NHP bids at the $500 ceiling, and its share of active choosers and its margin are below their values under the observed rule (Panels c and d). Active choosers' shares vary little along the sweep, and at a responsiveness of 1.0 they equal the shares with no auto-assignment, at 37.7 percent (BMC), 11.8 percent (NHP) and 50.6 percent (Network) (Panel c).

Bids fall through competition for the passive pool rather than through passives' lower costs. BMC's and Network's margins fall from $82 and $97 under the observed rule to $38 and $56 at a responsiveness of 1.8, while NHP's margin falls from $88 to $55 at a responsiveness of 1.0 and rises to $72 at 1.8 (Panel d). Once NHP no longer competes for passives, it prices to its active choosers. At a responsiveness of 1.8 its margin exceeds BMC's and Network's while its shares of both segments are the smallest.

The shift in passives is set mainly by the rule itself. Applying a rule as responsive as active choosers to the observed-rule bids reproduces most of NHP's loss of passives, and NHP's lower equilibrium bid recovers only a small part of it (Appendix D).

The rule sets the level of bids, while relative prices are set by competition for active choosers. Active choosers face no outside option. At a responsiveness of 1.0 the bid gaps between plans equal those with no auto-assignment, and active choosers' shares are therefore identical in the two equilibria (Panel c).

Figure 6: Bids, Enrollment Shares, and Margins by Insurer and Auto-Assignment Price Responsiveness



Note: Each point is the equilibrium at the indicated responsiveness; the estimated Massachusetts rule, at 0.10, is the second point on each line. Panel (a): equilibrium bid. Panel (b): share of passive enrollees' enrollment months. Panel (c): share of above-poverty active choosers' enrollment months. Panel (d): margin per member-month over all of the insurer's enrollees, average revenue less average cost. Squares mark the no-auto-assignment benchmark.

Enrollee Surplus and Government Cost. Table 5 reports enrollee surplus, government cost and insurers' profit under the observed rule and under a more responsive rule. A more responsive rule raises enrollee surplus and lowers government cost, and both gains come out of insurers' margins. Above-poverty active choosers pay $63 per member-month under the observed rule and $30 at a responsiveness of 1.0, against $42 with no auto-assignment (Panel A). Their surplus is $3.7 million below the no-assignment benchmark under the observed rule and $2.1 million above it at 1.0. Government cost falls from $103.6 million to $99.7 million, as payments for passive enrollees fall from $30.0 million to $26.6 million, while insurers' profit falls from $26.6 million to $16.7 million (Panel B). Importantly, the responsive rule raises enrollee surplus by $5.8 million and lowers government cost by $3.9 million, and insurers' profit falls by approximately the sum.

The surplus gain accrues to above-poverty active choosers rather than to the state. This is driven by the subsidy design. The state pays the bid net of the enrollee's contribution, and the contribution rises one for one with the bid. Since the subsidy is fixed, the state's spending on active choosers is unchanged across rules, at $73.4 million to $73.6 million, and every dollar of bid change passes through to premiums. Government cost therefore falls only through the state's payments for passive enrollees. Under the observed rule insurers' margin per member-month rises from $75 to $92 against the no-assignment benchmark (Panel A). The observed rule therefore transferred approximately $21 per month from above-poverty active choosers to insurers, and a rule at least half as responsive as active choosers reverses the transfer.

Matching Along the Sweep. The passive match value row of Table 5 reports what a more responsive rule is worth to the re-sorted passive enrollees. Competition for passive enrollees does not worsen their match. Moving from the observed rule to the responsive rule, passive enrollees' valuation of their assigned plan rises by $0.04 per member-month, while premiums paid by active choosers fall by $33. This is driven by which plans passive enrollees value. Outside Boston, NHP is the highest bidder and the plan that below-poverty active choosers select least often. Since a more responsive rule assigns fewer passives to the highest bidder, it assigns more of them to the plans that below-poverty active choosers in the same region select. In Boston the reverse holds, and the regions net to approximately zero. Importantly, raising its responsiveness lowered prices for active choosers and the state without worsening the match of passive enrollees.[7]

[7]Prior Partners use is unobserved for new enrollees. We impute it from first-year use, which random assignment makes representative of the passive population. Under the imputation the change in passive enrollees' valuation remains close to zero, and the gains from matched assignment in Section 6.2 rise. Both NHP and Network Health covered Partners hospitals in fiscal year 2009, and passive enrollees assigned to either plan used a Partners hospital at half the rate of active choosers who selected one.

Table 5: Welfare and State Spending Under Auto-assignment Scenarios

	No auto-assignment	Observed rule ($\hat{\alpha} = 0.10$)	Responsive rule ($\alpha = 1.0$)	Change
A. Per member-month ($)				
Average bid	\$378	\$402	\$365	−\$37
Premium paid, active choosers	\$42	\$63	\$30	−\$33
State payment per passive	–	\$309	\$273	−\$36
Insurer margin	–	\$92	\$58	−\$34
Passive match value	–	\$0	\$0.04	+\$0.04
B. Annual totals ($ million)				
Active choosers				
Premiums paid	8.07	12.08	5.79	−6.29
Consumer surplus	0	−3.70	2.05	+5.75
State				
Subsidies to active choosers	73.42	73.60	73.12	−0.48
Payments for passives	–	30.04	26.58	−3.46
Total	–	103.64	99.70	−3.94
Insurers				
Profit	–	26.63	16.67	−9.96

Notes: Each column is the equilibrium under the assignment rule in the header; the last column is the responsive rule less the observed rule. The no-auto-assignment column covers active choosers only. Active choosers are above poverty throughout. Average bid and insurer margin are over all enrollees; the margin is revenue, including risk-adjustment transfers, less cost. Premium paid is the bid less the observed subsidy. State payment per passive is the bid times the risk score. Passive match value is passive enrollees' mean valuation of their assigned plan, relative to the observed rule. Consumer surplus is the logit inclusive value divided by the price coefficient, relative to the no-auto-assignment column.

6.2 Benefits of Matching

The simulations above show that auto-assignment can be a policy tool to discipline price competition by more generously allocating passive enrollees to lower bid firms. In this section, we quantify the gains from matching passives to specific plans while holding each insurer's passive volume fixed. Specifically, we hold each insurer's count of passive enrollees at its observed fiscal year 2009 value and reassign passives across plans.

Matched Assignment. Under matched assignment, each passive enrollee is assigned to the plan which yields the highest expected utility within her choice set. Two constraints apply. Each insurer's count of passives remains at its observed value, and a passive is not placed in a plan she prefers less than her observed plan. Let v_{ij} denote the systematic utility of plan j for passive enrollee i from equation (18) with the premium term set to zero, since passives pay zero premiums. We predict v_{ij} from the demand estimates at each passive enrollee's own characteristics. Since passives are new enrollees, the prior-hospital terms of equation (18) are zero, and v_{ij} is the valuation of a below-poverty active new entrant with the same region, health and demographics.

Let $a^0(i)$ denote the plan the observed rule assigned to i, $\mathcal{P}$ the set of passive enrollees, and N_j the observed count of passives in plan j. The matched assignment a^M solves

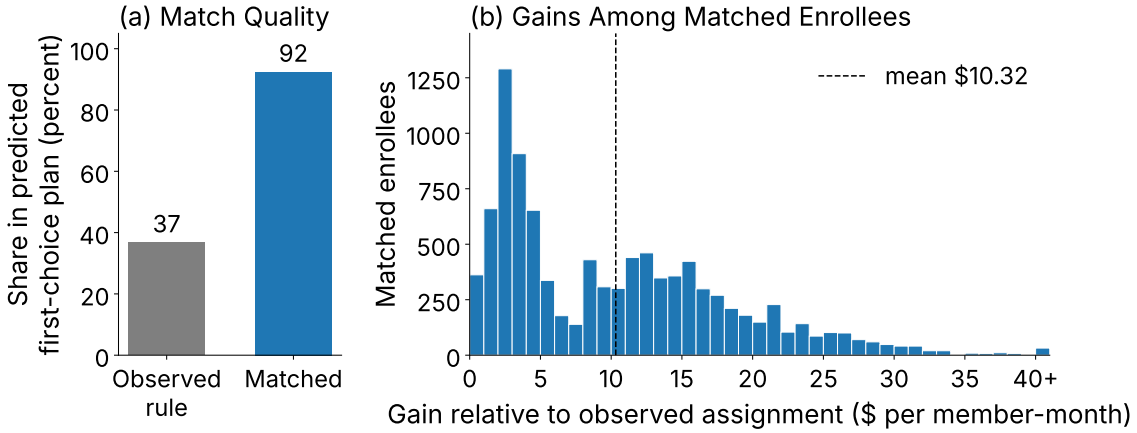
$$\max_{a} \sum_{i \in \mathcal{P}} v_{i\,a(i)} \quad \text{s.t.} \quad \underbrace{\sum_{i \in \mathcal{P}} \mathbf{1}\{a(i) = j\} = N_j \;\; \forall j}_{\text{counts fixed}} \quad \text{and} \quad \underbrace{v_{i\,a(i)} \;\geq\; v_{i\,a^0(i)} \;\; \forall i}_{\text{no enrollee worse off}} \tag{21}$$

The first constraint holds each insurer's passive volume fixed. In equation (20) the assignment enters insurer j's passive revenue and cost only through its share $s_j^{AA}(b)$, and holding N_j at its observed value makes matching a re-sorting of passives across plans at unchanged market shares. Matching therefore changes only the composition of each insurer's pool, the mean cost and risk score of its passives, and this is the channel through which it can affect bids (Table 6). The second constraint rules out reassignments that make a passive worse off than under the observed rule.[8] We solve equation (21) through plan-specific shadow prices on slots. Each passive's utility gain is converted to dollars per member-month with the price coefficient of equation (18) at the 100–150 percent FPL group, since passives' own price sensitivity is not identified (Appendix E). The matching population is the 16,895 fiscal year 2009 passive enrollees of the simulation sample outside Fallon.

[8]Without the second constraint, filling the under-demanded plans' observed counts displaces a small share of passives whom the observed rule had placed in a mildly preferred plan, and the aggregate gain is slightly larger (Appendix E).

Passive Enrollee Surplus. Figure 7, Panel (a), shows that under the observed rule 37 percent of passives are in their predicted first-choice plan, while matched assignment places 92 percent there. The observed share equals that of a uniform random draw. Within a region, the model ranks the same plan first for nearly every passive enrollee. Matched assignment therefore places each passive in the plan that below-poverty active choosers in her region select most often. Panel (b) plots the distribution of surplus gains among the 9,840 passives (58 percent) who change plan. Gains average $10.32 per member-month among them. The distribution is bimodal, with one mode at $2 to $4 and a second at $8 to $16. Across all passives the mean gain is $6.01, and the aggregate gain over fiscal year 2009 enrollment months is $526,000. Importantly, matching delivers this surplus with government cost unchanged.

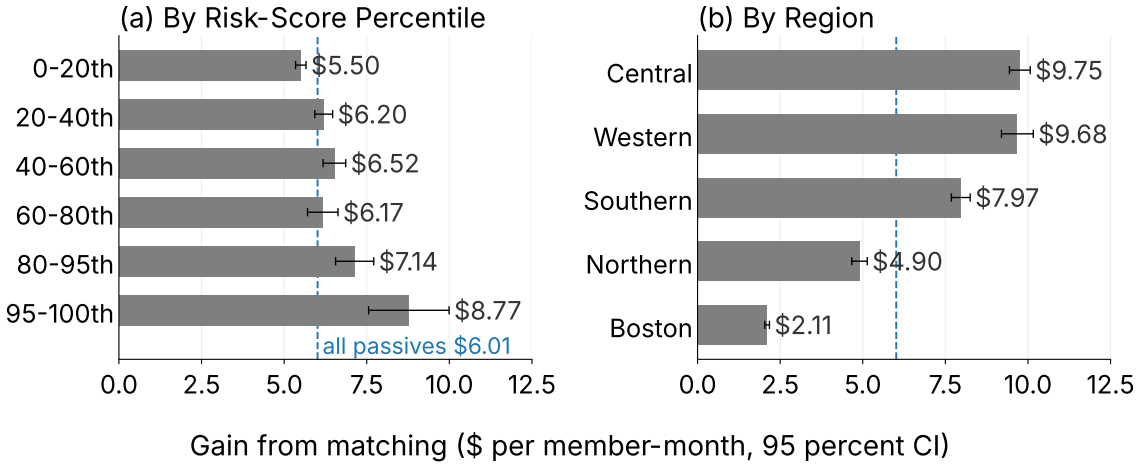
Figure 7: Passive Enrollee Surplus From Matching



Notes: Fiscal year 2009 passive enrollees excluding Fallon assignees (N = 16,895). Panel (a): share of passives placed in their predicted first-choice plan under the observed rule and under matched assignment. Panel (b): distribution of the surplus gain from matching, in dollars per member-month and $1 bins, among the 9,840 passives whose plan changes. Each plan's count of passives is held at its observed value.

Passive Enrollee Surplus by Region and Health. Figure 8 shows that surplus gains vary across regions and rise with health risk. Across the five regions in Panel (b), gains are $2.11 (Boston) and $4.90 (Northern) against $7.97 (Southern), $9.68 (Western) and $9.75 (Central). In Boston every plan's network covers a nearby hospital. A passive whose nearest hospital belongs to Partners has NHP, and one whose nearest hospital is Boston Medical Center has BMC or NHP. Outside Boston the two narrow networks diverge, and a random draw can place the enrollee in a plan that does not cover her nearest hospital. Across risk-score groups in Panel (a), gains are $5.50 in the bottom quintile against $8.77 in the top five percent. The health gradient is absent within Boston and present in every other region (Appendix Figure E2).

Figure 8: Passive Enrollee Surplus From Matching by Health Risk and Region



Notes: Mean surplus gain from matching in dollars per member-month, with 95 percent confidence intervals, by risk-score percentile group (Panel a) and by rating region (Panel b). The dashed line is the mean over all 16,895 passives. Risk-score groups follow the demand model's quantile bins.

Mismatch Under the Observed Rule. Preference for NHP is driven by region and is weak. Passives whose predicted first choice is NHP are Boston residents, while BMC-preferrers live in the Southern and Western regions and Network-preferrers in the Southern and Northern regions. The observed rule fills NHP's slots from every region. This implies that most of NHP's passives are mismatched, and the mismatched are non-Boston passives with the strongest regional preferences. The surplus gains from matching therefore concentrate among passives the observed rule placed in NHP. Appendix E reports the regional composition of each first-choice group, the utility gap between first- and second-choice plans, and the reassignment flows.

Effects on Insurers. Having quantified the surplus gain to passive enrollees, we now ask whether re-sorting them hurts the insurer that receives the sicker passives. Table 6 reports each insurer's passive pool, equilibrium bid and margin on passives under the observed assignment and under matching. Panel A shows that matching sorts higher-cost passives into NHP, whose passive enrollees' cost rises from $208 to $240 per member-month, against a fall from $238 to $204 at BMC. There is no change for Network. However, despite higher costs at NHP, risk adjustment compensates for sicker enrollees. Since risk-adjusted revenue rises with the risk score, NHP's net margin on passives reduces from $104 to $97 per member-month while Network's rises from $54 to $79 (Panel B). Matching therefore costs NHP $7 per passive member-month and raises Network's margin by $25.

With the matched pools, re-solving the pricing game raises NHP's equilibrium bid from $450 to $476 and BMC's and Network's by $2, and the average bid across all enrollees rises from $399 to $402 (Panel B). The bid increase is borne by NHP's above-poverty active

choosers, whose premium rises one for one with NHP's bid under the anchored subsidy. Passives pay zero premiums in either scenario. Holding each insurer's profit from passives at its observed level as well as its count retains most of the surplus gain to passives and lowers NHP's re-pricing (Appendix E).

Table 6: Matching and Insurers' Passive Pools and Bids

Panel A: Cost and health of the passive pool

		Mean monthly cost, θ_i ($)		Mean risk score, r_i	
Plan	Passives	Status quo	Matched	Status quo	Matched
BMC HealthNet	5,657	238.4	204.2	0.743	0.663
NHP	6,378	207.6	239.6	0.746	0.772
Network Health	4,860	227.3	225.2	0.670	0.729

Panel B: Equilibrium bids and margins on passive enrollees

		Equilibrium bid ($)		Net margin ($ per member-month)	
Plan	Passives	Status quo	Matched	Status quo	Matched
BMC HealthNet	5,657	392	394 (+2)	61.1	64.3 (+3.2)
NHP	6,378	450	476 (+26)	104.4	97.1 (−7.3)
Network Health	4,860	388	390 (+2)	54.1	79.2 (+25.1)
Market bid, all enrollees		399.0	402.4 (+3.4)		
Market bid, active choosers		394.9	396.4 (+1.5)		

Notes: Fiscal year 2009 passive enrollees excluding Fallon assignees ($N = 16{,}895$). "Status quo" is the observed assignment; "Matched" is the matched assignment at observed plan counts. Differences between 'Status quo' and 'Matched' are in parentheses. θ_i is the plan-neutral monthly cost; r_i is the risk score, normalized to a pooled mean of one. Bids are the equilibrium of the $500-ceiling game at the estimated rule with each column's passive pools. Net margin is $b_j r_i - \phi_j \theta_i$ averaged over the plan's passive pool. Market bids are weighted by enrollment months.

Limitations. These results are subject to three limitations. First, v_{ij} is the systematic component of utility, and the 92 percent in Figure 7 is the share of passives placed in the plan the model predicts they would choose rather than the plan they would choose given their idiosyncratic draw. Second, holding each insurer's count fixed holds its incentives fixed at the status-quo bids; the re-pricing in Table 6 passes part of the gain to passives through to NHP's active choosers as higher premiums, and the exercise does not net the two. Third, the dollar metric borrows the price sensitivity of the 100–150 percent FPL group. For these reasons, the exercise should be read as a transparent comparison of assignment rules at fixed counts, rather than as an evaluation of an optimal assignment mechanism.

7 Conclusion

This paper studies auto-enrollment as a supply-side market design instrument. An allocation rule that allocates passive enrollees regardless of price makes the aggregate demand

each insurer faces more inelastic, and insurers raise markups. A more price elastic rule disciplines competition. The same rule decides which plan each passive enrollee receives, which determines the matching effects.

These findings are relevant for any program that auto-enrolls consumers among competing firms. Medicaid managed care assigns passive enrollees at random, by continuity of care, or by plan quality; Medicare Part D's benchmark and the marketplaces that auto-enroll Medicaid leavers into the lowest-premium plan reward price; defined-contribution pensions auto-enroll savers into a fund chosen by the employer. In each case the rule sets part of the demand elasticity firms face and the product passive consumers receive. The condition that decides whether the two effects reinforce or offset is the correlation between firms' prices and passive consumers' valuations across firms. Where the low-priced firm is the valued firm, a price-sensitive rule serves both; where it is not, the two effects pull apart.

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A Derivations for the Theory

Equation (6), the markup decomposition. Start from the first-order condition, equation (5), with total demand from equation (1), $D_j^{Tot} = \theta_A D_j + \theta_P R_j$. Write the slopes as $D_j' = \partial D_j/\partial P_j$ and $R_j' = \partial R_j/\partial P_j$. Then $\partial D_j^{Tot}/\partial P_j = \theta_A D_j' + \theta_P R_j'$, and define $\sigma = \theta_P R_j'/(\theta_A D_j' + \theta_P R_j')$, the share of marginal enrollees who are passive. Marginal cost is the slope-weighted mean of the two segments' marginal costs,

$$MC_j = \frac{\sum_i C_{ij}\, \partial D_{ij}^{Tot}/\partial P_j}{\partial D_j^{Tot}/\partial P_j} = \frac{\theta_A D_j'\, MC_j^A + \theta_P R_j'\, MC_j^P}{\theta_A D_j' + \theta_P R_j'} = (1-\sigma)\, MC_j^A + \sigma\, MC_j^P$$

The markup splits the same way,

$$\begin{aligned}\frac{D_j^{Tot}}{-\partial D_j^{Tot}/\partial P_j} &= \frac{\theta_A D_j}{-(\theta_A D_j' + \theta_P R_j')} + \frac{\theta_P R_j}{-(\theta_A D_j' + \theta_P R_j')} \\ &= \frac{\theta_A D_j'}{\theta_A D_j' + \theta_P R_j'} \cdot \frac{D_j}{-D_j'} + \frac{\theta_P R_j'}{\theta_A D_j' + \theta_P R_j'} \cdot \frac{R_j}{-R_j'} = (1-\sigma)\,\frac{D_j}{-D_j'} + \sigma\,\frac{R_j}{-R_j'}\end{aligned}$$

Adding the two gives equation (6).

The markup in collected form. Substituting equation (1) and its slope into equation (5) directly gives the markup as a single ratio in which the two segments' slopes add,

$$P_j^* - MC_j = \frac{D_j^{Tot}}{-\partial D_j^{Tot}/\partial P_j} = \frac{\theta_A D_j + \theta_P R_j}{-\theta_A D_j' - \theta_P R_j'} \tag{22}$$

Equation (6) is this ratio with the numerator and denominator split by segment. Equation (22) remains defined when $R_j' = 0$, where the passive bracket of equation (6) is not, and the derivations below start from it.

Equation (7), the slope of the logit rule. With $R_j = \exp(\alpha^{AA} P_j)/\sum_k \exp(\alpha^{AA} P_k)$,

$$\frac{\partial R_j}{\partial P_j} = \alpha^{AA} R_j - \alpha^{AA} R_j^2 = \alpha^{AA} R_j (1 - R_j)$$

The semi-elasticity of the passive share is $\partial \ln R_j/\partial P_j = \alpha^{AA}(1 - R_j)$.

Equation (8), the uniform rule. Set $\alpha^{AA} = 0$ in equation (22). Then $R_j' = 0$, $\sigma = 0$, $MC_j = MC_j^A$ and

$$P_j^* = MC_j^A + \frac{\theta_A D_j + \theta_P R_j}{-\theta_A D_j'} = MC_j^A + \frac{D_j}{-D_j'} + \frac{\theta_P R_j/\theta_A}{-D_j'}$$

The first two terms are the price without passives and the third is the extra markup.

Equation (9), when auto-enrollment raises the markup. Compare the markup with passives, equation (22), with the markup without passives, $D_j/(-D_j')$, at the same D_j, D_j' and MC_j. The markup with passives is larger when

$$\begin{aligned}\frac{\theta_A D_j + \theta_P R_j}{-\theta_A D_j' - \theta_P R_j'} &> \frac{D_j}{-D_j'} \\ (\theta_A D_j + \theta_P R_j)\,(-D_j') &> D_j\,(-\theta_A D_j' - \theta_P R_j') \\ \theta_P R_j\,(-D_j') &> \theta_P D_j\,(-R_j') \\ \frac{-D_j'}{D_j} &> \frac{-R_j'}{R_j}\end{aligned}$$

The last line compares the two semi-elasticities. With $-D_j'/D_j = |\eta_j^A|$ and $-R_j'/R_j = |\alpha^{AA}|(1-R_j)$ from the logit slope, the condition is $|\alpha^{AA}|(1-R_j) < |\eta_j^A|$, equation (9).

Roy's identity for an active consumer's surplus. Under logit demand with utility $u_{ij} = -\alpha_i \phi_{ij} + \nu_{ij}$, where ν_{ij} collects the non-price terms, consumer surplus in dollars is the inclusive value divided by the price coefficient, $CS_i = \alpha_i^{-1} \ln \sum_k \exp(u_{ik})$. Then

$$\frac{\partial CS_i}{\partial P_j} = \frac{1}{\alpha_i} \cdot \frac{\exp(u_{ij})}{\sum_k \exp(u_{ik})} \cdot \frac{\partial u_{ij}}{\partial P_j} = \frac{1}{\alpha_i} \cdot D_{ij} \cdot \Big(-\alpha_i \frac{\partial \phi_{ij}}{\partial P_j} \Big) = -D_{ij} \frac{\partial \phi_{ij}}{\partial P_j}$$

This is Roy's identity, stated in the text before equation (13), and holds for any demand system derived from an indirect utility function.

Equation (12), the planner's first-order condition. Welfare is equation (10), $W(\alpha^{AA}) = \sum_{i \in \mathcal{A}} CS_i(P^*) + \sum_{i \in \mathcal{P}} \sum_j R_{ij}(P^*;\, \alpha^{AA})\, V_{ij} - \lambda G(P^*;\, \alpha^{AA})$ with $P^* = P^*(\alpha^{AA})$ and G from equation (11). By the chain rule,

$$\frac{dW}{d\alpha^{AA}} = \underbrace{\frac{\partial W}{\partial \alpha^{AA}}\Big|_P}_{\text{at fixed prices}} + \sum_j \frac{dP_j^*}{d\alpha^{AA}} \frac{\partial W}{\partial P_j}$$

At fixed prices only the passive term and the passive part of G depend on α^{AA},

$$\frac{\partial W}{\partial \alpha^{AA}}\Big|_P = \sum_{i \in \mathcal{P}} \sum_j \frac{\partial R_{ij}}{\partial \alpha^{AA}} V_{ij} - \lambda \sum_{i \in \mathcal{P}} \sum_j \frac{\partial R_{ij}}{\partial \alpha^{AA}} P_j = \sum_{i \in \mathcal{P}} \sum_j \frac{\partial R_{ij}}{\partial \alpha^{AA}} \left(V_{ij} - \lambda P_j\right)$$

which is the matching effect. The second term is the competition effect.

The derivative of the logit rule in its responsiveness. With $\bar{P} = \sum_k R_k P_k$,

$$\frac{\partial R_j}{\partial \alpha^{AA}} = \frac{P_j \exp(\alpha^{AA} P_j)}{\sum_k \exp(\alpha^{AA} P_k)} - \frac{\exp(\alpha^{AA} P_j) \sum_k P_k \exp(\alpha^{AA} P_k)}{\left(\sum_k \exp(\alpha^{AA} P_k)\right)^2} = R_j P_j - R_j \bar{P} = R_j\,(P_j - \bar{P})$$

Since every passive faces the same assignment probabilities, $R_{ij} = R_j$, and the matching effect is $\sum_{i\in\mathcal{P}}\sum_j R_j(P_j - \bar{P})(V_{ij} - \lambda P_j)$.

Equation (13), the marginal value of a lower price. Differentiate W in P_j at fixed α^{AA}. The active term gives $\sum_{i\in\mathcal{A}} \partial CS_i/\partial P_j = -\sum_{i\in\mathcal{A}} D_{ij}\,\partial\phi_{ij}/\partial P_j$ by Roy's identity above. The passive term gives $\sum_{i\in\mathcal{P}}\sum_k (\partial R_{ik}/\partial P_j)\,V_{ik}$. Government spending, equation (11), gives

$$\frac{\partial G}{\partial P_j} = \sum_{i\in\mathcal{A}}\sum_k \frac{\partial D_{ik}}{\partial P_j} S_{ik} + \sum_{i\in\mathcal{A}} D_{ij}\frac{\partial S_{ij}}{\partial P_j} + \sum_{i\in\mathcal{P}} R_{ij} + \sum_{i\in\mathcal{P}}\sum_k \frac{\partial R_{ik}}{\partial P_j} P_k$$

where the second term uses $\partial S_{ik}/\partial P_j = 0$ for $k \neq j$. Collecting,

$$-\frac{\partial W}{\partial P_j} = \sum_{i\in\mathcal{A}} D_{ij}\frac{\partial \phi_{ij}}{\partial P_j} + \lambda\sum_{i\in\mathcal{P}} R_{ij} + \lambda\sum_{i\in\mathcal{A}}\sum_k S_{ik}\frac{\partial D_{ik}}{\partial P_j} + \lambda\sum_{i\in\mathcal{A}} D_{ij}\frac{\partial S_{ij}}{\partial P_j} - \sum_{i\in\mathcal{P}}\sum_k \frac{\partial R_{ik}}{\partial P_j}\left(V_{ik} - \lambda P_k\right)$$

Equation (13) in the text keeps the first three terms. The fourth is zero when subsidies are fixed in the bid, as in our setting, and the fifth is the value of the rule's own re-sorting of passives in response to P_j.

Equation (14), perfect competition. With perfectly elastic active demand the markup in equation (22) is zero and $P_j^* = MC_j$. Since passives are assigned rather than self-selected, the marginal passive is the average passive, $MC_j^P = AC_j^P$, which does not depend on α^{AA}, and MC_j^A does not depend on the rule. Therefore $dP_j^*/d\alpha^{AA} = 0$, the competition effect in equation (12) is zero, and

$$\frac{dW}{d\alpha^{AA}} = \sum_{i\in\mathcal{P}}\sum_j \frac{\partial R_{ij}}{\partial \alpha^{AA}}\left(V_{ij} - \lambda\, MC_j\right)$$

Equation (15), the price response to the rule. Write the markup of equation (22) as $\mu_j = N_j/\Delta_j$ with $N_j = \theta_A D_j + \theta_P R_j$ and $\Delta_j = -\theta_A D_j' - \theta_P \alpha^{AA} R_j(1-R_j) > 0$. Holding D_j, D_j', R_j and MC_j fixed, $\partial\Delta_j/\partial\alpha^{AA} = -\theta_P R_j(1-R_j)$, and

$$\frac{dP_j^*}{d\alpha^{AA}} = \frac{d\mu_j}{d\alpha^{AA}} = -\frac{N_j}{\Delta_j^2}\frac{\partial\Delta_j}{\partial\alpha^{AA}} = \frac{N_j}{\Delta_j}\cdot\frac{\theta_P R_j(1-R_j)}{\Delta_j} = \mu_j\cdot\frac{\theta_P R_j(1-R_j)}{\Delta_j}$$

From the definition of σ_j under equation (6) and the logit slope, $\sigma_j = \theta_P R_j'/(\theta_A D_j' + \theta_P R_j') = \theta_P\alpha^{AA} R_j(1-R_j)/(-\Delta_j)$. Therefore $\theta_P R_j(1-R_j)/\Delta_j = -\sigma_j/\alpha^{AA} = \sigma_j/|\alpha^{AA}|$, and $dP_j^*/d\alpha^{AA} = \mu_j\,\sigma_j/|\alpha^{AA}| > 0$.

Equation (16), the first-order condition under imperfect competition. Substitute the derivative of the logit rule into the matching effect of equation (12), and equations (13) and (15) into its competition effect. The sign in front of the competition effect is negative since $-\partial W/\partial P_j$ is positive and $dP_j^*/d\alpha^{AA}$ is positive: raising α^{AA} toward zero raises prices and lowers welfare, and lowering it does the opposite.

B Structural Model: Details

This appendix gives the details of the structural model that Section 5 states in words: the construction of the demand estimation sample, the cost projection, the risk-score formula and its normalization, the anchored subsidy, and the simulation sample. Table B1 collects the parameters.

Table B2 reports the fit of the model at observed bids and at its equilibria. It reports the moments of Figure 4 together with the model's equilibria under the \$500 and \$700 ceilings and the no-assignment benchmark. The \$700 column is the end point of best-response iteration from the default start, while the full search finds two equilibria at the estimated rule under that ceiling (Appendix C). The \$700 column is therefore shown for reference only.

Table B1: Model Parameters

Parameter		Value	Source
Plan cost effects	ϕ_{BMC}	0.9807	(Jaffe and Shepard, 2020)
	ϕ_{NHP}	1.1373	(Jaffe and Shepard, 2020)
	$\phi_{Network}$	0.9196	(Jaffe and Shepard, 2020)
Risk adjustment	λ	0.95	Assumption
Risk-adjustment normalization	$\bar{c}$	\$316.72	Pooled mean observed cost
Auto-assignment price sensitivity	α^{AA}	-0.0040	Conditional logit, eq. (19)
Mean active price sensitivity	$\bar{\alpha}$	-0.0396	Demand estimates, eq. (18)
Bid floor, ceiling		\$350, \$500	Assumption
Counterfactual policy sample (fiscal year 2009 new enrollees)			
Above-poverty active choosers		36,080	190,549 member-months
Below-poverty passive enrollees		18,325	97,384 member-months

Note: Fallon is excluded from the simulations. The demand model is estimated on all enrollees over fiscal years 2008 to 2013, 1,713,390 choice instances of 620,512 enrollees, of whom 354,051 are above-poverty active enrollees. α^{AA} is estimated on the fiscal year 2009 auto-assignees. $\bar{\alpha}$ is the unweighted mean price sensitivity among the policy sample's active choosers. $\bar{c}$ is the enrollment-month-weighted mean of observed monthly costs over both groups of the policy sample. The bid interval brackets every plan's enrollment-weighted average bid in fiscal year 2009, \$356 to \$451.

B.1 Demand Estimation Sample

The demand estimation sample consists of "choice instances," the times at which an enrollee can select or switch plans. A choice instance arises when an enrollee newly enrolls in the market, or re-enrolls after a break in coverage, and when a continuing enrollee faces the annual open enrollment period. Continuing enrollees who remain with their plan are modeled as choosing it. A single enrollee may have multiple choice instances, and each unique enrollee-choice instance pair (i, t) is one observation.

The function $f(X_{jt}, Z_{it}; \beta)$ in equation (18) includes interactions of observed plan and consumer characteristics that affect demand. This includes the expected utility of a plan's hospital network for a given enrollee, computed from a hospital demand system, and the share of the enrollee's previously used hospitals that each plan covers, with a separate term for previously used Partners hospitals. We further include dummy variables for the

Table B2: Model Fit at the Status Quo: Observed and Simulated Moments, Fiscal Year 2009

	Observed	Model at observed bids	Equilibrium, $500 ceiling	Equilibrium, $700 ceiling	Equilibrium, no auto-assignment
A. Bid ($ per member-month)					
BMC	$363	$363	$394	$520	$376
NHP	$391	$391	$464	$490	$416
Network	$388	$388	$390	$458	$370
Market, all enrollees	$377	$377	$402	$478	$378
Market, active choosers	–	$375	$397	$473	$378
B. Share of active choosers (percent)					
BMC	51.9	53.5	41.1	14.2	37.7
NHP	19.0	19.6	6.8	20.6	11.8
Network	29.1	27.0	52.1	65.2	50.6
C. Share of passive enrollees (percent)					
BMC	34.3	35.7	36.1	29.3	–
NHP	34.6	31.9	27.2	33.1	–
Network	31.1	32.3	36.6	37.6	–
D. Mean risk score, all enrollees					
BMC	0.937	0.979	0.996	0.935	1.111
NHP	1.041	1.008	0.960	1.013	1.283
Network	1.065	1.034	1.018	1.020	1.109
E. Premium paid by above-poverty active choosers ($ per month)					
BMC	$32	$31	$70	$194	$49
NHP	$74	$75	$149	$174	$104
Network	$43	$38	$47	$109	$23
All plans	$43	$41	$63	$134	$42

Notes: Simulation sample: above-poverty active new enrollees and auto-assigned new enrollees in fiscal year 2009, Fallon excluded. Equilibrium columns are under the estimated assignment rule; the $700 column is the end point of best-response iteration from the default start. Observed bids are each plan's mean bid over its enrollees. Market rows weight plans by enrollment months. Shares are enrollment-month weighted. Risk scores are normalized to a pooled mean of one; the no-assignment column covers active choosers only. The observed active-chooser market bid is omitted, since bids in the enrollment file are rescaled by plan type.

immediate prior plan choice of continuing enrollees to capture switching costs and other state dependence, and the interactions of these variables with income, age-sex bins, risk scores, medical diagnoses, and immigrant status. Plan valuations therefore vary with the enrollee's network use, choice history and observed characteristics.

B.2 Enrollee Costs

We model the monthly cost of enrollee i in plan j as multiplicatively separable in an individual health component and a plan cost effect:

$$c_{ij} \;=\; \phi_j \, \theta_i, \tag{23}$$

where θ_i captures the enrollee's underlying medical costliness and ϕ_j captures the effect of plan j on the cost of treating a given enrollee, reflecting differences in provider prices, network breadth, and care management. Separability implies that selection occurs entirely through θ_i.

We recover θ_i from realized claims rather than estimating a parametric cost model. Let c_i^{obs} denote enrollee i's average monthly paid claims over the choice instance, realized under the chosen plan $c(i)$. Under equation (23), $\theta_i = c_i^{obs}/\phi_{c(i)}$, so the projected cost of enrollee i in any plan j is

$$c_{ij} \;=\; \frac{\phi_j}{\phi_{c(i)}} \, c_i^{obs}. \tag{24}$$

We take the plan cost effects from Jaffe and Shepard (2020), who estimate them for the CommCare plans: 0.9807 for BMC, 1.1373 for NHP, and 0.9196 for Network. Passive enrollees' cost components follow the same equations, with θ_i recovered from their realized claims under the assigned plan. Every enrollee's cost in every plan is therefore a rescaling of her own realized claims.

B.3 Risk Adjustment

The program scales each plan's revenue per member-month by an enrollee-specific risk score. Let $\bar{c}$ denote the enrollment-month-weighted mean of observed monthly costs pooled across active and passive enrollees in the simulation sample, and let κ denote the normalizing constant that sets the pooled mean risk score to one. The risk score is

$$r_i \;=\; \frac{1}{\kappa}\left(\frac{c_i^{obs}}{\bar{c}}\right)^{\lambda}, \qquad \kappa \;=\; \frac{\sum_i m_i \, (c_i^{obs}/\bar{c})^{\lambda}}{\sum_i m_i}, \tag{25}$$

where $\lambda \in [0,1]$ indexes the completeness of risk adjustment and m_i is enrollee i's months of enrollment. A plan bidding b_j thus earns $b_j \, r_i$ per member-month of enrollee i's coverage.

We set $\lambda = 0.95$ to reflect imperfect risk adjustment. At $\lambda = 0$ every enrollee carries the same revenue and plans bear the full cost of selection; at $\lambda = 1$ revenue is proportional to realized costs and the selection incentive on the cost margin disappears. At $\lambda = 0.95$ plans are undercompensated for their most expensive enrollees and retain incentives to avoid these enrollees.

The normalization κ holds the market's total risk-adjusted revenue equal to the total of bids. Without κ the mean of $(c_i^{obs}/\bar{c})^{0.95}$ is 0.933, since the concave transform of a right-skewed cost distribution averages below one, and every bid would have earned 6.7 percent less than its face value in aggregate. Under the pooled normalization active choosers carry a mean risk score of 1.155 and passive enrollees 0.725. Risk adjustment therefore redistributes revenue across plans without changing its level.

B.4 Subsidies and Premiums

We hold each active chooser's subsidy fixed at its observed level. Let $S_{ij} = b_j^{obs} - P_{ij}^{obs}$ denote the subsidy enrollee i receives in plan j at the observed bid b_j^{obs} and observed premium P_{ij}^{obs}. In the simulations the premium at bid vector b is

$$P_{ij}^{cons}(b) \;=\; b_j - S_{ij}, \tag{26}$$

so that the model reproduces every observed premium at observed bids and passes a change in plan j's bid through to its enrollees' premiums one for one. This implies that the state's outlay on an active chooser does not vary with bids. In other words, a bid increase is borne entirely by the insurer's above-poverty active choosers, while below-poverty enrollees and passive enrollees pay zero at any bid.

A single flat subsidy above poverty does not reproduce observed premiums. A flat subsidy of $300 puts the average above-poverty premium at $121 against $43 observed at observed bids. The observed contribution schedule varies with income group and region, and the anchored subsidy is the specification that carries that variation.

B.5 Simulation Sample and Bid Space

We simulate the pricing game for the full set of new enrollees in fiscal year 2009. This yields 36,080 above-poverty active choice instances, carrying 190,549 member-months, and 18,325 auto-assigned instances, carrying 97,384 member-months. Enrollees who chose Fallon are dropped. These enrollees are the population of every counterfactual in Section 6.

Insurers choose bids simultaneously to maximize equation (20), and we solve for pure-strategy Nash equilibria with bids restricted to $350 to $500 rather than the program's nominal $700 ceiling. Under the $700 ceiling the game has two pure-strategy equilibria at the estimated rule and none at several other levels of responsiveness; under a $500 ceiling the equilibrium is unique at every point we solve. Appendix C documents the existence pattern under both ceilings.

C Equilibrium Existence and the Bid Ceiling

This appendix documents where pure-strategy equilibria of the bidding game exist under the program's nominal $700 ceiling and under the $500 ceiling maintained in Section 6, and why the $500 ceiling is the one we use. Table C1 reports equilibrium average bids by responsiveness under the two ceilings, and Table C2 reports the insurer-level equilibria of the $500 game. All results use the full population of fiscal year 2009 new enrollees.

Table C1: Equilibrium Existence and Average Bids by Responsiveness and Bid Ceiling

Responsiveness ($\alpha^{AA}/\bar{\alpha}$)	\$700 ceiling (program range)	\$500 ceiling (main text)
No auto-assignment	398.77	398.77
0.0 (price-blind)	none	423.21^{c}
0.1 (observed rule)	427.61^{c}	421.19^{c}
0.2	412.79	413.68
0.4	402.80	403.87
0.5	n.c.	399.87
0.6	396.30	395.87
0.8	391.32	391.87
1.0	387.79	387.08
1.2	none	385.06
1.4	387.47^{c}	380.95
1.6	none	379.45
1.8	none	377.83

Note: Enrollment-weighted average bid among active choosers, in dollars per member-month, at the pure-strategy equilibrium with bids restricted to \$350 and the indicated ceiling. "None": the full search finds no pure-strategy equilibrium. "n.c.": not computed. Superscript c: NHP bids at the ceiling. The \$700 column is from the full search with first-order-condition refinement; the \$500 column is the best-response fixed point on a \$2 grid.

We search for equilibria in two ways. The sweep of Section 6 iterates best responses on a \$2 bid grid from three starting points, the observed bids and two symmetric vectors, and reports a fixed point when all three converge to the same bid vector. Where the iteration cycles, we run a full search that evaluates every insurer's exact best response at every grid configuration and records every bid vector at which no insurer deviates. A cycle of the iteration does not by itself establish that no equilibrium exists; the full search does.

Under the \$700 ceiling the sweep cannot be computed. The game has two pure-strategy equilibria at the estimated rule, with active-weighted average bids of \$470 and \$415, and none at responsiveness 0 or 1.2; where equilibria exist the average bid is not monotone in responsiveness. Best-response iteration cycles at the estimated rule and in the game without auto-assignment. A sweep that compares one equilibrium per responsiveness level is therefore undefined under this ceiling.

Every failure under the \$700 ceiling has the same source, a branch of some insurer's profit function that rises into the ceiling, and lowering the ceiling removes it. Under a \$500 ceiling best-response iteration converges to a fixed point at every responsiveness level from all three starting points, and the fixed point is the same from each. With competitive bids in the \$350 to \$470 range, a \$500 ceiling makes harvesting at the cap dominated by competing for every insurer. The \$500 ceiling therefore delivers a unique equilibrium at every point of the sweep.

The cycling we document is not an artifact of the smoothed rule. The logit smoothing softens exactly the undercutting incentive that drives every cycle. Cycling under the

Table C2: Equilibrium Bids and Costs by Insurer

	No AA	Observed Rule ($0.10 \times \bar{\alpha}$)	High Responsiveness ($1.8 \times \bar{\alpha}$)
Average bid ($)			
BMC	403.63	426.00	380.00
NHP	432.26	500.00	438.00
Network	388.45	412.00	370.00
Enrollment-weighted	398.77	421.19	377.83
Average cost per member-month, active choosers ($)			
BMC	345.59	348.06	343.57
NHP	521.76	607.10	585.14
Network	328.24	332.56	334.49
Enrollment-weighted	352.37	348.11	349.79
Enrollment share, active choosers (percent)			
BMC	43.19	46.55	48.82
NHP	8.59	3.03	4.34
Network	48.22	50.41	46.84
Share of passive assignments (percent)			
BMC	–	35.71	32.73
NHP	–	26.51	0.52
Network	–	37.78	66.75
Member-months, active choosers			
BMC	82,298	88,701	93,026
NHP	16,368	5,774	8,270
Network	91,883	96,056	89,253
Total	190,549	190,549	190,549
Member-months, passive enrollees			
BMC	–	34,776	31,874
NHP	–	25,816	506
Network	–	36,792	65,004
Total	–	97,384	97,384

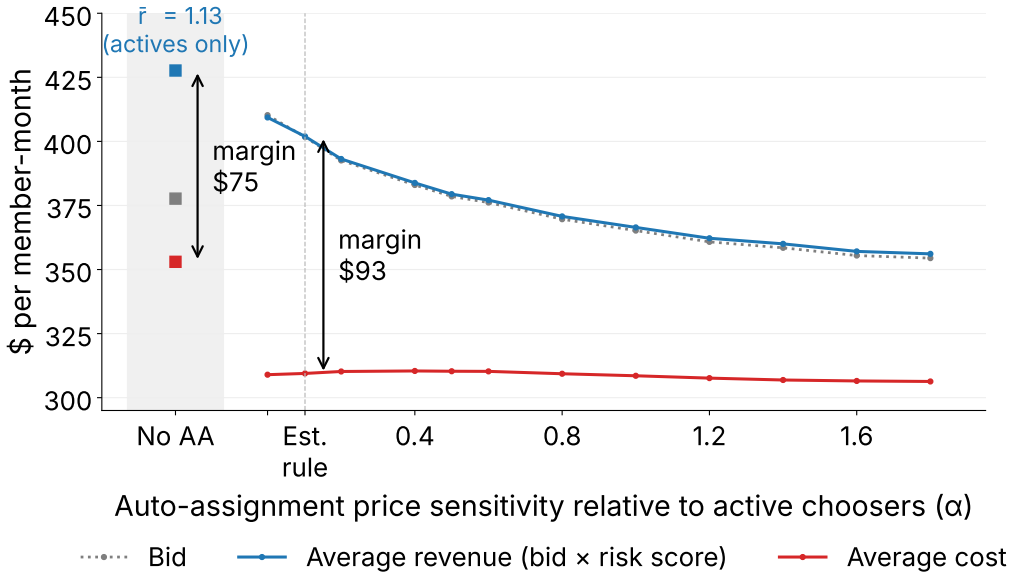
Note: Each column is the equilibrium of the bidding game under the indicated assignment rule, with bids restricted to $350 to $500. The No AA column has no passive segment. Average costs are over above-poverty active choosers in every column; passive enrollees' average costs do not vary across rules. Weighted rows use active enrollment months. Passive shares are the assignment probabilities at equilibrium bids. Member-months are shares applied to the fixed totals of 190,549 active and 97,384 passive months.

smoothed rule therefore implies cycling under the true stepwise rule over at least as wide a region.

D Additional Counterfactual Results

This appendix reports the series behind the sweep of Section 6.1 in aggregate and by insurer, and the incidence series at every responsiveness level rather than at the three levels of Table 5.

Figure D1: Bids, Average Revenue, and Average Cost by Auto-Assignment Price Responsiveness

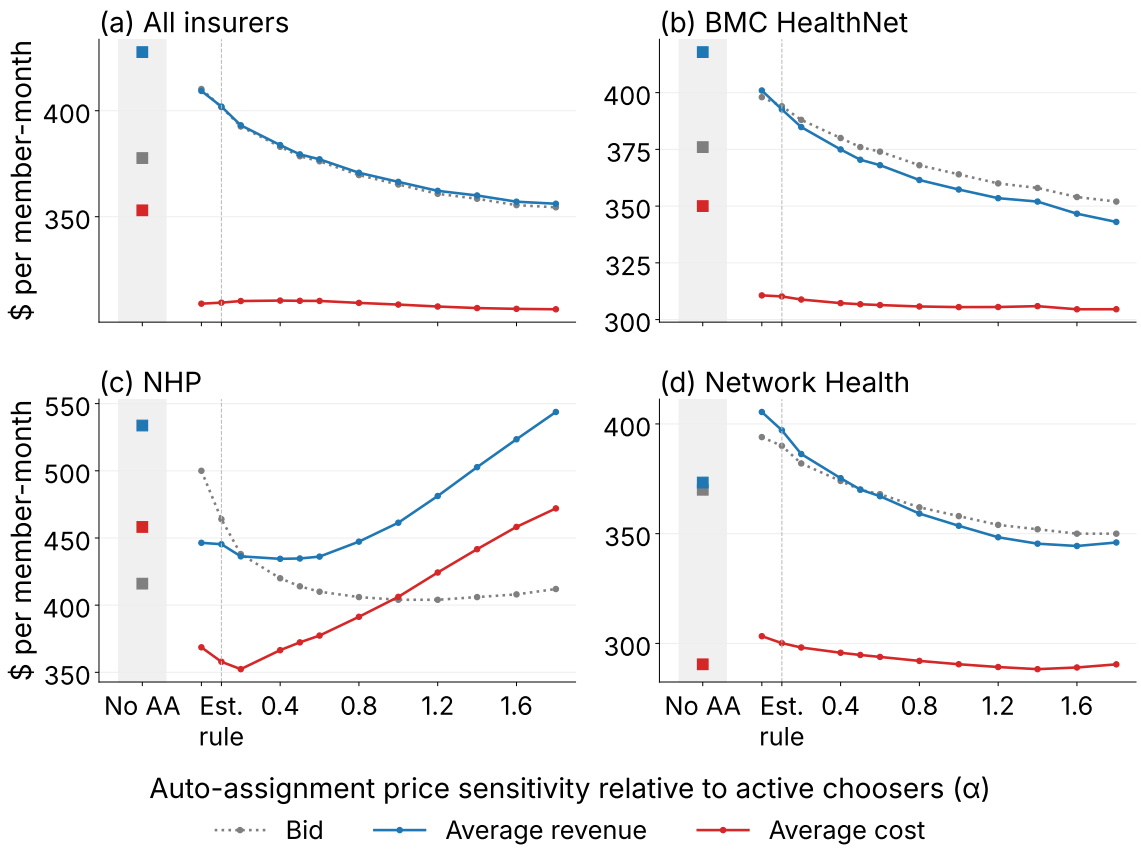


Notes: Each point is the equilibrium at the indicated responsiveness of the auto-assignment rule, weighted by the enrollment months of all enrollees. Average revenue is the bid times the pool's mean risk score; average cost is the projected plan cost. The no-auto-assignment benchmark covers active choosers only.

Passive shares shift mainly through the rule itself rather than through bids. At a responsiveness of 1.0, NHP's share of passive enrollees falls 18.9 percentage points against the estimated rule. Applying the responsiveness-1.0 rule to the estimated rule's bids accounts for 24.4 points of the fall, and the equilibrium bid response, NHP's lower bid, recovers 5.5 points. The rule shifts passives, and the bid response reverses only a small part of the shift.

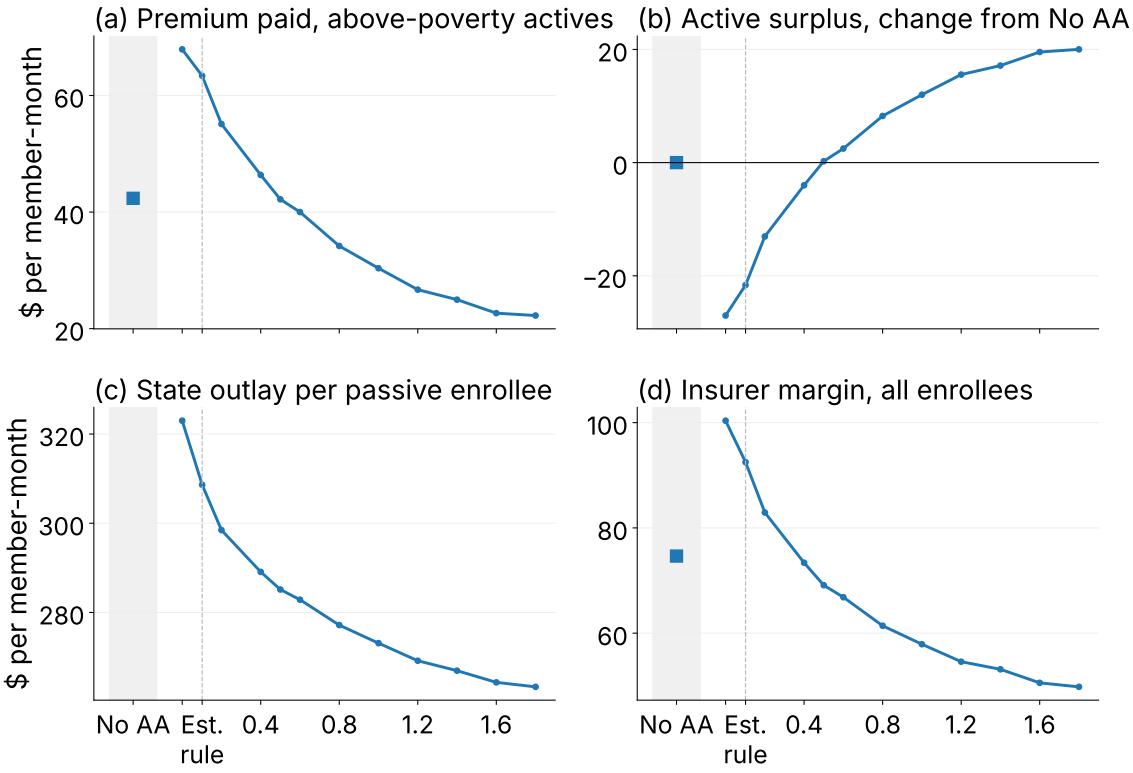
NHP's average cost rises along the sweep as its passive enrollment falls (Figure D2). Its remaining pool is its active choosers, who are costlier than the passives it loses. The rise in NHP's average cost is therefore a composition effect rather than a change in any enrollee's cost.

Figure D2: Bids, Average Revenue, and Average Cost by Insurer Along the Auto-Assignment Sweep



Notes: Each point is the equilibrium at the indicated responsiveness. Panel (a) pools all insurers; Panels (b)–(d) report each insurer's own enrollees. Average revenue is the bid times the pool's mean risk score; average cost is the projected plan cost. Squares mark the no-auto-assignment benchmark. Vertical axes differ across panels.

Figure D3: Who Pays: Premiums, Surplus, State Outlay, and Margins by Auto-Assignment Price Responsiveness



Notes: Each point is the equilibrium at the indicated responsiveness. Panel (a): premium paid by above-poverty active choosers. Panel (b): change in their surplus relative to the no-auto-assignment benchmark, the logit inclusive value divided by the price coefficient. Panel (c): state payment per passive member-month, the bid times the risk score. Panel (d): insurers' margin over all enrollees, average revenue less average cost. Squares mark the no-auto-assignment benchmark; the dashed line marks the estimated rule.

E Matching: Formulation, Robustness, and Reassignment Detail

This appendix gives the formulation of the matching exercise of Section 6.2 and the material that section states without numbers: the solution through shadow prices, the dollar metric, who is mismatched under the observed rule and why, the exercise with each insurer held whole on profit, and the re-solved bidding game.

E.1 Formulation and Solution

Let v_{ij} denote the systematic utility of plan j for passive enrollee i from equation (18). Passives pay zero. With $P_{ij}^{cons} = 0$,

$$v_{ij} \;=\; \underbrace{f(X_j, Z_i; \beta)}_{\text{Plan Attributes}} \;+\; \underbrace{\xi_j(W_i)}_{\text{Plan FE}} \qquad j \in \mathcal{J}_i \tag{27}$$

where $\mathcal{J}_i$ is the set of plans available in enrollee i's service area.

We solve equation (21) through plan-specific shadow prices. Let τ_j denote the shadow price of a slot in plan j. Each passive is assigned to

$$a^M(i) \;=\; \arg\max_{j \in \mathcal{J}_i^0} \; \{\, v_{ij} - \tau_j \,\} \qquad \mathcal{J}_i^0 = \{\, j \in \mathcal{J}_i : v_{ij} \geq v_{i\,a^0(i)} \,\} \tag{28}$$

and τ is set such that the counts in equation (21) hold. A positive τ_j rations an over-demanded plan and a negative τ_j fills an under-demanded one. In fiscal year 2009, $\tau_{\text{BMC}} = 0.32$, $\tau_{\text{NHP}} = -0.22$ and $\tau_{\text{Network}} = -0.10$ in utility units. BMC is therefore the rationed plan and NHP and Network the filled ones.

Matched assignment places each passive in the plan that active choosers in her region select. The plan fixed effects in equation (27) are region-specific and estimated on active choosers, and within a region they rank the same plan first for nearly every passive. The matched assignment is therefore a regional assignment.

The no-harm constraint costs little of the aggregate gain. Without it the aggregate gain is \$532,091 rather than \$525,848, and 2.6 percent of passives lose at most \$8 per member-month. Filling the under-demanded plans' observed counts requires displacing some passives whom the observed rule had placed in a mildly preferred plan, and the constraint rules those displacements out.

E.2 Dollar Metric and Population

We convert utility gains to dollars with the price coefficient of the 100–150 percent FPL group, since passives pay zero and their own $\alpha(Z_i)$ is not identified. We evaluate $\alpha(\cdot)$ at each passive's characteristics with income set to that group, and define the gain from matching as

$$G_i \;=\; \frac{v_{i\,a^M(i)} - v_{i\,a^0(i)}}{|\alpha(\tilde{Z}_i)|} \tag{29}$$

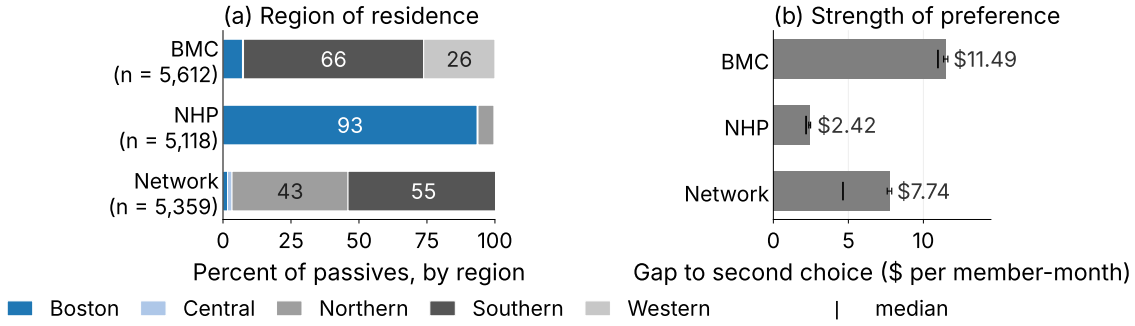
in dollars per member-month, where $\tilde{Z}_i$ denotes Z_i with the income bin reset. The mean of $|\alpha(\tilde{Z}_i)|$ over passives is 0.0621, above the mean of 0.0396 among above-poverty active choosers in the simulation sample, since passives are concentrated in the demographic

and risk-score cells with the largest price coefficients. The dollar gains are correspondingly conservative.

The matching population is the fiscal year 2009 passive enrollees of the simulation sample, excluding the 1,430 assigned to Fallon. This leaves 16,895 passives. Of the original 18,325, 18,120 are below 100 percent of the federal poverty level and 205 sit in higher income groups.

E.3 Characteristics of Matched Enrollees

Figure E1: Why Passives Prefer the Plans They Prefer



Notes: Passive enrollees grouped by predicted first-choice plan ($N = 16{,}895$). Panel (a): share of each group by rating region. Panel (b): mean utility gap between the first- and second-choice plan, in dollars per member-month.

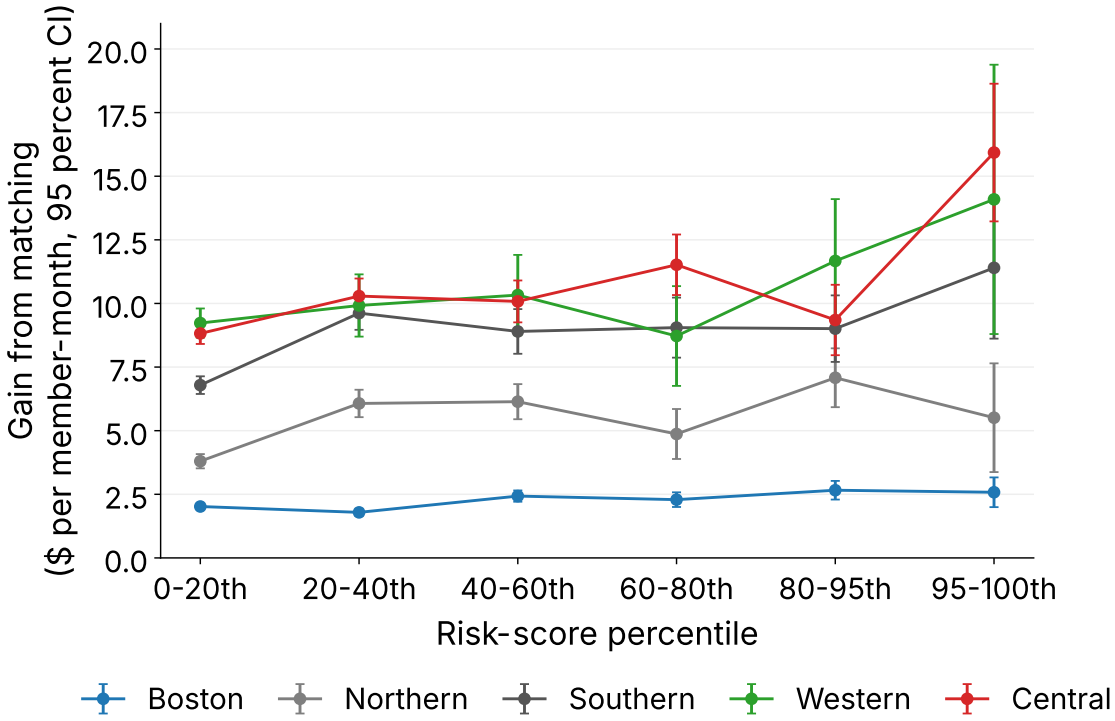
The gains from matching concentrate among passives the observed rule placed in NHP. They gain $7.26 per member-month against $4.83 for those placed in BMC and $5.75 for those placed in Network. NHP's gain is 60 percent of its passives changing plan at $12.08 each, against 52 percent at $9.37 for BMC. NHP's passives are therefore both the most likely to change plan and the ones who gain most from changing.

Preference for NHP is regional. Passives whose predicted first choice is NHP are 93 percent Boston residents, while BMC-preferrers live in the Southern and Western regions and Network-preferrers in the Southern and Northern regions (Figure E1, Panel a). The utility gap between first- and second-choice plan is $2.42 per member-month for NHP-preferrers against $11.49 (BMC) and $7.74 (Network) (Panel b). The observed rule fills NHP's 6,378 slots from every region while only Boston residents rank NHP first. This implies that 73 percent of NHP's passives are mismatched, and the mismatched are non-Boston passives with the strongest regional preferences.

Reassignment out of NHP is worth more than reassignment into it. Leaving NHP is worth $15.67 (to BMC) and $8.63 (to Network) per member-month, while entering NHP is worth $5.07 (from BMC) and $3.32 (from Network). Figure E3 reports the reassignment flows. The flows out of NHP therefore carry most of the aggregate gain.

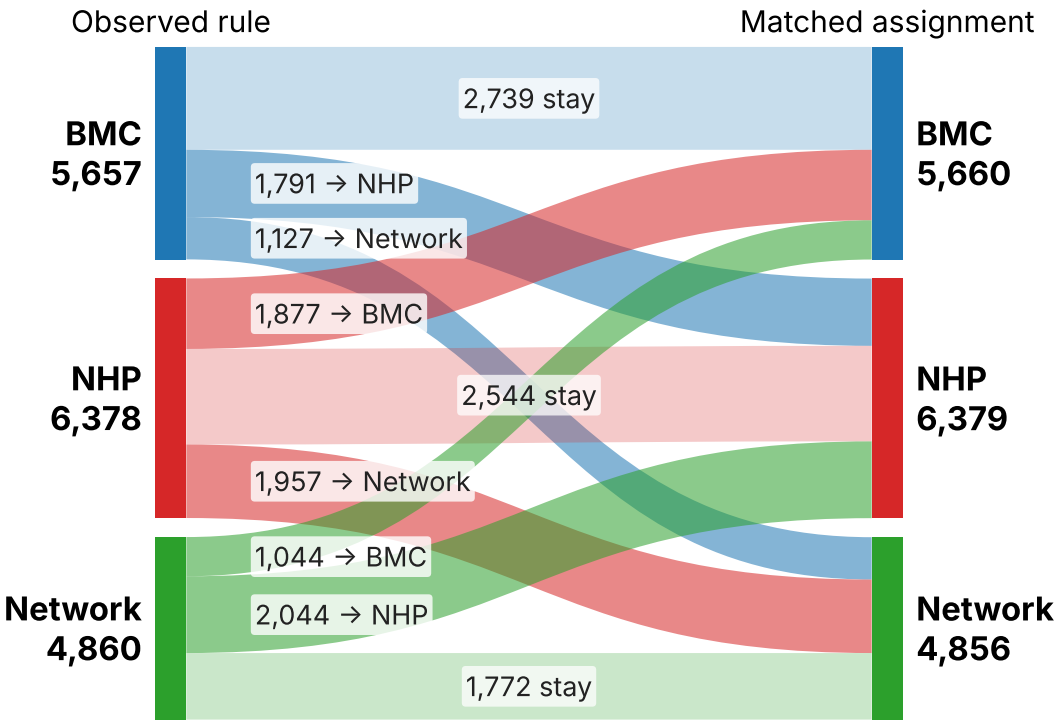
NHP-preferrers are costlier, and the difference reflects their regional composition rather than their health. Their mean θ_i is $241 against $210 for BMC-preferrers. Within each region, Figure E2 reports the health gradient of the gains: the top-quintile gain exceeds the bottom-quintile gain by $0.56 in Boston against $4.6 (Southern), $4.9 (Western) and $7.1 (Central). The gradient is therefore absent where every plan covers a nearby hospital and

Figure E2: Gains From Matching by Health Risk Within Region



Notes: Mean gain from matching in dollars per member-month by risk-score quintile within each rating region, with 95 percent confidence intervals.

Figure E3: Reassignment Flows Under Matching



Notes: Passive enrollees by plan under the observed assignment (left) and under matched assignment (right), with each plan's count held at its observed value. Band widths are proportional to the number of enrollees.

present where the narrow networks diverge, and it does not reflect a preference of healthy enrollees for the broad network.

E.4 Holding Insurer Profits Constant

Table E1: Matching Gains Under Supply-Side Constraints

	Top-plan share (%)	Mean gain ($/month)	Share of main (%)
Observed assignment	36.7	–	–
Counts fixed (main specification)	92.4	$6.01	100
Profit held at or above observed	90.5	$5.73	93
Profit held at observed	97.7	$6.22	103
Counts and profit held	85.8	$5.51	89

Notes: Each row re-assigns the 16,895 passive enrollees of fiscal year 2009 with no enrollee placed in a plan she prefers less than her observed plan, and reports the share placed in their predicted first-choice plan, the mean gain in dollars per member-month relative to the observed assignment, and the total gain as a share of the main specification. Rows hold each insurer's passive count, its profit from passive enrollees at status-quo bids, or both.

The gains from matching do not rest on a transfer across insurers. Table E1 replaces or adds to the count constraint in equation (21) a constraint that each insurer's profit from passive enrollees, evaluated at the status-quo equilibrium bids, is no lower than observed; the dual adds a per-dollar shadow price μ_j on profit to the per-head price τ_j. Holding both counts and profit, matching places 86 percent of passives in their first-choice plan against 92 percent under the count constraint alone, and delivers $5.51 per member-month, 89 percent of the main specification, with no passive worse off and every insurer within $32,000 of its observed passive profit. Holding profit alone, with counts free, delivers 93 percent of the gain, and holding profit exactly delivers 103 percent, since the count constraint rather than the profit constraint binds on NHP. Most of the gain therefore survives when every insurer is held whole.

Holding insurers whole on profit also dampens NHP's re-pricing. Table E2 repeats Table 6 with a third column in which each insurer's profit from passives is held at its observed level as well as its count. NHP's passive pool is then only slightly costlier than under the count constraint alone, at $235 against $240 per member-month, while its net margin on passives is unchanged from the status quo at $105 against $104. Re-solving the pricing game with this pool raises NHP's bid by $18 rather than $26 and the average bid across all enrollees by $2 rather than $3.

E.5 The Re-Solved Bidding Game

To re-solve the bidding game with a matched pool, we replace the market-wide passive pool in equation (20) with insurer-specific pools. Each insurer's passive term uses the mean cost $\phi_j\bar{\theta}_j$ and mean risk score $\bar{r}_j$ of the passives assigned to it, while the assignment rule $s_j^{AA}(b)$ continues to allocate passive volume across insurers in response to bids. We solve the $500-ceiling game at the estimated rule from three starting points on a $2 bid grid. Matching therefore enters the game only through the cost and risk of each insurer's pool.

Table E2: Full Information Matching By Insurers

Panel A: Cost and health of the passive pool

		Mean monthly cost, θ_i ($)			Mean risk score, r_i		
Plan	Passives	Status quo	Matched	Profit held	Status quo	Matched	Profit held
BMC HealthNet	5,657	238.4	204.2	182.7	0.743	0.663	0.610
NHP	6,378	207.6	239.6	235.3	0.746	0.772	0.800
Network Health	4,860	227.3	225.2	255.8	0.670	0.729	0.753

Panel B: Equilibrium bids and margins on passive enrollees

		Equilibrium bid ($)			Net margin ($ per member-month)		
Plan	Passives	Status quo	Matched	Profit held	Status quo	Matched	Profit held
BMC HealthNet	5,657	392	394 (+2)	392 (0)	61.1	64.3 (+3.2)	64.0 (+2.9)
NHP	6,378	450	476 (+26)	468 (+18)	104.4	97.1 (−7.3)	104.8 (+0.3)
Network Health	4,860	388	390 (+2)	390 (+2)	54.1	79.2 (+25.1)	63.4 (+9.3)
Market bid, all enrollees		399.0	402.4 (+3.4)	401.1 (+2.1)			
Market bid, active choosers		394.9	396.4 (+1.5)	395.7 (+0.8)			

Notes: Fiscal year 2009 passive enrollees excluding Fallon assignees ($N = 16{,}895$). "Status quo" is the realized assignment; the first two columns of each block repeat Table 6. "Matched" re-sorts passive enrollees to the plan maximizing predicted utility net of a plan-specific shadow price, with each plan's passive count held at its observed value and no enrollee placed in a plan she prefers less than her observed plan. "Profit held" adds the constraint that each insurer's profit from passive enrollees at status-quo bids is no lower than observed (Table E1, Panel A). Panel A: θ_i is the plan-neutral monthly cost (observed cost divided by the cost effect ϕ_j of the enrollee's observed plan); $r_i = (c_i/\bar{c})^{0.95}$, normalized to a pooled mean of one. Panel B: equilibrium bids are the estimated-rule Nash equilibrium of the $500-ceiling game with each passive pool, on a $2 bid grid; three starting points agree at every point. Net margin is $b_j r_i - \phi_j \theta_i$ averaged over the plan's passive pool at that column's equilibrium bids. Changes from the status quo in parentheses. Market bids are weighted by enrollment months of all enrollees and of active choosers.

The status-quo column of Table 6 differs slightly from the model's own status quo. It uses pool means recomputed from the matching data file and yields equilibrium bids of $392, $450 and $388, against $394, $464 and $390 in Table B2. The difference reflects NHP's recomputed passive cost and does not affect the changes reported in the table, which hold the pool construction fixed across columns.

Matching redistributes passive profit from NHP to Network. Under the count-fixed match, NHP's profit from passives falls by $591,869 against the observed assignment while Network's rises by $531,062 and BMC's falls by $33,917. The redistribution nets to approximately zero across insurers.